Department of Botany
University of Jammu

Syllabus for MDP- Botany

Semester-1

Course Code	Paper	Credits	Contact hours per week L-Tu-P
PSBOTC101	Biology and Diversity of Microorganisms	4	4-0-0
PSBOTC102	Algae and Bryophytes: Diversity and Evolution	4	4-0-0
PSBOTC103	Cytology, Genetics and Cytogenetics	4	4-0-0
PSBOTC104	Plant Ecology	4	4-0-0
PSBOPC105	Laboratory Courses (based on PSBOTC101 and PSBOTC102)	4	0-0-8
PSBOPC106	Laboratory Courses (based on PSBOTC103 & PSBOTC104)	4	0-0-8
	Total	24	16-0-16

COURSE TITLE: BIOLOGY AND DIVERSITY OF MICROORGANISMS

Course No.:PSBOTC101
Credit: 4
Duration: 3 hrs

Maximum Marks: 100
Minor Test I: 20
Minor Test II: 20
Major Test: 60

Objectives:

Microbes comprising the largest group of living organisms, contribute to human welfare in many ways. The course is conceived to familiarize the students with the diversity exhibited by microbes, their structural and reproductive details and economic aspects.

Unit-1 Eubacteria.

1.1 Microorganisms; discovery, major groups and classification (Haeckel's three kingdom concept, Whitaker's five kingdom concept, three domain concept of Carl Woese).
1.2 Variations in bacterial size, shape and arrangement; types of reproduction.
1.3 Eubacterial cell wall, structures external to the bacterial cell wall (glycocalyx, flagella, pili); plasma membrane, cytoplasm and cytoplasmic inclusions.
1.4 Bacterial endospores; their formation, structure and types.

Unit-II Archaebacteria and Phytoplasma.

2.1 General account of Archaebacteria, ultrastructure of cell wall.
2.2 Methanogenic Archaebacteria – characteristics of some representative genera, production of methane (biomethanation)
2.3 Halophilic and thermoacidophilic Archaebacteria- characteristics of some representative genera.
2.4 Phytoplasma – general characteristics and role in causing plant diseases (aster yellows, lethal yellowing of coconut palms, Peach X-disease).

Unit-III The Viruses, viroids and prions.

3.1 Distinguishing characteristics of viruses, ultrastructure, capsid symmetry.
3.2 Plant virus isolation and purification, chemical nature and replication of TMV, transmission of plant viruses.
3.3 Structure, replication and transmission of viroids, important diseases caused by viroids (Potato spindle tuber, cadang-cadang of coconut, citrus exocortis).
3.4 Discovery and characteristics of prions, diseases caused by prions.

Unit-IV Structure and reproduction of fungi.

4.1 General characters of fungi, cell ultrastructure, cell wall composition, thallus organization (unicellular and multicellular), nutrition (saprobic, biotrophic, symbiotic), reproduction.
4.2 Recent trends and criteria used in the classification of fungi with reference to vegetative and reproductive structures.

4.3 General account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina.
4.4 Homothallism and heterothallism, heterokaryosis and parasexuality in fungi.

Unit-V Economic importance of bacteria, viruses and fungi.

5.1 Biological and economic importance of Eubacteria and Archaebacteria.
5.2 Economic importance of viruses with emphasis on viral diseases of plants and human beings.
5.3 Role of fungi in industries with reference to production of medicines (antibiotics), organic acids (citric acid) and food (cultivation of yeast, button and oyster mushroom)
5.4 Fungal diseases of human beings and crop plants (brown spot of rice, stripe rust of wheat, apple scab, red rot of sugarcane, tikka disease of groundnut).

Note for Paper Setting

Theory Examination	Syllabus to be covered in the Examination	Time allotted for the Exam	% weightage (marks)
Minor Test I	Upto 20%	1 Hr.	20
Minor Test II	20% to 40%	1 Hr.	20
Major Test	41% to 100%	2.5 Hr.	60

Pattern to be followed for Major Test:

a. Major test will have seven questions each of 15 marks.
b. One question will be compulsory and will consist of very short answer type of multiple parts spread over entire syllabus.
c. Rest of the six questions will be from the remaining 41%-100% portion of the syllabus and the candidate will have to attempt any three of them.

Literature recommended:

1 Alexopoulus, CJ., Mims, C.W. and Blackwell, M. (1996). Introductory Mycology. John Wiley & Sons Inc. New York.
2 Alcamo, I. E. (2001). DNA Technology. 2nd Edn. Academic Press. USA.
3 Black, J. G. (2013). Microbiology. 8th Edn. John Wiley & Sons. New York.
4 Mehrotra, R.S. (1980). Plant Pathology. Tata McGraw Hill Publishing Co. Ltd New Delhi.
5 Mehrotra, R.S. and Aneja, K.R. (1990). An Introduction to Mycology. Wiley Eastern Ltd. New Delhi.
6 Singh, R.S. (1986). Plant Diseases. Oxford & IBH Publishing Co. Ltd. New Delhi.
7 Sumbali G. (2010). The Fungi. 2nd Edn. Narosa Publishing House, New Delhi.
8 Sumbali G. and Mehrotra R.S. (2009). Principles of Microbiology. 1st Edn. Tata McGraw Hill Publishing Co. Ltd. New Delhi.
9 Webster. J. (1985). Introduction to Fungi. Cambridge University Press, USA.
10 Willay J. and Sherwood M. (2011). Prescott's Microbiology. 8th Edn. Tata McGraw Hill Publishing Co. Ltd. New Delhi.

COURSE TITLE: ALGAE AND BRYOPHYTES - DIVERSITY AND EVOLUTION

Course No.:PSBOTC102
Credit: 4
Duration: 3 hrs

Maximum Marks: 100
Minor Test I: 20
Minor Test II: 20
Major Test: 60

Objectives:

Representing botanical novelties, Algae and Bryophytes are of great human use particularly in agriculture and biotechnology based industries. The course is designed to familiarize the students with the diversity, biology and economic value of these interesting non-flowering groups.

Unit-I Classification and thallus organization of algae.

1.1 Modern trends in the classification (Lee, 2008)
1.2 Evolutionary trends and range of thallus organization.
1.3 Origin of sex utility and modes of reproduction: Vegetative, Asexual and Sexual reproduction.
1.4 Life cycles: Mono-, di- and trigenetic types.

Unit-II Salient features of Cyanophyta, Chlorophyta, Bacillariophyta, Xanthophyta, Phaeophyta and Rhodophyta with special reference to:

2.1 Structure and composition of cell walls and flagella.
2.2 Structure and types of chloroplasts.
2.3 Structure of pyrenoids and eyespots.
2.4 Types of reserve storage products.

Unit-III Classification of mosses and diversity in liverworts and hornworts.

3.1 Classification of Bryophytes; general features of three major groups namely liverworts, hornworts and mosses.
3.2 General features and classification of Hepaticopsida; morpho-anatomical and reproductive features of gametophytes and sporophytes of the orders Calobryales and Sphaerocarpales.
3.3 Morpho-anatomical and reproductive features of gametophytes and sporophytes of the orders Metzgeriales, Jungermanniales and Marchantiales.
3.4 Morpho-anatomical and reproductive features of gametophyte and sporophyte of the order Anthocerotales.

Unit-IV Classification and diversity among mosses.

4.1 Classification of Bryopsida- an outline; evolutionary lines in mosses.
4.2 Morpho-anatomical and reproductive features of gametophyte and sporophyte of the orders Sphagnales and Andreales.
4.3 Morpho-anatomical and reproductive features of gametophyte and sporophyte of the orders Buxbaumiales, Archidales and Polytrichales.
4.4 Morpho-anatomical and reproductive features of gametophyte and sporophyte of the order Bryales.

Unit-V Economic importance of algae and bryophytes and evolutionary trends in bryophytes.

5.1 Toxic algae.
5.2 Algae in biotechnology.
5.3 Habitat diversity of bryophytes; trends in evolution of their gametophytes and sporophytes .
5.4 Fossil bryophytes; Origin of bryophytes.

Note for Paper Setting

Theory Examination	Syllabus to be covered in the Examination	Time allotted for the Exam	% weightage (marks)
Minor Test I	Upto 20%	1 Hr.	20
Minor Test II	20% to 40%	1 Hr.	20
Major Test	41% to 100%	2.5 Hr.	60

Pattern to be followed for Major Test:

a. Major test will have seven questions each of 15 marks.
b. One question will be compulsory and will consist of very short answer type of multiple parts spread over entire syllabus.
c. Rest of the six questions will be from the remaining 41%-100% portion of the syllabus and the candidate will have to attempt any three of them.

Literature recommended:

I. Algae

1. Fritsch, F.E. (1945). The Structure and Reproduction of Algae. Vol. I & II. Cambridge University Press.
2. Smith, G.M. (1955). Cryptogamic Botany. Vol. I. McGraw Hill Co. Ltd.
3. Bold. H.C. and Wynne, M. J. (1978). Introduction to the Algae: Structure and Function. Prentice Hall of India.
4. Trainor, F.R. (1978). Introductory Phycology. John Wiley and Sons Inc.
5. Kumar, H.D. and Singh, H.N. (1982). A Text Book of Algae. East West Press.

II. Bryophytes

1. Puri, P. (1985). Bryophytes: A Broad Perspective. Atma Ram & Sons, Delhi.
2. Rashid, A. (1998). An Introduction to Bryophyta, Vikas Publ. House, Pvt. Ltd.
3. Schuster R. M. (1983). New manual of Bryology Vol. I & II. The Hattori Botanical Laboratory, Japan.
4. Smith, G.M. (1955). Cryptogamic Botany Vol II, Tata McGraw Publ. Company, Inc., N.Y.
5. Vander poorten, A. and Goffinet, B. (2009). Introduction to Bryophytes. Cambridge University Press, New York.

COURSE TITLE: CYTOLOGY, GENETICS AND CYTOGENETICS

Course No.:PSBOTC103
Credit: 4
Duration: 3 hrs

Maximum Marks: 100
Minor Test I: 20
Minor Test II: 20
Major Test: 60

Objectives:

Genetics and cytogenetics provide scientific basis to the art of plant and animal breeding. Genetic improvement of crop plants cannot be sound, unless their genetic architecture has been fully understood. This course aims at equipping the student with up-to-date knowledge of the nature and structure of genetic material and principles of heredity in diploid, polyploid and aneuploid organisms.

Unit-I Chromatin organization.

1.1 Chromosome morphology; molecular organization of nucleosome, centromere and telomere.
1.2 Euchromatin and heterochromatin; banding patterns; karyotype evolution.
1.3 Specialized chromosomes; structure, occurrence and behavior of B- and sex chromosomes, and polytene and lampbrush chromosomes.
1.4 Organization of chloroplast and mitochondrial genomes.

Unit-II Numerical alterations in the genome.

2.1 Origin, occurrence, production and meiosis of monoploids and haploids.
2.2 Origin and production of autopolyploids: concept of chromosome and chromatid segregation.
2.3 Allopolyploids - types, genome constitution and analysis of wheat, *Arachis, Brassica* and cotton.
2.4 Origin, occurrence, production, meiosis and detection of monosomics, trisomics (primary, secondary, tertiary), nullisomics and tetrasomics.

Unit-III Genetic recombination and gene mapping.

3.1 Recombination: Holliday's model of recombination at molecular level, role of Rec A and Rec B,C,D enzymes; site-specific recombination.
3.2 Chromosome mapping, genetic markers, concept of molecular maps.
3.3 Correlation of genetic and physical maps; somatic cell genetics-an alternative approach to gene mapping
3.4 Genetic transformation; conjugation and transduction in bacteria.

Unit-IV Gene structure, expression and sudden changes.

4.1 Genetic fine structure; cis-trans test; r II locus; fine structure analysis in eukaryotes.
4.2 Regulation of gene expression in prokaryotes (*lac* operon & *trp* operon) and eukaryotes (Methylation, hormonal control, Britten - Davidson's model).

4.3 Spontaneous and induced mutations; physical and chemical mutagens; molecular basis of gene mutations; DNA damage and repair mechanisms.
4.4 Transposable elements in prokaryotes and eukaryotes; Ac-Ds & Spm-dSpm in maize, Copia & P elements in *Drosophila* and Ty elements of yeast.

Unit-V Cytogenetics of higher plants.

5.1 Characterization of mono-and trisomics and their use in chromosome mapping of diploid and polyploid species.
5.2 Breeding behaviour and genetics of complex translocation heterozygotes, translocation tester sets; Robertsonian translocations.
5.3 Breeding behaviour and genetics of inversion heterozygotes.
5.4 Production, characterization and utility of alien addition and substitution lines

Note for Paper Setting

Theory Examination	Syllabus to be covered in the Examination	Time allotted for the Exam	% weightage (marks)
Minor Test I	Upto 20%	1 Hr.	20
Minor Test II	20% to 40%	1 Hr.	20
Major Test	41% to 100%	2.5 Hr.	60

Pattern to be followed for Major Test:

a. Major test will have seven questions each of 15 marks.
b. One question will be compulsory and will consist of very short answer type of multiple parts spread over entire syllabus.
c. Rest of the six questions will be from the remaining 41%-100% portion of the syllabus and the candidate will have to attempt any three of them.

Literature recommended:

1. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Wason, J.D. (1989). Molecular Biology of the Cell. Garland Publishing Inc. NY & Dendor.
2. Avers, C. (1984). Genetics. PWS Publishers.
3. Brown, T.A. (1989). Genetics: A Molecular Approach. VNR international.
4. Brown, T.A. (1990). Gene Cloning-An introduction. Chapman and Hal London.
5. Garber, G.B. (1972). Cytogenetics. McGraw Publishing Co. Ltd.
6. Gupta, P.K. (1997). Elements of Biotechnology. Rastogi Publishers, Meerut.
7. Gupta, P.K. (1997). Genetics. Rastogi Publishers, Meerut.
8. Gupta, P.K. (2002). Cell and Molecular Biology. Rastogi Publication, Meerut.
9. Hartl, D.L. and Jones, E.W. (2000). Genetics – An Analysis of Genes and Genomes. Jones & Bartlett Publishers.
10. Karp, G. (1999). Cell and Molecular Biology – Concepts and Experiments. John Wiley and Sons Inc.
11. Klug (2012). Concept of Genetics. 10th Edn. Pearson publications.

12. Krebs, J. E. (2014). Lewin ‘s Genes XI. John Wiley and Sons Inc.
13. Lewin, B. (2000). Genes VII. Oxford University Press, NY.
14. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Scott, M.P., Bretscher, A., Ploegh, H. and Matsudaira, P. (2013). Molecular Cell Biology. 7th Edn. W. H. Freeman and Company. New York.
15. Old, R.W. and Primrose, S.B. (1994). Principles of Gene Manipulation. Blackwell Scientific Publication, London.
16. Russel, P.J. (1998). Genetics. Benjamin/Cummings Publishing Co. Inc.
17. Sinnott, E.W., Dunn L.C. and Dobzhansky T. (1958). Principles of Genetics. Kugakusha Co. Ltd.
18. Snustad, D.P. and Simmons, M.J. (2000). Principles of Genetics. John Wiley & Sons, NY.
19. Stansfield, W.D. (1991). Genetics (Schaums outlines), McGraw Hill.
20. Strick berger, M.W. (1976). General Genetics. McMillan Publishing Co. Inc. NY.
21. Swanson C.P., Merz, T. and Young, W.J. (1967). Cytogenetics. Prentice Hall of India, Pvt. Ltd.
22. Watson, J.D., Hopkins, N.H., Roberts, J.W., Steitz, J.A. and Weiner A.M.L. (1987). Molecular Biology of the Gene. The Benjamin/Cummings Publishing Company Inc.

COURSE TITLE: PLANT ECOLOGY

Course No.:PSBOTC104
Credit: 4
Duration: 3 hrs

Maximum Marks: 100
Minor Test I : 20
Minor Test II: 20
Major Test : 60

Objectives:

The course is designed to make students understand abiotic and biotic components of the ecosystems and their interactions at different levels. The course also emphasizes on the extent of biodiversity, its depletion and management using various conservation approaches.

Unit I Ecosystem: organization and function.

1.1. Ecosystem structure and function; primary productivity (methods of measurements, global patterns, controlling factors), decomposition, energy dynamics.
1.2 Ecosystem stability concept (resistance, resilience); eco-restoration and ecosynthesis.
1.3 Ecological niche-definition and concept, niche parameters (niche width, overlap and complementarity), ecotone and edge effect.
1.4 Species interactions; competition, parasitism, predation, herbivory, mutualism; Leslie-Gower and Lotka Voltera models for predator prey interactions.

Unit II Population and community ecology.

2.1 Population structure, metapopulations, evolution of biocoenosis, effective population size.
2.2 Population bottleneck and regulations, stochasticity, disturbance, and recruitment.
2.3 Nature and concept of biotic community, community analysis (analytic and synthetic characters), life forms and biological spectrum.
2.4 Role of single species in community structure; dominant, keystone and foundation species.

Unit III Community stability and applied ecology.

3.1 Ecological succession; types, mechanism, models and changes involved in succession, concept and properties of climax.
3.2 Biogeography; major biomes of world and plate tectonics (convergent boundaries, divergent boundaries and transform boundaries).
3.3 Concept of invasive and chemical ecology.
3.4 Climate change; effects of climate change on ecological components, glaciers, sea, flora and fauna.

Unit-IV Biodiversity and environment management.

4.1 Biodiversity- assessment, conservation and management, Biodiversity Act of India and related international conventions (CBD, Ramsar Convention, CITES, Brundtland Report, Agenda 21, Kyoto Protocol).
4.2 Sustainable development, natural resource management in changing environment.
4.3 Molecular ecology, genetic analysis of single and multiple populations.
4.4 Remote sensing and Geographical Information System; satellites-concept, principles and applications in ecological studies.

Unit-V Advances in ecology.

5.1 Biosensors and their applications in environment and ecosystem, environmental degradation and environmental impact assessment.
5.2 Carbon trading, forestry carbon credit; cases studies on carbon trading.
5.3 Principle component analysis; definition and application in ecology.
5.4 Ecological footprint; concept and application in Agro-ecosystem.

Note for Paper Setting

Theory Examination	Syllabus to be covered in the Examination	Time allotted for the Exam	% weightage (marks)
Minor Test I	Upto 20%	1 Hr.	20
Minor Test II	20% to 40%	1 Hr.	20
Major Test	41% to 100%	2.5 Hr.	60

Pattern to be followed for Major Test:

a. Major test will have seven questions each of 15 marks.
b. One question will be compulsory and will consist of very short answer type of multiple parts spread over entire syllabus.
c. Rest of the six questions will be from the remaining 41%-100% portion of the syllabus and the candidate will have to attempt any three of them.

Literature recommended:

1. Claude, F., Christiane, F., Medori, P. and Devaux, J. (2001). Ecology: Science and Practice. Oxford and IBH publishing Co. Pvt. Ltd. New Delhi.
2. Trevor, B. and Graham, R. (2005). An Introduction to Molecular Ecology. Oxford University Press.
3. Begon, M., Townsend, C.R. and Harper, J.L. (2006). Ecology from Individuals to Ecosystems. 4th Edn. Blackwell publishing¸ USA.
4. Eisner, T. and Meinwald, J. (1995). Chemical Ecology: The Chemistry of Biotic Interaction, National Academies Press.
5. Ali, M. (2012). Diversity of Ecosystems, In Tech.

6. Subrahmanyan, N. S and Sambamurty A.V.S.S. (2006). Ecology. 2nd Edn. Narosa, New Delhi.
7. Chapman, J.L. and Reiss, M.J. (1998). Ecology: Principles and Applications. Cambridge University Press.
8. Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall of India Pvt. Ltd. New Delhi.
9. Odum, E. P. (1971). Fundamentals of Ecology. Saunders, Philadelphia.
10. Dash, M. (1999). Fundamentals of Ecology. Tata Mc-Graw-Hill Publishing Company Ltd. New Delhi.
11. Ambasht, R.S. and Ambasht N.K. (1995). A Textbook of Plant Ecology. 11th Edn. Students Friends & Co. Varanasi, India.

Course No. PSBOPC105 (Based on PSBOTC101 and PSBOPC102)

Credit: 4

Maximum Marks: 100
Daily evaluation of practical records /Assignment test / Viva voce etc. : 50
Final Practical performance +viva voce:50

Laboratory Exercises based on PSBOTC101

1. Demonstration of various staining techniques for bacteria (Gram staining, negative/indirect staining, cell wall staining and endospore staining).
2. Symptomatology of plant diseases caused by bacteria (leaf spot of peach, angular leaf spot of cotton, Kresek of rice and citrus canker).
3. Symptomatology of plant diseases caused by virus. (tobacco mosaic virus, tomato aspermy virus, carnation ring spot virus, cauliflower mosaic virus, tobacco necrosis virus, tobacco leaf curl virus, bean common mosaic virus and yellow vein mosaic virus).
4. Symptomatology of plant diseases caused by fungi (brown leaf spot of rice, red rot of sugarcane, late blight of potato, early blight of potato, smut of bajra, yellow or stripe rust of wheat, loose smut of wheat, ergot of rye, tikka disease of groundnut).
5. Morphological characters of some microfungi (*Curvularia, Alternaria, Fusarium, Penicillium, Colletotrichum, Trichothecium, Aspergillus, Mucor, Rhizopus, Syncephalastrum, Chaetomium, Emericella, Peronospora, Bremia, Phyllactinia* and *Uncinula*).
6. Morphological characters of some macrofungi (*Agaricus, Morchella, Pleurotus, Geastrum* and *Calocybe*).

Laboratory Exercises based on PSBOTC102

1. Morphological study of representative members of Algae: *Microcystis, Aulosira, Oocystis, Pediastrum, Hydrodictyon. Ulva, Pithophora, Stigeoclonium, Draparnaldiopsis, Closterium, Cosmarium, Chara.*
2. Study of morphology, anatomy and reproductive structures of bryophytes: *Marchantia, Anthoceros, Polytrichum,Plagiochasma, Asterella.*

Course No. PSBOPC106 (Based on PSBOTC103 and PSBOPC104)

Credit: 4 **Maximum Marks: 100**
Daily evaluation of practical records /Assignment test / Viva voce etc. : 50
Final Practical performance +viva voce: 50

Laboratory Exercises based on PSBOTC103

1. Karyotype analysis and preparation of ideogram.
2. Study of somatic chromosomes from root tip squashes.
3. Comparative effect of various pretreating agents on somatic chromosomes.
4. Study the effect of various known mutagens and adulterants on somatic chromosomes.
5. Study of chromosomes during meiosis (*Aloe vera, Delphinium ajacis. Allium cepa. Tradescantia canaliculata, Phlox drummondii, Papaver sominiferum*).
6. Attempt silver banding for staining nucleolus – organizing region.
7. Study the polytene chromosomes in *Chironomus.*
8. Study the characteristics and behavior of B chromosomes in an appropriate material.
9. Study the sex chromosomes of *Spinacea, Rumex/Cannabis, Mirabilis*.
10. Study the effect of induced polyploidy on plant phenotype, meiosis, pollen and seed fertility and fruit set.
11. Work out the effect of mono and trisomy on fertility and meiotic behavior.
12. Study the effect of translocation heterozygosity on chromosome pairing, chromosome disjunction and pollen and seed fertility.
13. Study the meiosis of complex translocation heterozygotes.
14. Construction of genetic maps from the given data.
15. Calculation of recombination frequencies.
16. Determination of linkage relationships.
17. Study of Mendelian and non-Mendelian inheritance patterns.

Laboratory Exercises based on PSBOTC104

1. Determination of the Minimum requisite size of a sampling unit for vegetation study and calculation of Importance Value Index of herbaceous flora.
2. Determination of the plant density through plotless sampling methods.
3. Determination of α , β and γ diversity and various diversity indices.
4. Determining primary productivity in terms of biomass and chlorophyll content.
5. Estimation of the gross and net primary productivity of an aquatic ecosystem by light and dark bottle method.
6. Determination of phytoclimate and biological spectrum.
7. Determination of dissolved oxygen in the aquatic water body.
8. Determination of Ca^{++} and Mg^{++} ions in polluted and unpolluted water samples.
9. Determination of the water holding capacity and cation exchange complex of different soils.
10. Determination of the stomatal index in the plants grown in polluted and unpolluted water samples.

Semester-II

Course Code	Paper	Credits	Contact hours per week L-Tu-P
PSBOTC201	Cell and Molecular Biology of Plants	4	4-0-0
PSBOTC202	Pteridophytes and Gymnosperms: Diversity and Evolution	4	4-0-0
PSBOTC203	Taxonomy of Angiosperms	4	4-0-0
PSBOTC204	Plant Development and Reproduction	4	4-0-0
PSBOPC205	Laboratory Course (based on PSBOTC201 AND PSBOTC204)	4	0-0-8
PSBOPC206	Laboratory Course (based on (PSBOTC202 and PSBOTC203)	4	0-0-8
	Total	24	16-0-16

COURSE TITLE: CELL AND MOLECULAR BIOLOGY OF PLANTS

Course No.:PSBOTC201
Credit: 4
Duration: 3 hrs

Maximum Marks: 100
Minor Test I: 20
Minor Test II: 20
Major Test: 60

Objectives:

The present course envisages the structural and functional aspects of cell and its related organelles at micro- and macro-molecular levels. Basic aim is to impart student this knowledge and updated information pertaining to the fine structure of gene and gene expression in pro- and eukaryotes.

Unit-I Plant cell; its envelope and unique features.

1.1 An overview of the diversity in structure of cell- basic organization of a plant cell; extracellular matrix- structure, function and biogenesis of cell wall
1.2 Plasma membrane- chemical composition, organization of various components, fluid-mosaic model; artificial membranes.
1.3 Plasma membrane functions- transport and signal transduction, concept of carriers, pumps, channels and receptors.
1.4 Unique structures of a plant cell- structure and functions of vacuole and plasmodesmata.

Unit-II Cell organelles, membrane system and mirobodies.

2.1 Structure and role of microfilaments and microtubules.
2.2 Cell organelles- structure, biogenesis and an overview of functions of mitochondria and chloroplasts.
2.3 Internal membrane system- structure and functioning of endoplasmic reticulum and Golgi apparatus.
2.4 Microbodies- structure and functions of lysosomes, peroxisomes and melanosomes.

Unit-III Nucleus and its contents including structure and function of DNA.

3.1 Nucleus; structure, nuclear pore complex and transport; ultrastructure of nucleolus.
3.2 DNA structure; A, B & Z forms; single stranded DNA; supercoiling of DNA.
3.3 DNA replication; mechanism in pro- and eukaryotes; rolling circle replication.
3.4 Transcription- mechanism and regulation; plant promoters and transcription factors.

Unit-IV RNA and Proteins-structure, synthesis and function

4.1 Types of RNA- mRNA, tRNA and rRNA; their structure and biosynthesis; concept of micro-RNAs.
4.2 Introns- types and their significance; RNA editing and splicing; mRNA transport.

4.3 Translation-ribosomes; mechanism in pro- and eukaryotes; factors involved thereof.
4.4 Protein trafficking- concept of chaperones, co-translation and post-translation transport.

Unit-V Cell cycle and cell death.

5.1 Cell cycle: control mechanism; role of cyclins and cyclin dependent kinases; retinoblastoma and E2F proteins; concept of hereditary and non-hereditary cancers.
5.2 Cell cycle: checkpoints in cell cycle regulation; cytokinesis and cell plate formation.
5.3 Types of cell death, programmed cell death in the life cycle of plants.
5.4 *In-situ* hybridisation: GISH, FISH and confocal microscopy.

Note for Paper Setting

Theory Examination	Syllabus to be covered in the Examination	Time allotted for the Exam	% weightage (marks)
Minor Test I	Upto 20%	1 Hr.	20
Minor Test II	20% to 40%	1 Hr.	20
Major Test	41% to 100%	2.5 Hr.	60

Pattern to be followed for Major Test:

d. Major test will have seven questions each of 15 marks.
e. One question will be compulsory and will consist of very short answer type of multiple parts spread over entire syllabus.
f. Rest of the six questions will be from the remaining 41%-100% portion of the syllabus and the candidate will have to attempt any three of them.

Literature recommended:

1. Albert B., Bray D., Lewis J., Raff M., Roberts K. and Watson J. D. (1989). Molecular Biology of the Cell. Garland Publisher Inc. NY & London.
2. Brown, T.A. (1989). Genetics: A molecular Approach. VNR International
3. Brown, T.A. (2010). Gene cloning and DNA Analysis- An introduction. 6th Edn. Wiley Blackwell.
4. Brown, T.A. (2010). Genomes. John Wiley and Sons (Asia) Pvt. Ltd.
5. Darnell, J., Lodish, H. and Baltimore, D. (1986). Molecular Cell Biology. W. H. Freeman and Company. New York.
6. De, D.N. (2000). Plant Cell Vacuoles: An introduction. CSIRO Publication, Colling wood, Australia.
7. Freifelder, D. and Malacinski (1993). Essentials of Molecular Biology. Jones and Bartlett Publishers.
8. Gardner, E.J., Simmons, M.J. and Snustad, D. (1991). Principles of Genetics. 8th Edn. John Wiley.
9. Gupta, P.K. (1997). Elements of Biotechnology. Rastogi Publication, Meerut.
10. Gupta, P.K. (2002). Cell and Molecular Biology. Rastogi Publication, Meerut.

11. Hartl, D.L. and Jones, E.W. (2000). Genetics – An Analysis of Genes and Genomes. Jones and Bartlett Publishers.
12. Karp, G. (1999). Cell and Molecular Biology – Concepts and Expts. John Wiley and Sons Inc.
13. Kleinsmith, L.J and Kish, V.M. (1995). Principles of Cell and Molecular Biology. Harper Collins College Publishers, NY.
14. Krishna Murphy, K.V. (2000). Methods in Cell Wall Cytochemistry. CRC Press, Boca Raton, Florida.
15. Lewin, B. (2000). Genes VII. Oxford University Press. N.Y.
16. Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell, J. (2000) Molecular Cell Biology. W. H. Freeman and Co., NY.
17. Old, R.W. and Primrose, S.B. (1994). Principles of Gene Manipulation. Blackwell Scientific Publication, London.
18. Russel, P.J. (1998). Genetics. Benjamin/Cummings Publishing Co. Inc.
19. Sadava, D. E. (1992). Cell Biology – Organelle Structure and Function. Jones & Barlert Publishers.
20. Snustad, D.P. and Simmons, M.J. (2000). Principles of Genetics. John Wiley and Sons, NY.
21. Stansfield, W.D. (1991). Genetics (Schaums outlines). McGraw Hill.
22. Watson, J.D., Hopkins, N.H., Roberts, J.W., Steitz, J.A. and Weiner, A.M.L. (1987). Molecular Biology of the Gene. The Benjamin/Cummings Publishing Company Inc.
23. Wolfe, S.L. (1993) Molecular and Cellular Biology. Wadsworth Publishing Co. Calfornia, USA.

COURSE TITLE: PTERIDOPHYTES AND GYMNOSPERMS- DIVERSITY AND EVOLUTION

Course No.:PSBOTC202
Credit: 4
Duration: 3 hrs

Maximum Marks: 100
Minor Test I: 20
Minor Test II: 20
Major Test: 60

Objectives

Pteridophytes and gymnosperms represent important non-flowering plants. While the former are important for maintaining the ecosystems, gymnosperms are in great demand in Himalayas for timber. The present course will unfold the diversity as well as structural and biological details of these plant groups to the students. The information generated will help in conservation of these plants.

Unit-I Classification of pteridophytes; diversity among early land plants and microphyllous pteridophytes.

1.1 Classification of pteridophytes (Sporne 1975; as per Parihar 1996) upto ordinal level.
1.2 Comparative organography and reproduction of fossil pteridophytes: *Rhynia, Trimerophyton, Zosterophyllum, Lepidodendron, Sphenophyllum* and *Calamites*.
1.3 Comparative organography, reproduction and phylogeny of *Psilotum, Lycopodium, Selaginella* and *Isoetes.*
1.4 Comparative organography, reproduction and phylogeny of *Equisetum.*

Unit-II Diversity among megaphyllous pteridophytes.

2.1 Comparative organography, reproduction and phylogeny of eusporangiate ferns: *Ophioglossum* and *Marattia.*
2.2 Comparative organography, reproduction and phylogeny of protoleptosporangiate ferns- *Osmunda*.
2.3 Comparative organography, reproduction and phylogeny of homosporous leptosporangiate ferns- *Schizaea, Pteris, Dryopteris, Ceratopteris, Platyzoma, Asplenium* and *Acrostichum.*
2.4 Comparative organography, reproduction and phylogeny of heterosporous leptosporangiate ferns- *Marsilea* and *Salvinia.*

Unit-III Evolutionary trends in pteridophytes and classification of gymnosperms.

3.1 Life cycle of pteridophytes with respect to alternation of haploid and diploid phases; deviations.
3.2 Soral (Eu- and Lepto-sporangiate) and prothallial evolution with emphasis on the role of cytology, polyploidy and hybridization in speciation of ferns.
3.3 General characters of gymnosperms.

3.4 Past and present trends in the classification of gymnosperms with reference to Sporne (1965) and Sandra Holmes (1986).

Unit-IV Morphology and anatomy of vegetative and reproductive organs of major orders of gymnopsperms.

4.1 Morphology and anatomy of the vegetative organs of Cycadales, Ginkgoales and Coniferales.
4.2 Reproductive organs of Cycadales, Ginkgoales and Coniferales with emphasis on male gametophyte development.
4.3 Morphology and anatomy of vegetative organs of Ephedrales, Welwitschiales and Gnetales.
4.4 Reproductive organs of Ephedrales, Welwitschiales and Gnetales with emphasis on male gametophyte development.

Unit-V General account of fossil gymnosperms and distribution of living gymnosperms in India.

5.1 Distribution of living gymnosperms in India.
5.2 Concept of Progymnosperms.
5.3 General account of Cycadeoidales.
5.4 General account of Cordaitales.

Note for Paper Setting

Theory Examination	Syllabus to be covered in the Examination	Time allotted for the Exam	% weightage (marks)
Minor Test I	Upto 20%	1 Hr.	20
Minor Test II	20% to 40%	1 Hr.	20
Major Test	41% to 100%	2.5 Hr.	60

Pattern to be followed for Major Test:

d. Major test will have seven questions each of 15 marks.
e. One question will be compulsory and will consist of very short answer type of multiple parts spread over entire syllabus.
f. Rest of the six questions will be from the remaining 41%-100% portion of the syllabus and the candidate will have to attempt any three of them.

Literature recommended

1. Bierhorst, D.W. (1971). Morphology of Vascular Plants. Mac Millan Co.
2. Bower, F.O. (1923, 1926 and 1928). The Ferns. Vol. I-III, Cambridge Univ.Press.
3. Bower, F.O. (1935). Primitive Land Plants. Mac Millan Co.
4. Eames, A.J. (1936). Morphology of Vascular Plants. McGraw Hill, NY.

5. Foster, A.S. and Gifford, E.M. (1979). Comparative Morphology of Vascular Plants. W.H. Freeman & Co.
6. Parihar, N.S. (1989). The Biology and Morphology of Pteridophytes (Diversity and Differentiation). Vikas Publishing House.
7. Rashid, A. (1976). An Introduction to Pteridophytes (Diversity and Differentiation). Vikas Publishing House.
8. Sporne K.R. (1970). The Morphology of Pteridophytes. Hutchinson Univ. Library, London.

COURSE TITLE: TAXONOMY OF ANGIOSPERMS

Course No.:PSBOTC203
Credit: 4
Duration: 3 hrs

Maximum Marks: 100
Minor Test I: 20
Minor Test II: 20
Major Test: 60

Objective

The course is formulated to understand the origin of angiosperms, their phylogeny and classification using various methods. Advanced APG treatment of plants and of plant taxonomy is important component of the course which will make students understand the progress being made in the subject of Botany.

Unit – I Origin of angiosperms and classification systems.

1.1 Origin of angiosperms; place of origin, monophyletic and polyphyletic concepts, origin of monocotyledons.
1.2 Evolutionary trends in angiosperms; co-evolution with animals, evolution of xylem, stamens and pollen grains, carpel and inferior ovary.
1.3 Evolution and diversity of woody, seed and flowering plants.
1.4 Systems of classification; artificial, natural and phylogenetic systems.

Unit – II Resources in plant taxonomy and phytogeography.

2.1 Plant collection and documentation: methods of plant collection.
2.2 Plant descriptions and illustrations as the tools of data information system
2.3 Concept of phytogeography and its relevance, phytogeographic regions of the world and India.
2.4 Factors determining vegetational types, endemism, hotspots and hottest hotspots, plant explorations.

Unit – III History of taxonomy and ICBN.

3.1 History of development in taxonomy; Linnean and Post Linnean era, need for taxonomy, systematics, contributions of taxonomy to biology.
3.2 Historical perspective of plant classification; Bentham and Hooker's system of classification, phenetic versus phylogenetic system; Concept of APG-II system (2003), cladistics in taxonomy.
3.3 Phylogenetic system of classification after Engler and Prantl (1887-1915), Thorne (1968), Dahlgren(1974), Cronquist(1988).
3.4 Principles of plant nomenclature, kinds of names, salient features of the International Code of Botanical Nomenclature, citation of authors, priority, type method, naming a new species, legitimate, synonyms.

Unit – IV Phylogeny and tools of taxonomy.

4.1 Origin of angiosperms; inter-relationships of dicots and monocots; phylogeny of Ranales, Amentiferae, Tubiflorae and Helobiales and their treatment in the modern systems of classification.

4.2 Principles of plant taxonomy, alpha taxonomy versus modern taxonomy; chemotaxonomy, cytotaxonomy, numerical taxonomy; anatomy, palynology and embryology in relation to taxonomy.

4.3 Taxonomic categories and characters: structure of taxonomic hierarchy; concept of taxonomic categories (supra-specific, species, and infra-specific); taxonomic characters (kinds and criteria).

4.4 Taxonomic tools: Floras, keys, field and herbarium techniques; DNA hybridization; amino acid sequencing; serology; GIS; electrophoresis; computer application in systematics.

Unit – V New Approaches in plant taxonomy.

5.1 Taxonomic description of basal angiosperms: Nymphaeaceae and Magnoliaceae.

5.2 Taxonomic description of basal (Araceae and Alismataceae) and petaloid (Liliaceae and Orchidaceae) monocots.

5.3 Taxonomic description of commelinid monocots: Arecaceae and Poaceae.

5.4 Taxonomic description of eudicots (Ranunculaceae) and Caryophyllids (Caryophyllaceae).

Note for Paper Setting

Theory Examination	Syllabus to be covered in the Examination	Time allotted for the Exam	% weightage (marks)
Minor Test I	Upto 20%	1 Hr.	20
Minor Test II	20% to 40%	1 Hr.	20
Major Test	41% to 100%	2.5 Hr.	60

Pattern to be followed for Major Test:

a. Major test will have seven questions each of 15 marks.
b. One question will be compulsory and will consist of very short answer type of multiple parts spread over entire syllabus.
c. Rest of the six questions will be from the remaining 41%-100% portion of the syllabus and the candidate will have to attempt any three of them.

Literature recommended:

1. Cole, A.J. (1969) Numerical Taxonomy. Academic Press, London.
2. Davis, P.H. and Heywood, V.H. (1973). Principles of Angiosperm Taxonomy. Robert E. Kreiger Publ. 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 Taxomony. Hieman Educational Books Ltd., London.

6. Heslop-Harrison, J. (1967). Plant Taxonomy. English Language Book Soc. & Edward Arnold Publ. 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 Williams, A.D. (1971). Variations and Adaptations in Plant Species. Hieman & Co. Educational Books Ltd. London.
9. Simpson, M. G. (2006). Plant Systematics. Elsevier Academic Press. USA.
10. Singh, G. (2010). Plant Systematics. Science Publishers. USA.
11. Stace, C.A. (1990). Plant Taxonomy and Biosystematics. Cambridge Univ. Press.

COURSE TITLE: PLANT DEVELOPMENT AND REPRODUCTION

Course No.:PSBOTC204
Credit: 4
Duration: 3 hrs

Maximum Marks: 100
Minor Test I: 20
Minor Test II: 20
Major Test: 60

Objectives:

Knowledge regarding plant reproduction and development plays a pivotal role in making student understand population structure and natural diversity in a better way. The course so framed on these aspects includes classical as well as experimental approaches to the phenomena of sporogenesis, gametogenesis, fertilization, and embryogenesis and seed development.

Unit-I Vegetative and sexual reproduction.

1.1 Modes of reproduction in plants: vegetative options- natural and artificial; sexual reproduction- a general account.
1.2 Sex expressions- variability; sex determination mechanisms.
1.3 Transition to flowering, role of environmental factors; floral meristem identity genes- their characterization in *Arabidopsis.*
1.4 Floral development: genetics of floral organ determination, homeotic mutants in *Arabidopsis* and *Antirrhinum.*

Unit-II Sex organs, male and female gametophytes, pollination.

2.1 Structure of anthers; microsporogenesis, role of tapetum, pollen development – a general account.
2.2 Ovule development, megasporogenesis, organization of embryo sac: structure of embryo sac cells.
2.3 Pollination in angiosperms – auto, allo and geitonogamy, advantages and disadvantages; contrivances adopted by plants to ensure different types.
2.4 Pollinating agents- vectors, adaptation in plants to suit different vectors.

Unit-III Pollen –pistil interaction, self-incompatibility and fertilization.

3.1 Structure of the pistil; types of detailed structure of stigma and style, their, pollen- pistil interaction, pollen germination and pollen tube growth.
3.2 Entry of pollen tube in the ovule and embryo sac. Double fertilization; process and products.
3.3 Self- incompatibility- types, cytological and molecular aspects of each type.
3.4 *In vitro* fertilization- techniques and achievements.

Unit-IV Endosperm, embryo and seed.

4.1 Endosperm- types and development, detailed structure of cereal endosperm, its storage products.
4.2 Embryogenesis in dicots and monocots, unique embryogenesis in Gramineae, reduced embryos, storage products.
4.3 Dynamics of fruit growth and development; biochemistry of fruit ripening.
4.4 Development of sexual seed; types and structure; apomixis- process and types.

Unit-V *In vitro* embryogenesis, seed germination and seedling growth.

5.1 Pollen embryogenesis- technique and utility; use of pollen in gene transfer.
5.2 Induction, development and maturation of somatic embryos; synthetic seeds - concept, development and uses.
5.3 Seed germination- metabolism of nucleic acids, proteins and mobilization of food reserves.
5.4 Seedling growth: hormonal control of seedling growth, gene expression during growth, use of mutants in understanding the process.

Note for Paper Setting

Theory Examination	Syllabus to be covered in the Examination	Time allotted for the Exam	% weightage (marks)
Minor Test I	Upto 20%	1 Hr.	20
Minor Test II	20% to 40%	1 Hr.	20
Major Test	41% to 100%	2.5 Hr.	60

Pattern to be followed for Major Test:

a. Major test will have seven questions each of 15 marks.
b. One question will be compulsory and will consist of very short answer type of multiple parts spread over entire syllabus.
c. Rest of the six questions will be from the remaining 41%-100% portion of the syllabus and the candidate will have to attempt any three of them.

Literature Recommended:

1. Atwell, B.J., Knedermann, P.E. and Jumbull, C.G.N. (1999). Plants in Action-Adaption in Nature: Performance in cultivation. MacMillan Education, Sydney, Australia.
2. Bewley, J.D. and Black, M. (1994). Seeds Physiology of Development and Germination. Plenum Press, New York.
3. Bhojwani, S.S. and Bhatnagar, S.P. (2000). The Embryology of Angiosperms. 4th Edn. Vikas Publishing House, New Delhi.
4. Burgess, J. (1985). An Introduction to Plant Cell development. Cambridge University Press, Cambridge.
5. Faegri, K. and Vander Pijl, L. (1979). The Principles of Pollination Ecology. Pergamon Press, Oxford.
6. Fahn, A. (1982). Plant Anatomy. 3rd Edn. Pergamon Press, Oxford.

7. Fosket, D.E. (1994). Plant Growth and Development: A Molecular Approach. Academic Press, San Diego.
8. Geber, M.A., Dawson, T.E. and Delph, L.F. (1999). Gender and Sexual dimorphism in Flowering Plants. Springer Berlin-Heidelberg.
9. Howell, S.H. (1998). Molecular Genetics of Plant Development. Cambridge University press, Cambridge.
10. Leivs, P., Tucker, S.C. and Endress, P.K. (1988). Aspects of Floral Development. J. Cramer, Germany.
11. Lyndow, R.F. (1990). Plant Development: The Cellular Basis. Unnin Hyman, London.
12. Murphy, T.H. and Thompson, W.F. (1988). Molecular Plant Development. Prentice Hall, New Jersey.
13. Proctor, M. and Yeo, P. (1973). The Pollination of Flowers. William Collins Sons, London.
14. Raghavan, V. (1997). Molecular Embryology of Flowering Plants. Cambridge University Press, Cambridge.
15. Raghavan, V. (1999). Developmental Biology of Flowering Plants. Springer-Verlag, New York.
16. Salisbury, F.B. and Ross, C.W. (1992). Plant Physiology. 4th Edn. Wadsworth Publishing, Bolmont, California.
17. Shivanna, K.R. and Sawhney, V.K. (1997). Pollen Biotechnology for Crop Production and Improvement. Cambridge University Press, Cambridge.
18. Shivanna, K.R. and Rangaswamy, N.S. (1992). Pollen Biology-A Laboratory Manual. Springar-Verlag, Berlin.
19. Shivanna, K.R. and Johri, B.M. (1986). The Angiosperm Pollen: Structure and Function. Wiley Eastern Ltd., New York.
20. Steeves, T.A. and Sussex, I.M. (1989). Patterns in Plant development. 2nd Edn. Cambridge Univ. Press, Cambridge.
21. The Plant Cell. Special issue on Reproductive Biology of Plants, Vol. 5(10) (1993). The American society of Plant Physiologists. Rockvills, Maryland, USA.
22. Raghvan, V. (2006). Double fertilization. Springar Verlag, Berlin-Heidelberg.

Course No. PSBOPC205 (Based on PSBOTC201 and PSBOPC204)

Credit: 4 **Maximum Marks: 100**
Daily evaluation of practical records /Assignment test / Viva voce etc. : 50
Final Practical performance +viva voce:50

Laboratory Exercises based on PSBOTC201

1. Demonstration of SEM using an appropriate plant material and detailed study of electron micrograph of the plant cell thus taken to see the distribution of cell organelles.
2. Isolation of mitochondria and the activity of its marker enzyme, succinate dehydrogenase (SDH).
3. Isolation of chloroplasts and SDS-PAGE profiles of proteins to demarcate the two subunits of Rubisco.
4. Fluorescence staining with FDA for cell viability and cell wall staining with calcoflour.
5. Work out various problems associated with DNA replication process from the given data.
6. Calculation of replication rates from the provided data.
7. Preparation of agarose gel.
8. Isolation of plasmid DNA from an appropriate host by alkali lysis method.
9. Study the effect of some restriction enzymes on DNA.
10. Estimate the molecular weight of different DNA fragments generated above (S.No.5).
11. Work out the biochemical pathways operative in *Neurospora* on the basis of experimental data.
12 Study the genic and extragenic inheritance patterns.
13 Detection of structural changes in the chromosomes using FISH technique.
14. Bring out the phylogenetic relation between different taxa (varieties, species, genera) on the basis of enzyme profiles.
15. Work out interspecific variation using zymograms and mt DNA-RFLP.
16. Isolation of nuclei and identification of histones by SDS-PAGE
17. Isolation of DNA and its quantification by spectrophotometric method
18. Isolation of DNA and preparation of 'Cot' curve
19. Restriction digestion of plant DNA: its separation by agarose gel electrophoresis and visualization by ethidium bromide staining.
20. Northern and southern blot analysis using a gene specific probe
21. Western blotting

Laboratory Exercises based on PSBOTC204

1. Study of structure of dicot and monocot seed; albuminous and exalbuminous seeds.
2. Seed storage structures- maize and pulses.
3. Study of seed dormancy and methods to break dormancy.
4. Study of diversity of vegetative propagation in plants, its comparison to sexual reproduction.
5. Study flower as organ of sexual reproduction: accessory vs. essential organs, reproductive apparatus.

6. Study of microsporogenesis and microgametogenesis by making acetocamine squashes of anthers of different developmental stages.
7. Examination of modes of anther dehisence and collection of pollen grains for microscopic examination (Maize, Grasses, Solanums, *Petunia, Acacia, Canna, Calotropis*, etc.)
8. Test for pollen viability using stains and *in-vitro* germination. Pollen germination using hanging drop and sitting drop cultures: Suspension culture and surface culture.
9. Estimating percentage and average pollen tube length *in vivo*.
10. Field study of several types of flowers with different pollination mechanisms i.e., pollination effected by wind, thrips, bees, butterflies and birds.
11. Emasculation, bagging and hand pollination to study pollen germination, seed set and fruit development using self-compatible and obligate out crossing system.
12. Study of cleistogamous flowers and their adaptations.
13. Study of nuclear and cellular endosperm through dissections and staining.
14. Isolation of zygotic, globular, heart-shaped, torpedo shaped and mature embryo from suitable material.
15. Study of polyembryony in *Citrus* by dissections.

Course No. PSBOPC206 (Based on PSBOTC202 and PSBOTC203

Credit: 4

Maximum Marks: 100
Daily evaluation of practical records /Assignment test / Viva voce etc. : 50
Final Practical performance +viva voce:50

Laboratory Exercises based on PSBOTC202

1. Anatomy of fossil pteridophytes (*Aglaophyton, Rhynia, Asteroxylon, Lepidophloios, Lepidocarpon, Sphenophyllum, Calamites*) from permanent slides.
2. Morphology and anatomy of fern-allies (*Psilotum, Lycopodium, Selaginella, Isoetes, Equisetum*).
3. Anatomy of spore-bearing organs of taxa listed at S.No. 2.
4. Diversity in spore bearing organs of some ferns (*Ophioglossum, Cyathea, Dryopteris, Gleichenia, Pteris, Asplenium, Salvinia*).
5. Anatomy of vegetative and reproductive organs of some ferns listed at S.No. 4.
6. Comparative study of the anatomy of vegetative and reproductive parts of *Cycas, Ginkgo, Pinus, Cedrus, Abies, Picea, Cupressus, Araucaria,Podocarpus, Agathis, Taxus* and *Ephedra.*
7. Study of important fossil gymnosperms from prepared slides and specimens.

Laboratory Exercises based on PSBOTC203

1. Description of a specimen from representative, locally available families.
2. Description of various species of a genus; location of key characters and preparation of keys at genetic level.
3. Compilation of field notes and preparation of herbarium sheets.

Semester-III

Course Code	Paper	Credits	Contact hours per week L-Tu-P
PSBOTC301	Plant Physiology and Metabolism	4	4-0-0
PSBOTC302	Plant Breeding and Biostatisitics	4	4-0-0
PSBOTC303	Plant Resource Utilization and Conservation	4	4-0-0
*PSBOTE304	Entrepreneurship in Botany	4	4-0-0
PSBOPC305	Laboratory course (based on PSBOTC301)	4	0-0-8
PSBOPC306	Laboratory course (based on PSBOTC302 & PSBOTC303)	4	0-0-8
	Total	24	16-0-16

***Optional for outside department students and not available for departmental students.**

COURSE TITLE: PLANT PHYSIOLOGY AND METABOLISM

Course No.:PSBOTC301
Credit: 4
Duration: 3 hrs

Maximum Marks: 100
Minor Test I: 20
Minor Test II: 20
Major Test: 60

Objectives:

The course is designed to make students understand how different enzymes, molecular signals and hormones regulate important reactions and activities in plants. Another aim is to impart students knowledge regarding the mechanisms underlying absorption of water and minerals, solute transport, photosynthesis, respiration, nitrogen and sulphur metabolism.

Unit-I Enzymology and transport mechanisms.

1.1 Enzymes- general concept, allosteric mechanism, regulatory and active sites, isozymes and co-enzymes.
1.2 Enzyme kinetics- Michaelis-Menton equation and its various derivations.
1.3 Transport- phloem loading and unloading, xylem transport, passive and active transport, membrane transport proteins.
1.3.1 Nernst equation, Donnan equilibrium, symport and antiport.

Unit-II Photobiology and signal transduction.

2.1 Signal transduction- concept, receptors, G-proteins, phospholipid signaling, second messengers-a general account.
2.2 Diversity in protein kinases and phosphatases, calcium-calmodulin cascade, specific signaling mechanisms; two component sensor-regulator system in bacteria.
2.3 Phytochromes and cryptochromes- discovery, photochemical and biochemical properties, photophysiology of light induced responses; signal perception and execution.
2.4 Photoperiodism and its significance- endogeneous clock and its regulation, floral induction and development role of vernalization.

Unit-III Plant hormone signaling: perception, execution and its role.

3.1 Auxins and cytokinins- biosynthesis, signal perception (receptors), execution and role in plant growth and development.
3.2 Gibberellins and brassinosteroids- biosynthesis, signal perception (receptors), execution and role in plant growth and development.
3.3 Abscisic acid and ethylene- biosynthesis, signal perception (receptors), execution and role in plant growth and development.
3.4 Jasmonic acid, salicylic acid, strigolactones and polyamines- signal perception (receptors), execution and role in plant growth and development.

Unit-IV Photochemistry and photosynthesis.

4.1 Evolution of photosynthetic apparatus, light harvesting complexes, photo-oxidation of water.
4.2 Mechanism of electron and proton transport, energy flow pathways, cyclic, non-cyclic and pseudo-cyclic pathways.
4.3 Carbon assimilation-Calvin cycle, C4 cycle, difference between C3 and C4 pathways, CAM pathways, photorespiration and its significance.
4.4 Biosynthesis of starch and sucrose and their regulation.

Unit-V Respiration, nitrogen and sulphur metabolism.

5.1 Overview of plant respiration, glycolysis, TCA cycle.
5.2 Electron transport system and recent advances in mechanism of ATP synthesis.
5.3 Nitrogen fixation-overview, biological nitrogen fixation, nodule formation and nod factors, mechanism of nitrate uptake and reduction; ammonium assimilation.
5.4 Sulphur metabolism- overview, sources and mechanism of sulphur uptake, transport, assimilation and its significance.

Note for Paper Setting

Theory Examination	Syllabus to be covered in the Examination	Time allotted for the Exam	% weightage (marks)
Minor Test I	Upto 20%	1 Hr.	20
Minor Test II	20% to 40%	1 Hr.	20
Major Test	41% to 100%	2.5 Hr.	60

Pattern to be followed for Major Test:

g. Major test will have seven questions each of 15 marks.
h. One question will be compulsory and will consist of very short answer type of multiple parts spread over entire syllabus.
i. Rest of the six questions will be from the remaining 41%-100% portion of the syllabus and the candidate will have to attempt any three of them.

Literature recommended:

1. Buchanan, B.B., Gruissem, W. and Jones, R.L. (2000). Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologist, Maryland, USA.
2. Galston, A.W. (1989). Life Processes in Plants. Scientific American Library, Springer-Verlag, New York, U.S.A.
3. Hopkins, G.W. and Hiinner, N.P.A. (2008). Introduction to Plant Physiology. 4th Edn. Wiley and Sons. Inc. New York, U.S.A.
4. Kuchel, W.P. and Ralston, B.G. (1998). Theory and Problems of Biochemistry. Schaum's outline series. McGraw-Hill Book Co. New York, USA.
5. Nelson, D.L. and Cox, M.M. (2013). Lehninger-Principles of Biochemistry. Worth Publishers Inc. New York, USA.
6. Mehta, S.L., Lodha, M.L. and Sane, P.V. (1993). Recent Advances in Plant Biochemistry. ICAR Publication, New Delhi, India.

7. Moore, T.F. (1989). Biochemistry and Physiology of Plants Hormones. 2nd Edn. Springer-Verlag.
8. Nobel, P.S. (1999). Physio-chemical and Environmental Plant Physiology. 2nd Edn. Academic Press, San Diego, U.S.A.
9. Salisbury, F.B. and Ross, C.W. (1992). Plant Physiology. 4th Edn. Wadsworth Publishing Co., California, U.S.A.
10. Singhal, G.S., Renger, G., Sopory. S.K., Irrgang, K.D. and Govindjee. (1999). Concepts in Photobiology: Photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi.
11. Taiz, L. and Zeiger, E. (2010). Introduction to Plant Physiology. 5th Edn. Sinauer Associates, Inc.
12. Thomas, B. and Vince-Prue, D. (1997). Photoperiodism in Plants. 2nd Edn. Academic Press. San Diego, U.S.A.
13. Srivastava, L.M. (2002). Plant Growth and Development. Academic Press, USA.

COURSE TITLE: PLANT BREEDING AND BIOSTATISTICS

Course No.:PSBOTC302
Credit: 4
Duration: 3 hrs

Maximum Marks: 100
Minor Test I: 20
Minor Test II: 20
Major Test: 60

Objectives:

Knowledge of various plant breeding techniques is a must for designing strategies to meet the ever-increasing demand of food in a progressing country like India. Understanding developed by the student on these aspects will be of great practical application. Clubbing with Biostatistics will prove helpful in designing biological experiments and analyzing and interpreting the data generated.

Unit-I Reproductive modes and their impacts on genetic makeup of a species.

1.1 General concepts of domestication and plant breeding; major crop improvement centers of the world, important achievements.
1.2 Reproductive modes in flowering plants- an overview; methods of vegetative propagation-natural and artificial; apomixis-phenomenon and significance; concept of clonal propagation.
1.3 Sexual reproduction and breeding system- types of breeding systems, their significance in controlling population structure, Hardy-Weinberg equation.
1.4 Concept of pure lines, inbreeding depression and heterosis; significance of these phenomena in crop improvement.

Unit-II Breeding methods and crop improvement.

2.1 Selection in self-pollinating crops- pure line and mass selection.
2.2 Selection in cross-pollinated crops- recurrent selection- types and implications.
2.3 Hybridization for improvement of crop plants- relative efficiency in self and cross pollinated crops; pedigree and bulk population breeding.
2.4 Hybrid and synthetic varieties– production and achievements.

Unit-III Data collection, presentation and descriptive statistics

3.1 Importance and scope of biometry/biostatistics; presentation of data in the form of tables, graphs, histograms, frequency polygon.
3.2 Descriptive statistics of the distribution of any variable: mean, mode, median, variance, standard deviation, coefficient of variation, box & whisker plots.
3.3 Descriptive statistics of averages, dispersion, skewness and kurtosis; scatter plots.

3.4 Sampling of data: random and non random sampling.

Unit - IV Probability distributions and various tests of significance

4.1 Applications of probability distribution; binomial and normal distribution; Poisson distribution and its applications.

4.2 Tests of hypothesis and two types of errors.

4.3 Parametric and Non-parametric tests- concept and major differences.

4.4 Tests of means and proportions; t-,z-,F-and Chi-square tests and their applications.

Unit - V Experimental designs, analysis of data and their significance.

5.1 Principles and designs of experiments, examples of CRD and RBD.

5.2 Correlation: simple, partial and multiple; simple and multiple regressions.

5.3 One way and two way analysis of variance– their importance in the study of variation.

5.4 Analysis of population diversity, concept of PCV, GCV, heritability (narrow and broad sense), methods of clustering in phylogeny.

Note for Paper Setting

Theory Examination	Syllabus to be covered in the Examination	Time allotted for the Exam	% weightage (marks)
Minor Test I	Upto 20%	1 Hr.	20
Minor Test II	20% to 40%	1 Hr.	20
Major Test	41% to 100%	2.5 Hr.	60

Pattern to be followed for Major Test:

a. Major test will have seven questions each of 15 marks.
b. One question will be compulsory and will consist of very short answer type of multiple parts spread over entire syllabus.
c. Rest of the six questions will be from the remaining 41%-100% portion of the syllabus and the candidate will have to attempt any three of them.

Literature recommended:

1. Allard, R.W. (1999). Principles of Plant Breeding. John Wiley and Sons.
2. Balaam, L.N. (1972). Fundamentals of Biometry. Unwin Publishers Inc. London (Halsted Press; John Wiley & Sons).
3. Datta, A.K. (2006). Basic Biostatistics and its Applications. New Central Book Agency (P) Ltd., Kolkata, India.
4. Dhar, M.K. and Kaul, S. (1997). Statistics in Biology. Malhotra Publishers, Jammu.
5. Gupta, S.P. (2002). Statistical Methods. Sultan Chand and Sons, New Delhi.
6. Norman, G.R. and Streiner, D.L. (2008). Biostatistics- the Bare Essentials. BC Decker Inc., Hamilton, Canada.
7. Sharma, J.R. (1998). Statistical and Biometrical Techniques in Plant Breeding. New Age International Publishers.

8. Singh, B.D. (2013). Plant Breeding. Kalyani Publishers, New Delhi.
9. Sokal, R.R. and Rohlf, F.J. (2001). Biometry-The Principles and Practice of Statistics in Biological Research. W.H. Freeman and Company, New York.
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11. Senedecor, G. and Cochran, W. (1980). Statistical Methods. 7th Edn. Iowa State University Press.
12. Sukhatme, P.V. and Amble, V.N. (1976). Statistical Methods for Agricultural Workers. ICAR, New Delhi.
13. Singh, R.K. and Chaudhary, B.D. (1999). Biometrical methods in Quantitative Genetic Analysis. Kalyani Publishers, New Delhi.
14. Sokal, R.R. and Rohlf, F.J. (2012). Biometry. W.H. Freeman and Company, New York.

COURSE TITLE: PLANT RESOURCE UTILIZATION AND CONSERVATION

Course No.:PSBOTC303
Credit: 4
Duration: 3 hrs

Maximum Marks: 100
Minor Test I: 20
Minor Test II: 20
Major Test: 60

Objectives:

This course has been framed for enhancing the knowledge of students about the important plant resources and their sustainable utilization. Knowledge about the origin and domestication will help the students appreciate the need to conserve.

Unit-I Plants and civilization.

1.1 Origin of agriculture-time and places of origin.
1.2 Centre of origin and domestication of cultivated plants; Vavilov's and de Candolle's concept.
1.3 Forest sustainable utilization and development – basic concepts.
1.4 Ethnobotany-role of plants in migratory and settled tribes.

Unit- II Plant resource utilization.

2.1 Pulse crops – distribution and cultivation in India, food value of pulses.
2.2 Spices and condiments in India.
2.3 Source and utility of resins, tannins, gums and natural dyes.
2.4 Non-wood forest products: distribution and utility of bamboos and rattans, raw materials for paper making and the processing procedure involved.

Unit-III Plants and drugs.

3.1 Drugs-concept, types (natural and synthetic).
3.2 Alkaloids, steroids and glycosides- sources, classification, distribution and mode of action.
3.3 Psychoactive drugs- sources, types, distribution and mode of action.
3.4 Medicinal plants of religious importance as mentioned in different holy books.

Unit –IV Extinction and plant conservation.

4.1 Plant diversity, extinction, types and causes of extinction and methods to prevent biodiversity extinction.

4.2 IUCN categories of plants, land races of crops, RET and endemic plants as the target groups of extinction.

4.3 Principles of conservation, CBD, green revolution, international agreement to protect species and habitat.

4.4 Habitat protection, sacred groves and indigenous knowledge (IK) for the conservation of the plant species.

Unit –V In-site/ off site conservation practices and conservation enactments.

5.1 Protected areas: concept, categories, design of protected areas; sanctuaries, national parks and biosphere reserves and wetlands.

5.2 Off-site conservation: role of botanic gardens, field gene banks and seed banks in conservation; cryopreservation of pollen and seed- a tool for plant conservation.

5.3 Legislation and enactments on resource conservation and environmental protection in India.

5.4 Intellectual property rights: basic concept of patenting in R&D, patenting system in India.

Note for Paper Setting

Theory Examination	Syllabus to be covered in the Examination	Time allotted for the Exam	% weightage (marks)
Minor Test I	Upto 20%	1 Hr.	20
Minor Test II	20% to 40%	1 Hr.	20
Major Test	41% to 100%	2.5 Hr.	60

Pattern to be followed for Major Test:

a. Major test will have seven questions each of 15 marks.
b. One question will be compulsory and will consist of very short answer type of multiple parts spread over entire syllabus.
c. Rest of the six questions will be from the remaining 41%-100% portion of the syllabus and the candidate will have to attempt any three of them.

Literature Recommended:

1. Akeroyd, J. and Jackson, P.W. (1995). A Handbook of Botanic Garden and Reintroduction of Plants to the Wild. Botanic garden conservation Union, UK.
2. Arora, R.K. and Nayar, E.R. (1984). Wild Relatives of Crop Plants in India. NBPGR Science Monograph No.7.
3. Bole, P.V. and Vaghani, Y. (1986). Field Guide to Common Indian Trees. Oxford University Press, Mumbai.
4. Chandel, K.P.S., Shukla, G. and Sharma, N. (1996). Biodiversity in Medicinal and Aromatic Plants in India- Conservation and Utilization. National Bureau of Plant Genetic Resources, New Delhi.

5. Chowdhery, H.J. and Murty, S.K. (2000). Plant Diversity and Conservation in India – an overview. Bishen Singh Mahendra Pal Singh, Dehradun.
6. Directory of Indian Wetlands (1993). W.W.F. India, New Delhi and AWB, Kuala Lumpur.
7. Falk, D.A., Olwell, M. and Millan C. (1996). Restoring Diversity. Island press, Columbia, USA.
8. FAO/IBPGR (1989). Technical Guidelines for the Safe Movement of Germplasm. FAO/IBPGR, Rome.
9. Frankel, O.H., Brown, A.H.D. and Burdon, J.J. (1995). The Conservation of Plant Diversity. Cambridge University Press, Cambridge, U.K.
10. Gadgil, M. and Guha, R. (1996). Ecology and Equality: Use and Abuse of Nature in Contemporary India. Penguin, New Delhi.
11. Heywood, V. (1995). Global Biodiversity Assessment. United National Environment Programme. Cambridge University Press, Cambridge, U.K.
12. Haunter, M.L. and Gibbs, J. (2007). Fundamentals of Conservation Biology. 3rd Edn. Blackwell Publishing, U.K.
13. Kothari, A. (1997). Understanding Biodiversity: Life Sustainability and Equity. Orient Longman.
14. Kohli, R., Arya, K.S., Singh, P.H. and Dhillon, H.S. (1994). Tree Directory of Chandigarh. Lovedale Educational, New Delhi.
15. Meffe, G.K. and Ronald, C.R. (1994). Principles of Conservation Biology. Sinauer Associates. INC Publishers, USA.
16. Paroda, R.S. and Arora, R.K. (1991). Plant Genetic Resources Conservation and Management. IPGRI Publication. South Asia Office, C/O NBPGR. Pusa Campus, New Delhi.
17. Plucknett, D.L., Smith, N.J.H. William, J.T. and Murti Annishetty, N. (1987). Gene Banks and Worlds Food. Princeton University Press, Princeton, New Jersey, USA.
18. Primack, R.E. (2006). Essentials of Conservation Biology. 4th Edn. Sinauer Associates, U.S.A.
19. Rodgers, N.A. and Panwar, H.S. (1988). Planning a Wildlife Protected Area Network in India. Vol. I. The Report Wildlife Institute of India, Dehradun.
20. Swaminathan, M.S. and Kocchar, S.L. (1989). Plants and Society. MacMillan Publication Ltd., London.
21. Thomas, P. (2000). Trees: their National History. Cambridge University Press, Cambridge.
22. Walter, K.S. and Gillett, H.J. (1998). 1997 IUCN Red List of Threatened Plants. IUCN, the World Conservation Union, IUCN, Gland. Switzerland and Cambridge, U.K.

ENTREPRENEURSHIP IN BOTANY

Course No.:PSBOTE304
Credit: 4
Duration: 3 hrs

Maximum Marks: 100
Minor Test I: 20
Minor Test II: 20
Major Test: 60

Objectives:

This course will prepare students to establish their plant resource based business units. Therefore, the course content involves practices used for growing and maintaining economically important plant species.

Unit-I Food and fodder.

1.1 Essential components of human nutrition; concept of human disorders due to nutritional deficiencies, concept of rabi (wheat) and kharif (rice) crops.
1.2 Cereals- rice and wheat, nutritional value, agro-technology and varieties.
1.3 Legumes- pea and soybean, nutritional value, agro-technology and varieties.
1.4 Fodder crops- types (conserved forage, compound feed, crop residues, freshly cut forage) and their storage.

Unit-II Horticulture and floriculture.

2.1 Fruits- types, nutritional value, economic importance, preservation and storage.
2.2 Ber and amla - agro-technology, varieties and market trends.
2.3 Flowers - economic importance (decorative, medicinal, aromatic, food).
2.4 Gladiolus and marigold – agro-technology and market trends.

Unit-III Medicinal and aromatic plants (MAPs).

3.1 Introduction, history of use of MAPs and quality control in medicinal plants.
3.2 Ashwgandha and safed musli - agro-technology, market trends and economics.
3.3 Lemon grass and rose- cultivation, agro-technology and economics.
3.4 Extraction of essential oils (distillation, expression, effleurage, maceration).

Unit-IV Vegetable oil and sugar industry.

4.1 Composition and uses of vegetable oils (food and medicinal).

4.2 Sunflower and mustard- agro-technology, storage and uses.
4.3 Extraction and refining of vegetable oils (oil expeller, degumming, bleaching and hydrogenation).
4.4 Sugarcane and beet sugar- agro-technology, extraction and economic importance of sugars.

Unit-V Plant fibres, natural dyes and paper industry.

5.1 Plant fibres-types; agro-technology (hemp, cotton and *Agave*) and extraction of fibres.
5.2 Natural dyes- types, agro-technology (henna, indigo and safflower) and extraction of dye.
5.3 Dyeing with natural dyes (process, colour combinations, dye recipes- flower, leaves, bark, and roots).
5.4 Paper industry - sources and processes (mechanical and chemical).

Note for Paper Setting

Theory Examination	Syllabus to be covered in the Examination	Time allotted for the Exam	% weightage (marks)
Minor Test I	Upto 20%	1 Hr.	20
Minor Test II	20% to 40%	1 Hr.	20
Major Test	41% to 100%	2.5 Hr.	60

Pattern to be followed for Major Test:

a. Major test will have seven questions each of 15 marks.
b. One question will be compulsory and will consist of very short answer type of multiple parts spread over entire syllabus.
c. Rest of the six questions will be from the remaining 41%-100% portion of the syllabus and the candidate will have to attempt any three of them.

Literature recommended:

Bibliography

1. Bedi, Y.S., Dutt, H.C. and Kaur, H. (2011). Plants of Indian System of Medicine (Vol. I &II). Lambert Academic Publishing, Germany.
2. Bose, T.K. and Som, M.G.V. (1986). Vegetable crops in India. Naya Prokash, Calcutta
3. Bose, T.K. (1985). Fruits of India tropical and subtropical. Naya Prokash, Calcutta.
4. Chrispeels, M.J. and Sadava, D.E. (1994). Plants, Genes and Agriculture. Jones and Bartlett Publishers, London
5. Furry S.M. and Viemont V.M. (1935). Home Dyeing with Natural Dyes. Thresh Publications. California
6. Hanson, H. Borlaug N.E. and Anderson, R.G. (1982). Wheat in the Third World. Westbiew Press, Colorado.

7. Jadhav, D. (2009). Medicinal Plants of India. Vol. 1-3. Scientific Publishers, India. NIIR Board (2004).Cultivation of Fruits, Vegetables and Floriculture. NIIR.
8. Jindal, S.L. (1982). Lawns and Gardens. Ministry of Information and Broadcasting, GoI
9. Kent, N.L. (1983). Technology of Cereals. 3rd Edn. Pergamon Press, Oxford.
10. Kochar, S.L. (2009). Economic Botany in the Tropics. 3rd Edn. MacMillan Publishers Ltd.
11. Martin J.H., Leonard, W.H., Stamp, D.L. (1976). Principles of Field Crops. Macmillan Publishers, London.
12. Maiti, R.K. and Singh R.K. (2006). An Introduction to Modern Economic Botany. Agrobios (India).
13. Metcalfse, D.S. and Elkins, D.M. (1980). Crop Production: Principles and Practices (IV ed.). Macmillan Publishing Co. Inc. New York.
14. Pradhan S. (1995). Economic Botany. Har Anand Publication, New Delhi
15. Radhakrishnan, T., Anandaraja, N., Ramasubramanian, M., Nirmala, L. and Israel, M. T. (2009). Traditional Agricultural Practices: Applications and Technical Implementations. New India Publishing, India.
16. Sharma, O.P. (1996). Hill's Economic Botany. Tata McGraw Hill's, Noida.
17. Singh, R. (1969). Fruits. National Book Trust, India.
18. Trivedi, P. (1996). Home Gardening. ICAR, New Delhi
19. Vardhana R. 2009. Economic Botany. Sarup Book Publishers Pvt. Ltd., New Delhi
20. Verma, V. (2009). Textbook of Economic Botany. Ane Books Pvt. Ltd, India.
21. West, R.B. (1999). Practical Gardening in India. Discovery publishing House, New Delhi.

Course No. PSBOPC305 (Based on PSBOTC301)

Credit: 4

Maximum Marks: 100
Daily evaluation of practical records /Assignment test / Viva voce etc. : 50
Final Practical performance +viva voce:50

Laboratory Exercises based on PSBOTC301

1. Extraction of chloroplast pigments from leaves and preparation of the absorption spectrum of chlorophylls and carotenoids.
2. Determination of chlorophyll a and chlorophyll b ratio in C3 and C4 plants.
3. Extraction of seed proteins depending upon the solubility.
4. Determination of the respiratory quotient (RQ) for germinating seeds by Ganong's Respirometer.
5. Desalting of proteins by gel filtration chromatography employing Sephadex G25.
6. Preparation of the standard curve of protein (BSA) and estimation of the protein content in extracts of plant material by Lowry's and Bradford's method.
7. Fractionation of proteins using gel filtration chromatography by Sephadex G100 or Sephadex G200.
8. Extraction and qualitative estimation of amino acids from plant tissue by using paper chromatography.
9. Extraction and qualitative estimation of sugars and organic acids by paper chromatography.
10. Ascorbic acid extraction and quantitative estimation from plant tissues.
11. Determination of effect of time and enzyme concentration on the rate of reaction of enzyme. eg. acid phosphatase, nitrate reductase, catalase.
12. Determination of effect of substrate concentration of activity of an enzyme.
13. Determination of the effect of anaesthetics, temperature and high pressure on the permeability of beet root tissue.
14. Principles of colorimeter, spectrophotometer and fluorimeter.
15. Separation of isozymes i.e. esterase, peroxidase using PAGE.
16. Study of degree of dissociation of an electrolyte by plasmolytic method.
17. Determination of temperature coefficient (Q_{10}) of water absorption by wheat seeds and potato tubers.

Course No. PSBOPC306 (Based on PSBOTC302 and PSBOTC303)

Credit: 4

Maximum Marks: 100
Daily evaluation of practical records /Assignment test / Viva voce etc. : 50
Final Practical performance +viva voce:50

Laboratory Exercises based on PSBOTC302

1. Classification of the medicinal plants growing in botanical garden in accordance with IUCN categories.
2. Determination of the percentage of conservation value of soil and water for an herbaceous community.
3. Estimation of possible biological threats on the existence of *Allium roylei* and *Eremostychus superba* on the basis of provided meiotic spread and flower respectively.
4. Analysis of the biotic components of a man made wetland and graphically represent the studied aquatic ecosystem.
5. Determination of seed viability of highly threatened medicinal plants by tetrazolium chloride test.
6. Comparison of the seed morphology and viability of variously temperature treated seeds for seed storage practice.
7. Comparison of the germplasm diversity in economic traits of provided vegetable material.
8. Determination of the spatial and temporal distribution of plants through herbarium upholding.
9. Determination of the percentage of species association using Jaccard's index.
10. RET plants growing in the botanical garden in respect of morphology and physiognomy.
11. Pharmacognostic details (morphology, anatomy and organoleptic characters) of the provided crude drugs of Indian system of medicine.
12. Determination of organoleptic characters of different tea samples and determine the presence of tannins and flavonoids in the provided tea samples.
13. Comparison of the percentage of protein bodies in the provided pulses.
14. Preparation of temporary mount using iodine solution as stain and compare type, shape, structure, and size of starch granules in the provided plant material.
15. Determination the presence of phlobatannins, flavonoids, steriods and glycosides in the provided drug samples.
16. Preparation of soap from vegetable oil.
17. Extraction and characterisation of the plant fibers from provided plant material.

Laboratory Exercises based on PSBOTC303

1. Calculation of mean, mode, median, standard deviation and coefficient of variation.
2. Skewness and Kurtosis- coefficients and probability.
3. Frequency and probability distributions.
4. Students’t-test, F-test, one way and two way ANOVA.
5. Correlation and regression analysis.
6. Cluster analysis.
7. Study of natural modes of vegetative propagation using appropriate methods (bulb, corm, tuber, runner and sucker).
8. Attempt different types of grafts using proper stock and scion.
9. Demonstrate various types of layering.
10. Study the floral characters, pollen-ovule ratio and pollen stigma interactions in any self-pollinated crop preferably legumes.
11. Study various contrivances for out-crossing in common cross pollinated crops. available in the season (maize, bajra, jowar, trifoliums).
12. Demonstration of various steps involved in carrying out hand/manual pollinations.

Semester-IV

Course Code	Paper	Credits	Contact hours per week L-Tu-P
PSBOTC401	Plant Anatomy	4	4-0-0
PSBOTC402	Principles of Plant Pathology	4	4-0-0
PSBOTC403	Genetic Engineering of Plants and Microbes and Plant Tissue Culture	4	4-0-0
*PSBOTE404	Plant Propagation	4	4-0-0
PSBOPC405	Laboratory course (based on PSBOTC401 &402)	4	0-0-8
PSBOPC406	Laboratory course (based on PSBOTC403)	4	0-0-8
	Total	24	16-0-16

***Optional for outside department students and not available for departmental students.**

COURSE TITLE: PLANT ANATOMY

Course No.:PSBOTC401
Credit: 4
Duration: 3 hrs

Maximum Marks: 100
Minor Test I: 20
Minor Test II: 20
Major Test: 60

Objectives:

This course will acquaint the students with internal basic architecture and cellular composition of plant body. This will help them to correlate important functions performed by different plant parts.

Unit-I Plant growth, development and cellular organization.

1.1 Unique features of plant growth and development- polarity and cell division.
1.2 Origin, growth, structure and composition of cell wall, special structures of cell walls: fine structure of plasmodesmata, pits and their types.
1.3 Diversity of cell types in plants- structure and arrangement of parenchyma and collenchyma.
1.4 Sclerenchyma- origin, development and structure of fibres and sclereids.

Unit-II Fundamental tissues, types and constituent cells.

2.1 Epidermis-structure in root and aerial parts, origin and composition of cuticle.
2.2 Stomata and trichomes- structural diversity, origin and functions.
2.3 Xylem- origin and elements, structure and functions of tracheary elements.
2.4 Phloem- origin and elements, structure and functions of sieve tube elements and companion cells.

Unit-III Meristems and vascular tissues-components and composition.

3.1 Meristems- types and composition; structure, cytohistological zonation and function of shoot and root apical meristem.
3.2 Vascular cambium- organization, formation of secondary xylem and phloem.
3.3 Secondary xylem- basic structure; storied and non storied wood; growth rings.
3.4 Secondary phloem- structure of sieve tube elements and companion cells.

Unit-IV Secondary vascular tissues, leaf formation, expansion and abscission.

4.1 Components and development of periderm; structure and products of phellogen, phellem and phelloderm.
4.2 Concept of rhytidome, polyderm and wound periderm.
4.3 The leaf- formation and expansion; control of form.
4.4 Senescence and abscission- phenomena and implications; metabolic changes associated with these phenomena.

Unit-V Specialized structures and their functions.

5.1 Salt glands and hydathodes- general account.
5.2 Nectaries- variation in structure; an overview of glandular structures of carnivorous plants.
5.3 Osmophores; structure and role of stinging hairs.
5.4 Laticifers- structure and development of articulated and non articulated laticifers.

Note for Paper Setting

Theory Examination	Syllabus to be covered in the Examination	Time allotted for the Exam	% weightage (marks)
Minor Test I	Upto 20%	1 Hr.	20
Minor Test II	20% to 40%	1 Hr.	20
Major Test	41% to 100%	2.5 Hr.	60

Pattern to be followed for Major Test:

a. Major test will have seven questions each of 15 marks.
b. One question will be compulsory and will consist of very short answer type of multiple parts spread over entire syllabus.
c. Rest of the six questions will be from the remaining 41%-100% portion of the syllabus and the candidate will have to attempt any three of them.

Literature recommended:

1. Atwell, B.J., Kriedermann, P.E. and Jumbull, C.G.N. (1999). Plants in Action: Adaptation in Nature, Performance in Cultivation. Mc Millan Education, Sydney, Australia.
2. Bewley, J.D. and Black, M. (1994). Seeds: Physiology of Development and Germination. Plenum Press, New York.
3. Burgess, J. (1985). An Introduction to Plant Cell Development. Cambridge University Press, Cambridge.
4. Cutler D.F., Bother, C.E.G. and Stevenson, D.W. (2007). Plant Anatomy: An Applied Approach. Blackwell Publishing, USA.

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7. Fosket, D.E. (1994). Plant Growth and Development: A Molecular Approach. Academic Press, San Diego.
8. Howell, S.H. (1998). Molecular Genetics of Plant Development. Cambridge University Press, Cambridge.
9. Murphy, T.H. and Thompson, W.F. (1988). Molecular Plant Development. Prentice Hall, New Jersey.
10. Steeves, T.A. and Sussex, I.M. (1989). Patterns in Plant Development. 2nd Edn. Cambridge University Press, Cambridge.
11. Dickison, W.C. (2000). Integrative Plant Anatomy. Academic Press Inc.

COURSE TITLE: PRINCIPLES OF PLANT PATHOLOGY

Course No.:PSBOTC402
Credit: 4
Duration: 3 hrs

Maximum Marks: 100
Minor Test I: 20
Minor Test II: 20
Major Test: 60

Objectives:

This course has been conceived to equip students with the knowledge of various plant diseases caused by different pathogens, means of their entry in plants and defense system of plants. Besides, the course also deals with the post harvest losses and methods generally adopted for their management.

Unit-I Disease inoculum.

1.1 Concept of disease in plants, significance of plant diseases, disease triangle.
1.2 Production, types and survival of inocula of plant pathogens.
1.3 Dispersal of infectious plant pathogens (active and passive dispersal).
1.4 Plant disease epidemic forecast, disease warning systems and important examples of plant disease forecast systems.

Unit-II Pathogenesis and defense mechanisms.

2.1 Pre-penetration activities of the pathogens on host surface; direct penetration through intact plant surfaces, penetration through wounds and natural openings.
2.2 Post-penetration inter -and intra-cellular development of pathogens involving growth and reproduction of the pathogen.
2.3 Defense mechanism in plants, morphological and histological defense structures, cytoplasmic defense reaction in response to infection by pathogens.
2.4 Biochemical defense mechanisms, phytoalexins, Pathogenesis-related (PR) proteins.

Unit-III Chemical weapons of pathogenesis.

3.1 Enzymes in plant disease: enzymatic degradation of cell wall substances.
3.2 Microbial toxins in plant disease, non-host specific and host specific toxins.
3.3 Growth regulators in plant diseases.
3.4 Role of polysaccharides in plant diseases.

Unit-IV Post-harvest storage rots.

4.1 Concept and extent of post-harvest losses, factors influencing post-harvest storage rots.
4.2 Mycotoxin producing storage fungi and major mycotoxins produced by them.

4.3 Factors responsible for fungal growth and mycotoxin production in agricultural commodities.

4.4 Aflatoxins – occurrence and historical perspective, major types, properties, toxicity; Prevention of aflatoxin formation, criteria for detoxification, physical methods of detoxification and their importance.

Unit-V Management of plant diseases.

5.1 Regulatory and biological methods – quarantine and inspection, antibiosis, fungistasis.

5.2 Cultural methods – eradication of secondary hosts, crop rotation, rogueing, tillage, sanitation, creating conditions unfavourable to the pathogens, nutritional and soil amendments.

5.3 Chemical methods – requisites of a good fungicide, protective and systemic fungicides, seed and soil treatment by fungicides.

5.4 Breeding for disease resistance – important methods for developing resistant varieties, types of plant resistance to pathogens, genetics of virulence in pathogen and resistance in host plant.

Note for Paper Setting

Theory Examination	Syllabus to be covered in the Examination	Time allotted for the Exam	% weightage (marks)
Minor Test I	Upto 20%	1 Hr.	20
Minor Test II	20% to 40%	1 Hr.	20
Major Test	41% to 100%	2.5 Hr.	60

Pattern to be followed for Major Test:

a. Major test will have seven questions each of 15 marks.
b. One question will be compulsory and will consist of very short answer type of multiple parts spread over entire syllabus.
c. Rest of the six questions will be from the remaining 41%-100% portion of the syllabus and the candidate will have to attempt any three of them.

Literature Recommended:

1. Agrios, G.N. (2012). Plant Pathology. 5th Edn. Academic Press, London.
2. Bhatnagar, D., Lillehoj, E.B. and Arora, D.K. (1992). Handbook of Applied Mycology: Mycotoxins in Ecological Systems. Vol. 5. Marcel Dikker Inc.
3. Dasgupta, M.K. and Mandal, N.C. (1989). Post-harvest Pathology of Perishables. Oxford & IBH Publishing Co. Pvt. Ltd.
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5. Nene, Y.L. and Thapiyal, P.N. (1971). Fungicides in Plant Diseases Control. Oxford & IBH Publishing Co. Pvt. Ltd.
6. Sharma, R.P. and Salunkhe, D.K. (1991). Mycotoxins and Phytoalexins. CRC Press, Boca Raton
7. Sumbali G. (2010). The Fungi. 2nd Edn. Narosa Publishing House, New Delhi.

8. Sumbali G. and Mehrotra R.S. (2009). Principles of Microbiology. 1st Edn. Tata McGraw Hill Publishing Co. Ltd. New Delhi.
9. Vyas, S.C. (1993). Handbook of Systemic Fungicides. Vol. I, II & III. Tata Mc Graw Hill Publ. Co.
10. Waller J. M., Lenne, J. M. and Waller S. J. (2001). Plant Pathologist's Pocket Book. 3rd Edn. CDBI Publishers.

COURSE TITLE: GENETIC ENGINEERING AND PLANT TISSUE CULTURE

Course No.:PSBOTC403
Credit: 4
Duration: 3 hrs

Maximum Marks: 100
Minor Test I: 20
Minor Test II: 20
Major Test: 60

Objectives:

Genetic Engineering is one of the most important and controversial field of genetic research. Making students knowledgeable about the methods involved in modifying and manipulating genes within and between species, creating new medicines, producing disease resistant plants and diagnosing human diseases is the main aim of this course. The component of tissue culture has been deliberately clubbed with genetic engineering, since for culturing genetically modified plants; one should know the tissue culture techniques.

Unit-I Recombinant DNA technology.

1.1 Principles and Techniques of gene cloning.
1.2 Genomic/cDNA libraries – construction and choice of vectors.
1.3 DNA synthesis and sequencing; Polymerase Chain Reaction.
1.4 DNA fingerprinting – Technique and applications.

Unit-II Genetic engineering of plants and microbes.

2.1 Aims and strategies for development of transgenic plants. Transgenic plants for herbicide tolerance, pest (insect and viral) resistance and molecular farming; *Agrobacterium* – The natural genetic engineer; T-DNA and transposon mediated gene tagging.
2.2 Chloroplast transformation – technique and its utility; bacterial transformation; selection of recombinants and transformants.
2.3 Genetic improvement of industrial microbes and nitrogen fixers, fermentation technology – a general account.
2.4 Intellectual property rights with reference to genetically engineered organisms; possible ecological risks and ethical concerns.

Unit-III Genomics and proteomics.

3.1 Genetic and physical mapping of genes, molecular markers for introgression of useful traits.
3.2 Artificial chromosomes – BAC and YAC.
3.3 Human genome project–aims, objectives, achievements and risks; introductory bioinformatics.
3.4 Functional genomics–general concept; microarrays; protein profiling and its significance.

Unit-IV Plant tissue culture and organogenesis.

4.1 Introduction, history and scope of plant tissue culture.
4.2 General techniques and tissue culture media; suspension cultures and testing viability of cultured cells.
4.3 Factors affecting single cell culture, plant cell reactors.
4.4 Factors affecting organogenic differentiation, loss of morphogenetic potential in long term cultures.

Unit-V Somatic hybridization, micropropagation, variant selection and secondary metabolite production.

5.1 Protoplast isolation and fusion, hybrid selection and regeneration, genetic consequences of protoplast fusion, hybrids versus cybrids, applications of protoplast research.
5.2 Factors affecting *in-vitro* stages of micropropagation, rooting, hardening of micropropagated plants; applications and limitations of micropropagation.
5.3 Origin of somaclonal variation, mechanisms underlying genetic variation, selection of variants at plant and cell levels, prospects and achievements of somaclonal variation.
5.4 Strategies used for production of useful compounds through cell culture, factors affecting yield of products in culture, applications of *in vitro* production of secondary metabolites.

Note for Paper Setting

Theory Examination	Syllabus to be covered in the Examination	Time allotted for the Exam	% weightage (marks)
Minor Test I	Upto 20%	1 Hr.	20
Minor Test II	20% to 40%	1 Hr.	20
Major Test	41% to 100%	2.5 Hr.	60

Pattern to be followed for Major Test:

a. Major test will have seven questions each of 15 marks.
b. One question will be compulsory and will consist of very short answer type of multiple parts spread over entire syllabus.
c. Rest of the six questions will be from the remaining 41%-100% portion of the syllabus and the candidate will have to attempt any three of them.

Literature recommended:

1. Brown, T.A. (1989). Genetics: A molecular Approach. VNR International

2. Brown, T.A. (2010). Genomes. John Wiley and Sons Pvt. Ltd., Singapore.
3. Brown, T.A. (2010). Gene cloning and DNA Analysis- An introduction. 6th Edn. Wiley Blackwell.
4. Bhojwani, S.S. and Razdan, M.K. (2005). Plant Tissue Culture: Theory and Practice. Revised Edn. Elsevier Science Publication, The Netherlands.
5. Bhojwani, S.S. (2013). Plant Tissue Culture: Applications and Limitations. Elsevier Science Publishers, New York, USA.
6. Chrispeels, M.J. and Sadava, D.E. (1994). Plants, Genes and Agriculture. Jones & Bartlett Publishers, Boston, USA.
7. Das, H.K. (2007). A Textbook of Biotechnology. 3rd Edn. Wiley India Pvt. Ltd. U.P., India.
8. Glezer, A.N. and Nikaido, H. (1995). Microbial Biotechnology. W.H. Freeman and Company, New York, USA.
9. Glick, B.R., Pasternak J.J. and Patten, C.L. (2010). Molecular Biotechnology: Principles and Applications of Recombinant DNA. 4th Edn. A.S.M. Press, Washington, DC.
10. Henry, R.J. (1997). Practical Applications of Plant Molecular Biology. Chapman & Hall, London, UK.
11. Jolles, O. and Jornvall, H. (2000). Proteomics in Functional Genomics. Birkhauser Verlag, Basel, Switzerland.
12. Primrose, S.B. (1995). Principles of Genome analysis. Blackwell Science Ltd., Oxford, UK.
13. Raghavan, V. (1997). Molecular Biology of Flowering Plants. Cambridge University Press, New York, USA.
14. Jain, S.M., Sopory, S.K. and Veilleux, R.E. (1996). *In vitro* Haploid Production in Higher Plants-Fundamental Aspects and Methods. Vols. 1-5. Kluwer Academic Publishers, Dordrecht, the Netherlands.
15. Kartha, K.K. (1985). Cryopreservation of Plant Cells and Organs. CRC Press, Boca Raton, Florida, USA.
16. Vasil, I.K. and Thorpe, T.A. (1994). Plant Cell and Tissue Culture. Kluwer Academic Publishers. The Netherlands.

COURSE TITLE: PLANT PROPAGATION

Course No.:PSBOTE404
Credit: 4
Duration: 3 hrs

Maximum Marks: 100
Minor Test I: 20
Minor Test II: 20
Major Test: 60

Objectives:

Basic and applied tools of plant propagation are of immense commercial utility. Thus, this course is formulated to introduce the students to various means of propagation, their advantages and disadvantages.

Unit-I Seed production in plants.

1.1 Biology of propagation in plants- General account of sexual and asexual means and their correlation with genetic variability; seedlings versus clonal propagation.
1.2 Sexual seed - structure, development, ripening and dissemination.
1.3 Apomixis - phenomenon and implications; concept of asexual seeds and polyembryony.
1.4 Propagation from seeds - germination process, dormancy- its types and control, methods to break dormancy.

Unit-II Modes of vegetative propagation.

2.1 Vegetative propagation- advantages and limitations, natural and artificial means.
2.2 Propagation by specialized vegetative structures- bulbs, tubers corms, rhizomes, runners and suckers.
2.3 Propagation by cutting and layering- types of cuttings and layering, description of adventitious root and bud formations; processes in layering.
2.4 Grafting and budding- concept and types, formation of graft union, graft incompatibility, top budding and micro-budding.

Unit-III Breeding systems and methods.

3.1 Concept of breeding systems, cross and self pollination; contrivances for cross pollination, concept of sex expression, dichogamy and self- incompatibility.
3.2 Breeding methods for self-pollinated crops; selection methods- mass and pure line selection.
3.3 Breeding methods for cross pollinated crops, concept of inbreeding depression and hybrid vigour.
2.4 Hybridization methods-hybrid and synthetic varieties, selection after hybridization, pedigree selection and bulk population.

Unit-IV *In vitro* multiplication.

4.1 Advantages of *in-vitro* propagation, various stages in micropropagation, acclimatization of *in vitro* raised plants.
4.2 Propagation of plants by organogenesis-factors affecting indirect and direct organogenesis.
4.3 Propagation of plants by somatic embryogenesis-factors affecting indirect and direct somatic embryogenesis, synthetic seed production.
5.4 Storage organ formation-production of bulbils, cormlets and miniature tubers, micrografting.

Unit-V Micropropagation and its utility.

5.1 Micropropagatin of fruit crops.
5.2 Micropropagation of ornamental plants.
5.3 Micropropagation of vegetable, spice, and plantation (e.g. tea, coffee, coconut oil, palm) crops.
5.4 Industrial potential of micropropagation in India.

Literature recommended:

1. Allard, R.W. (2010). Principles of Plant breeding. Wiley India Pvt. Ltd.
2. Bhojwani, S.S. and Razdan, M.K. (2005). Plant Tissue Culture: Theory and Practice. Elsevier Science Publication, The Netherlands.
3. Bhojwani, S.S. (2013). Plant Tissue Culture: Applications and Limitations. Elsevier Science Publishers, New York, USA.
4. Das, H.K. (2007). A Textbook of Biotechnology. 3rd Edn. Wiley India Pvt. Ltd. U.P., India.
5. Hartman, H.T., Kester, D.E., Davies, F.T. and Genevre, R.L. (1997). Plant Propagation – Principles and Practices. Prentice Hall of India Pvt. Ltd., New Delhi.
6. McMillan-Browse, P.D. A. (1979). Plant Propagation. New York: Simon and Schurter.
7. Nanda, K.K. and Kochar, V.K. (1985). Vegetative Propagation of Plants. Kalyani Publishers, New Delhi.
8. Razdan M.K. (1993). An Introduction to Plant Tissue Culture. Oxford & BDH Publishing Co. Pvt. Ltd.
9. Sadhu, M.K. (1999). Plant Propagation. New Age International (P) Limited Publishers, New Delhi.
10. Singh, B. D. (2010) Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi.
11. Trigiano, R. N. and Gray, O.J. (2000). Plant Tissue Culture: Concepts and Laboratory Exercises. CRC Press. BOCA Raton. London, U.K.

Course No. PSBOPC405 (Based on PSBOTC401 and PSBOTC402)

Credit: 4

Maximum Marks: 100
Daily evaluation of practical records /Assignment test / Viva voce etc. : 50
Final Practical performance +viva voce:50

Laboratory Exercises based on PSBOTC401

16. Study of living shoot apices by dissections using aquatic plants such as *Ceratophyllum* and *Hydrilla*.
17. Study of cytohistological zonation in the shoot apical meristem in sectioned and double stained permanent slides of suitable plant such as *Coleus, Kalanchoe, Tobacco*.
18. Examination of shoot apices in a monocotyledon in both T.S. and L.S. to show the origin and arrangement of leaf primordia.
19. Study of alternate and distichous, alternate and superposed, opposite and decussate leaf arrangement. Examination of rosette plants (*Raphanus, Hyoscyamus* etc.) and induction of bolting under natural conditions as well as by GA treatment.
20. Microscopic examination of vertical sections of leaves such as *Cannabis, Tobacco, Nerium*, maize and wheat to understand the internal structure of leaf tissues and trichomes, glands etc. Also study the leaf anatomy of C_3 and C_4 plants.
21. Study of epidermal peels of leaves such as *Coccia*, *Tradescantia*, etc.
22. To study the development and final structure of stomata and determine stomata index. Demonstration of the effect of ABA on stomata closure.
23. Study of whole roots in monocots and dicots. Examination of L.S. of root from a permanent preparation to understand the organization of apical meristem and its derivatives (use maize, aerial roots of banyan, *Pistia*). Origin of lateral roots with different types of nodules.

Laboratory Exercises based on PSBOTC402

1. Preparation of Potato Dextrose Agar medium, sterilization, plating and making of PDA slants.
2. Isolation, purification, culturing and subculturing of fungal pathogens.
3. Methods of preservation and maintenance of fungal cultures.
4. Field diseases of local crop plants.
5. Post-harvest fungal diseases of fruits and vegetables.

Course No. PSBOPC406 (Based on PSBOTC403)

Credit: 4

Maximum Marks: 100
Daily evaluation of practical records /Assignment test / Viva voce etc. : 50
Final Practical performance +viva voce:50

Laboratory Exercises based on PSBOTC403

1. Isolation of plasmid DNA from *E. coli* by alkaline lysis method and its quantization using spectrophotometer.
2. Restriction digestion of the plasmid and estimation of the size of various DNA fragments.
3. Cloning of a DNA fragment in a plasmid vector, transformation of the given bacterial population and selection of recombinants.
4. Demonstration of DNA sequencing by Sanger's dideoxy method.
5. DNA isolation from microbial cultures and plant tissues.
6. Isolation of plasmid from *E. coli* by alkaline lysis method.
7. Preparation of agarose gel and preparation of buffers.
8. Southern blotting of DNA from agarose gel.
9. Study of restriction digestion of DNA.
10. DNA sequencing studies from autoradiographs of sequencing gels and construction of autoradiographs of sequencing gels from provided template sequence.
11. DNA finger printing studies from data on various cases of disputed parentage and forensic applications.
12. Organogenesis and somatic embryogenesis using appropriate explants and preparation of artificial seed.
13. Demonstration of axillary shoots proliferation method for micropropagation.
14. Isolation of protoplasts from various plant tissues and testing their viability.
15. Effect of physical (e.g. temperature) and chemical (eg. osmoticum) factors on protoplast yield.
16. Electroporation of protoplasts and checking of transient expression of the reporter gene.
17. Demonstration of the technique of micropropagation by using different explants e.g. axillary buds, shoot meristems.
18. Demonstration of the technique of anther culture.
19. Isolation of protoplasts from different tissues using commercially available enzymes.
20. Demonstration of root and shoot formation from the apical and basal portion of stem segments in liquid medium containing different hormones.