DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,

CHHATRAPATI SAMBHAJINAGAR

M. Sc. BOTANY SYLLABUS FOR UNIVERSITY DEPARTMENT

AS PER NEP-2020

Illustrative Credit distribution structure for Two year Programme with Multiple Entry and Exit option

Class: M. Sc. II year ACADEMIC AUTONOMY Semester: III

Course code: BOT/MJ/UD/600 -(SAD266003T)

Course Name: Course Name:

BIOLOGY & DIVERSITY OF PTERIDOPHYTES & GYMNOSPERMS

Course type: Major Mandatory Discipline Specific Course

Credits: 3, Contact Hours: 45 clock hours, 3 hours/ week

Marks: 75, Internal assessment: 30, External assessment: 45

Unit I. Pteridophyta: Classification, Origin and evolution, Phylogenetic relationship with Bryophyta. Morphology, anatomy, phylogeny and interrelationships of the orders Psilopsida – Psilotales and Psilophytales, Lycopsida – Lycopodiales, Selaginellales, Isoetales, Equisetopsida – Equisetales and Pteropsida – Filicales.

Unit II. Sporophyte and gametophyte in Pteridophytes, Stelar organization and evolution, Origin of leaf and Telome concept, Sporocarp, Heterospory and seed habit, Comparison of Pteridophyta with Bryophyta and Gymnosperms.

Unit III. Gymnosperms: Introduction, Classification and distribution of Gymnosperms, Morphology, anatomy, reproduction, phylogeny of the orders Pteridospermales (Caytoniaceae, Medullosaceae) Bennettitales (Williamsoniaceae, Cycadeoideaceae) Cycadales (Cycadaceae) Ginkgoales (Ginkgoaceae) Coniferales (Pinaceae, Araucariaceae) Taxales (Taxaceae) Gnetales (Gnetaceae) and Economic importance of gymnosperms.

Unit IV. Paleobotany: Introduction, Geological time scale, Fossils and fossilization, Various types, Continental drift/ plate tectonics, Fossil localities in Maharashtra, Contributions of Prof. Birbal Sahani.

SUGGESTED READINGS:

Agashe, S. N. (1995) Paleobotany, Oxford & IBH, New Delhi

Bir, S. S. (2005) Pteridophytes their Morphology, Cytology, Taxonomy and Phylogeny.Today & Tomorrow's Printers and Publisher.

Biswas, C. and B. M. Johri (2004) The Gymnosperms, Narosa Publishing House, New Delhi

Campbell, C. J. (1940) Evolution of land Plants, Stanford University Press.

Coulter J. M. and C. J. Chamberlain (1978) Morphology of Gymnosperms, Central Book Depot, Allahabad

Eames, A. J. (1974) Morphology of Vascular Plants- lower groups, Tata Me Graw-Hill Publishing Co. New Delhi.

Foster, A. S. & F. M. Gifford (1967) Comparative morphology of vascular plants, Freeman Publishers, San Fransisco.

Kakkar, R. K. and B. R. Kakkar (1995) The Gymnosperms (Fossils and Living) Central Publishing House, Allahabad.

Kashyap S. R. (1932) Liverworts of Western Himalayas and the Plains.Vol. I & II, The University of Panjab, Lahore.

Parihar, N. S. (1976) The biology and morphology of the Pteridophyta, Central Book Depot, Allahabad.

PuriPrem (2005) Bryophytes Morphology, Growth and Differentiation- Pulisher- Atmaram and Sons New Delhi

Rashid, A. (1976) An introduction to pteridophyta, Vikas Publishing House Ltd., New Delhi.

Sambamurty, A. V. S. S., (2005) A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany, Today & Tomorrow's Printers and Publishers

Sharma O. P. (2002) Gymnosperms, Pragati Prakashan, Meerut.

Sharma P. N. and Sahni K. C. (2005) Gymnosperms of India and Adjacent Countries Publisher- Bhishan Singh Mahendra Pal Singh, Dehradun

Tewari, Shiv Datt and GiriBala Pant (2005) Bryophytes of Kumaun Himalaya. Publisher- Bhishan Singh Mahendra Pal Singh- Dehradun

Siddiqui K. A. (2002) Elements of Paleobotany, KitabMahal, Allahabad.

Smith, G. M. (1976) Cryptogamic Botany - Vol. II, Tata Me Graw-Hill Publishing Co. Ltd. New Delhi.

Sporne, K. R. (1976) Morphology of Pteridophyta. Hutchinson University Library, London.

Course code: BOT/MJ/UD/601 - (SAD266013T)

Course Name: PLANT ECOLOGY AND CONSERVATION

Course type: Major Mandatory Discipline Specific Course

Credits: 3, Contact Hours: 45 clock hours, 3 hours/ week

Marks: 75, Internal assessment: 30, External assessment: 45

Unit I i. An introduction to plant ecology and its scope.

ii. **Structure of ecosystem:** Abiotic components (climatic factors, Topographic/factors, Edaphic factors); Biotic components (Interactions among organisms, Autotrophs and Heterotrophs) Ecological Pyramids (Pyramid of numbers, Biomass and energy)

iii. **Functions of ecosystem:** Productivity (Primary and secondary productivity, food chains, Grazing and detritus food chains) food webs. Biogeochemical cycles: C, N, P and S.

Unit II i. **Community ecology:** Classification, Analysis of communities, characteristics of communities, species diversity, Growth form and structure, origin, development and composition.

ii.Competition and coexistence, intra-specific interactions, interspecific interactions, scramble and contest competition model, mutualism and commensalism,prey-predator interactions.

Unit III. **Biogeography:** Major biomes of the World -Terrestrial, Tundra, arboreal coniferous forests, temperate and tropical grasslands and deciduous forests, Mediterranean and Desert vegetation, Tropical rain forests; Aquatic Ecosystems-Fresh water, Estuarine and marine. Endemism and hotspots of biodiversity.

Unit IV. i. **Environmental pollution** in relation to air, water and soil. Use of fertilizer, pesticides and other chemicals in agriculture and hygiene and their disposal.

ii. Climate change: Greenhouse gases, their sources, trends and role, Ozone layer and its depletion (Global warming, Sea level rise, UV radiation) acid rain, Bioindicator and biomarkers of environmental health.

iii. Concepts of ecological management and sustainable development.

Unit V. i**. Biodiversity:** Concept, types and situation in India. IUCN categories.

ii. **Strategies of conservation**: *In situ* conservation, protected regions in India: Sanctuaries, National parks, Wetlands, Sacred groves, mangroves for conservation of wild biodiversity. *Ex situ* conservation: Principles and practices, Botanic gardens- Definitions, Criteria and types; Important Botanic Gardens in India and World, BGCI, gene bank, seed banks, cryobanks and contribution of Smt. Rahibai Popre, Smt. Tulsi Gowda and Madhav Gadgil

Unit VI.i. General activities of Botanical Survey of India **(BSI)** and National Bureau of plant Genetic Resources **(NBPGR)** for conservation efforts.

ii. Biological Diversity Act 2002, 2020, Forest Conservation Act 1980, Wild Life Protection Act 1972 and related international conventions.

iii. Earth Summit, Climate Change 2021 UNO, MoEFCC recent report of Biodiversity in India.

SUGGESTED READINGS:

Ambasht, R. A. (1990) A text book of Plant Ecology, Students Friends & Co., Varanasi.

Benny Joseph (2005) Environmental Studies, Tata McGraw Hill Publishing Co., Ltd., New Delhi.

Conklin, A. R. Jr. (2004) Field Sampling: Principles and Practices in Environmental Analysis. CRC Press.

Fahey, T. J. and Knapp, A. K. (2007) Principles and Standards for Measuring PrimaryProduction. Oxford.

Grant, W. E. and Swannack, T. M. (2008) Ecological Modeling. Blackwell.

Hajra P. K. & V. Mudgal, 1997, Plant Diversity Hotspots in India – an overview, Botaniical Survey of India, MoEF & CC, Culcatta

Koromondy, E. J. (2005) Concepts of Ecology.4th Ed. Prentice Hall of India, New Delhi.

Muller, Dombosis, D. and H. Ellenberg (1974) Aims and methods of vegetation ecology, Wiley, New York.

Mungikar, A. M. (2003) Biostatistial Analysis. Saraswati Printing Press. Aurangabad.

Mungikar A. M. (2008) An Introduction to Biometry, Sarswati Printing Press, Aurangbad.

Odum E. P. (1971) Fundamentals of Ecology, Saunders, Philadelphia.

Rajagopalan, R. (2005) Environmental studies, Oxford University Press, New Delhi.

Ramkrishna, P. S. (2001) Ecology and Sustainable Development. National Book Trust, New Delhi.

Sharma, P. D. (2001) Ecology and Environment, Rastogi Publications. Meerut.

Stiling, Peter. (2004) Ecology- Theories and Applications.4th Ed. Prentice Hall of India, New Delhi.

Trivedi, P. R. (1999) Encyclopedia of Ecology and Environment. Vol. 1 - 10, Indian National Green Party, New Delhi.

Trivedi. R. K., Goel P. K., Trisal C. L. (1998) Practical Methods in Ecology and Environmental Science: Enviro-media Publisher, Karad

Wilkinson, D. M. (2007) Fundamental Processes in Ecology: An Earth system Approach. Oxford.

Wyse Jackson, P. S. and Sutherland, L. A. (2000) International Agenda for Botanic Gardens in Conservation, Botanic Garden Conservation International (BGCI) UK

Yadav, Manju (2003) Ecology. Discovery Publishing House, New Delhi.

WEBSITES:

www.nbaindia.org

www.envfor.nic.in

www.moef.nic.in

www.bgci.org.uk

www.bsi.nic.in

www.bsienvis.nic.in

www.nbpgr.ernet.in

www.maharashtrastatebiodiversityboard.gov.in,

www.iucn.org,

www.iucnredlist.org,

www.iucnredlistecosystems.org,

www.conservation.org,

www.biodiversity-a-z.org

Course code: BOT/MJ/UD/602 - (SAD266023T)

Course Name: PLANT BIOTECHNOLOGY

Course type: Major Mandatory Discipline Specific Course

Credits: 3, Contact Hours: 45 clock hours, 3 hours/ week

Marks: 75, Internal assessment: 30, External assessment: 45

Unit I. Biotechnology: Basic concept, Historical account, Discoveries of Plant Growth hormones in brief review, Contribution of Sir Gottlieb Haberlandt, Development of Tissue culture as a technique, Scope and Importance.

Unit II. Introduction to tissue culture: Principles of tissue culture, Tissue culture laboratory, Equipment's in Tissue culture laboratory, Preparation of Media, Media composition, Plant Growth Regulators and their Role, selection of media for specified applications, Selection of explant, Sterilization, Sterilizing agents, initiation of tissue culture

Unit III. Cellular totipotency: Cellular totipotency, Media for initiation of callus, dynamics of callus growth, measurement of growth, organogenesis and factors controlling it, genome instability in reaction to morphogenesis, somaclonal variation and its applications.

Unit IV. Cell and organ culture: Plant organ culture; shoot tip, shoot apical meristem, root, leaf, flower and ovary culture, embryo rescue, factors influencing embryogenesis, suspension culture in stationary and stirred tank reactors, isolation of single cells and their culture, measurement of growth.

Applications of tissue culture: Applications in agriculture and Horticulture, Forestry, pharmaceutical industry. *In situ* and *ex-situ* conservation. *In vitro* mutagenesis and its application. Production of transgenic plants.

Unit V. Practical approaches of single cell culture: Somatic embryogenesis, protoplast isolation, regeneration of protoplasts and protoplasts fusion, Synthetic seeds, generation of cybrid and hybrids, cryopreservation of plant cells.

Unit. VI. Recombinant DNA technology: Gene cloning and its techniques - Gene gun, Electroporation, Microinjection, Liposome mediated gene transfer, Ultra

sonication and Pollen Mediated gene transfer. Role of *Agrobacterium* and other Vectors in DNA recombinant technology.

Suggested readings:

1. Henry, R. J. 1997, Practical application of plant molecular Biology, Champman and Hall.
2. Kalyan kumar De, 2004, Introduction to Plant Tissue culture, New Central Book
3. Bhojwani, , S. S. and Razdan M. K., 2003, Plant Tissue Culture: Theory and Practice., Elsevier.
4. Mantell S. H. 1985, Principles of Plant Biotechnology: Introduction to Genetic Engineering in plants, Weley-Blackwell publisher.
5. Glover, D. M. and Hanes, B. D. (eds.) 1995. DNA cloning 1: A practical approach, core techniques , 2nd edition, PAS, IRL press at Oxford University Press.
6. Victor M. Loyola-Vargas and Felique Vazquez – Flota, 2006, Plant cell culture protocols. Springer-Humana Press, Inc. New Jersey, USA.
7. Shaw, C. H. (ed.) 1998, Plant Molecular Biology. A practical approach IRI Press, Oxford.
8. Smith, R. H. 2000. Plant Tissue culture: Techniques and Experiments. Academic Press, New York.
10. Susan R. Barnum (1998). *Biotechnology: an introduction*. Thomson Brooks/cole.
11. George Acquaah (2005). *Understanding biotechnology*. Pearson.
12. Lewin, B. 2000, Genes VII, Oxford University Press, New York.
13. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J.D.I 999. Molecular Biology of the cell. Garland Publishing, Inc. New York.
14. Wolfe, S. L. 1993. Molecular and cellular biology. Woodsworth Publishing Company, California, U.S. A.
15. Kleinsmith, I. J. and Kish, V.M. 1995. Principles of Cell and Molecular Biology (End Edition). Harper Collins College publishers, New York, U.S.A.
16.

Course Code: BOT/MJ/UD/603 - (SAD266003P)

(Practical based on **BOT/MJ/UD/600**)

Course Name: Practical

BIOLOGY & DIVERSITY OF PTERIDOPHYTES & GYMNOSPERMS

Course type: Major Mandatory Discipline Specific Course

Credit: 1, Contact Hours: 30 clock hours, 2 hours/ week

Marks: 25, Internal assessment: 10, External assessment: 15

Pteridophytes: Morphological and anatomical studies of

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

Gymnosperms : Study of the vegetative and reproductive parts, including anatomy of the following genera: 1) *Cycas* 2) *Zamia* 3) *Pinus* 4) *Cedrus* 5) *Taxodium* 6) *Cryptomeria,* 7) *Cupressus* 8) *Thuja* 9) *Juniperus* 10) *Podocarpus* 11) *Cephalotaxus* 12) *Agathis* 13) *Araucaria,* 14) *Taxus,* 15) *Ginkgo* 16) *Gnetum.*

Fossil Types: Impression, Compression, Petrifaction, Coal ball, TS of *Rhynia, Lygenopteris, Calamitis and Cycadeodea*

Course Code: BOT/MJ/UD/604 - (SAD266013P)

(Practical based on **BOT/MJ/UD/601**)

Course Name: Practical

PLANT ECOLOGY & CONSERVATION

Course type: Major Mandatory Discipline Specific Course

Credit: 1, Contact Hours: 30 clock hours, 2 hours/ week

Marks: 25, Internal assessment: 10, External assessment: 15

1. To calculate mean, variance, standard deviation, standard error, coefficient of variation and to use 't' test for comparing two means related to ecological data.
2. To find out relationship between two ecological variables using co-relation and regression analysis.
3. To find out association between important grassland species using chi-square test.
4. To determine minimum size and number of quadrates required for reliable estimate of biomass in grassland.
5. To determine diversity indices (Shannon-Wiever concentration of dominance) for protected and unprotected grass land stands.
6. To estimate IVI of the species in a wood land using point centerquadrate method.
7. To determine soil moisture content, porosity and bulk density of soils collected from varying depths at different locations.
8. To determine the water holding capacity of soils collected from different locations.
9. To estimate the DO content in water samples by Winkeler's method.
10. To estimate chlorophyll content in SO_2 fumigated and non-fumigated plant leaves.
11. Visits to different ecosystems and submission of report.
12. Scientific visits to laboratories / Industries / Research Institutes working in conservation of plants and submission of report.

Course Code: BOT/MJ/UD/605 - (SAD266023P)

(Practical based on **BOT/MJ/UD/602**)

Course Name: Practical

BIOTECHNOLOGY

Course type: Major Mandatory Discipline Specific Course

Credit: 1, Contact Hours: 30 clock hours, 2 hours/ week

Marks: 25, Internal assessment: 10, External assessment: 15

1. Equipment's required in Tissue culture Lab
2. Media preparation
3. Sterilization of media
4. Sterilization of explant.
5. Explant Culture.
6. Anther culture
7. Pollen culture,
8. Micropropagation.
9. Embryo rescue technique.
10. Somaclonal variation.
11. *In vitro* mutation.
12. Isolation of plant protoplasts and viability testing.
13. Protoplast fusion by PEG.
14. Tissue culture of Horticultural plant Banana.
15. Tissue culture of Medicinal plants.

Course Code: BOT/MJ/UD/606 - (SAD266033P)

Course Name: Practical

INDUSTRIAL TECHNOLOGY

Course type: Major Mandatory Discipline Specific Course

Credits: 2, Contact Hours: 60 clock hours, 8 hours/ week

Marks: 50, Internal assessment: 20, External assessment: 30

I. Introduction to basic Industrial Techniques, Lab. Safety; Methods of sterilization, media preparation and culturing.

II. Fermentation Equipments (Types of Fermenters) and Its Uses
    a. Simple Fermenters (batch and continuous)
    b. Fed batch Fermenter
    c. Multipurpose Fermenter and its auxiliary equipment

III. Commercial Production of Ethyl Alcohol and Citric Acid

IV. Yogurt fermentation

V. Beer fermentation

VI. Bakery Dough Preparation (*Saccharomyces* sp.)

VII. Legume technology: -
    a. Fermented Soy products
    b. Soy milk

VIII. Fruit Juices—Methods of Preservation.

IX. Dehydrated Food Production Technique. (Lemon peels Powder/Pudina Powder/Dehydrated Garlic Powder etc.)

X. Mushroom Cultivation and harvesting

XI. SCP (Production of Spirulina/Chlorella)

XII. Industry Visit (Seed/Beverage/Food Processing etc)

Reference: -

- Change. S.T. and P.G. Miles - Edible mushrooms and their cultivation.
- Berry, R. - Industrial mycology (Vol. I)

- Dubey, S.C. - Biotechnology.
- Jeffrey C. Pommerville - Alcamo’s Fundamentals of Microbiology
- Arora D.R. and B. Arora - Text book of Microbiology
- Aneja, K. R. Experiments in Microbiology, Plant pathology and Biotechnology. New Age International.
- Presscott, Dunn, IndustrialMicrobiology, 1st edition, Agrobios (India), CBS Publication, 2004
- Casida Jr, L.E., Industrial Microbiology, 1st edition, New Age International (P) Ltd, 2007.
- A.H. Patel, Industrial Microbiology, 1st edition, MacMillan Publication, 2008.
- Desrosier- Technology of Food Preservation
- Cruss- Fruits and vegetable processing
- Falguera, V., & Ibarz, A. (Eds.). Juice processing: quality, safety and value-added opportunities. CRC Press.
- Plant cell culture Technology—MM Yeomen (2012) Blackwell
- Preservation of Fruits & Vegetables by IRRI

Course Code: BOT/DSE/UD/607 - (SBD266043T)

Course Name: ADVANCED GENETICS – I

Course type: Discipline Specific Elective Course

Credits: 3, Contact Hours: 45 clock hours, 3 hours/ week

Marks: 75, Internal assessment: 30, External assessment: 45

UNIT I. MICROBIAL GENETICS:

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

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

UNIT II. GENOME ORGANIZATION:

A. Genome size variation, cot curve analysis, DNA complexity, LINES and SINES, gene amplification and gene families

B. Mitochondria and chloroplast genome.

UNIT III. APPLIED GENETICS:

Genetic engineering: Isolation of DNA, restriction endonucleases, construction of genomic library, screening of DNA library for desired gene, Southern, Northern and Western blotting, prokaryotic and eukaryotic vectors, DNA sequencing, Maxam and Gilbert's procedure, Sanger Coulson method, automated DNA sequencing machine, PCR and DNA amplification, Marker gene, reporter and selection marker gene, Ti plasmids and viral vectors, Direct gene transfer through electroporation, biolistic gun, micro injection, liposome and PEG mediated gene transfers. Application of recombinant DNA technology in medicine, industry and agriculture.

UNIT IV. GENETIC BASIS OF CANCER:

Forms of cancer, genetic basis, Immortalization, transformation, cancer and cell cycle, oncogenes, genetic pathway to cancer, genetic counseling.

UNIT V. GENOMICS:

Structural genomics, cytogenetic maps, RFLP, RAPD, QT maps, FISH and chromosome specific library. Genome sequencing: Human, Yeast, Arabidopsis, functional genomics expressed sequences, DNA chips and genome evolution.

Suggested Readings:

1. Snustad, P. D. and Simmons, M. J. 2000, Principles of Genetics, 2Qd Ed, John, Wiley and Sons, Inc., London.

2. Lewin, R. 1999, Human genetics, Concepts and applications. 3rd Ed, McGraw Hill, Dubuque,

IA.

3. Lewin, B. 2000, Genes VII, Oxford University, New York.

4. Griffith, A. J. F., Miller, J. H. Suzuki, D. T. Lewontin, R. C. and Gilbert, .M, 2000. Introduction to genetic analysis, 5th Ed. W.H. Freeman, N. Y.

5. Lodish, H., Berk, A., Zipursky, S. L., Matsudaira, P., Baltimore, D. and Darnell, J. 2000.

Molecular cell Biology, Freeman, W. H. and Co., N. Y.

6. Watson, J. D., Gilman, M., Witkowski, J. and Zoller, M. 1992, Recombinant DNA

W.H. Freeman and Co., N. Y. A.. c
(Hi. (1994). Molecular Biology of cell, 3rd Ed. Garland

7. Albart A. et. al 1914 J.M.and Gingold, E. B. 1993, Molecular biology and Biotechnology,

Royal Soc., Publications,

8. U. K. Ifftinaiin, R. 1991, Principles of Genetics, 3rd Ed. Win Brown, Dubuque, USA.

9. Brown J. A. 1992. Genetics, a molecular approach II Ed.

10. Tamarin, R. 1991 principls of Genetics III edition, Win brown , Duabuque, USA

11. Watson J. D. 1989. Molecular biology of the gene

Course Code: BOT/DSE/UD/608 - (SBD266043P)

Course Name: Practical ADVANCED GENETICS – I

(Practical based on BOT/DSE/UD/607)

Course type: Discipline Specific Elective Course

Credits: 1, Contact Hours: 30, clock hours, 2 hours/ week

Marks: 25, Internal assessment: 10, External assessment: 15

1. Isolation of genomic DNA using C TAB method and quantification.
2. Evaluation of quality of isolated DNA.
3. Isolation of plasmid DNA
4. Conjugation in E. coli
5. Study of growth curve in E. coli.
6. Transformation in bacteria.
7. Substrate induced enzyme induction in plants.
8. Comparative radio-sensitivity in two crop species.
9.

Course Code: BOT/DSE/UD/609 - (SBD266053T)

Course Name: MYCOLOGY AND PLANT PATHOLOGY-III

Course type: Discipline Specific Elective Course

Credits: 3, Contact Hours: 45 clock hours, 3 hours/ week

Marks: 75, Internal assessment: 30, External assessment: 45

Unit I. Plant disease diagnosis and Preservation Techniques:

Field observations, laboratory investigations, isolation and purification of plant pathogens, Koch's postulates; identification of plant pathogens, Screening for crop disease and soil fungi, Plant disease clinics; History and development of plant pathology in India.

Culture media for Microbes–Types of media, Types of culturing, Sterilization methods and its types, Impact of physical and nutritional factors Microbial Growth. Preservation methods, Microbial culture collections and their importance. A brief account on ITCC, MTCC and ATCC.

Unit II. Dispersal of plant pathogens and Pathogenisis: Dispersal of pathogens: Direct, and Indirect transmission; Plant disease epidemiology; Some important epiphytotics.

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

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

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

Unit V. Disease Management: Cultural Methods- Avoidance of pathogen, exclusion of inoculum, eradication of pathogen, Chemical methods- sulphur fungicides, Copper fungicides, Mercury fungicides, Quinone fungicides, Systemic fungicides, Antibiotics, Breeding for disease resistance, Biopesticides and bioagents; Trichoderma and VA Mycorrhiza. Application of Biotechnology in disease management.

Suggested Reading

Mehrotra, R. S. Plant Pathology, Tata Mc Graw Hill Publication Co., Ltd., New Delhi.

Agrios, G. N. Plant Pathology, Academic Press, New York and London.

Mukadam D.S., M. S. Patil, Ashok M Chavan, Anjali R. Patil (2006) 'The Illustrated of Fungi', Saraswati Printing Press, Aurangabad.

Mahendra Rai**,** and Paul Bridge**,** (2009). Applied Mycology. CABI, UK.

L. E. J. R. Casida (2019). Industrial Microbiology. New Age International Private Limited.

Chandnivala, M. (1955). Recent advances in plant pathology, Amol Publication, Pvt. Ltd.

Nurenburg, H.W. (1985) Pollution and their ecotoxicological significance, John Wiley and Sons, New York.

Bilgrami, K. S. and H. C. Dubey, A text book of Modem plant pathology, Vikas Publishing House, New Delhi.

Nene, Y. and P. N. Thaphyal Fungicides in plant disease control II lidiv Oxford and IBH Publishing Co., New Delhi

Vyas, S. C. Systemic fungicides, Vol. 1 - 3, Tata Mc Hill Publishing Co., Ltd., New Delhi.

Dekker, J. and S.G. Georgopoulos (Ed), Fungicides Resistance in plant Protection, CARD, Publications,

Pres loot Dunn, Industrial Microbiology Peppler, Industrial Microbiology Vol.I and Vol.II

Smith Fermentation fungi, Industrial mycology - Vol. I.

Keeney, Practical medical mycology.

Shrikant B. Mane 2023, Practical Manual for Mycology and Plant Pathology, Apex publication, Jaipur.

Ahenkan A, Boon E. Commercialization of non-timber forest products in Ghana: processing, packaging and marketing. *J Food Agricult Environ.* 2010; 8:962–9.

Belcher B, Ruiz Pérez M, Achdiawan R. Global patterns and trends in the use and management of commercial NTFPs: implications for livelihoods and conservation. *World Dev.* 2005:1435–52.

Calixto, J. B., Efficacy, safety, quality control, marketing and regulatory guidelines for herbal medicines (phytotherapeutic agents). Br. J. Med. Biol. Res., 2000, 33, 179–189.

William C G. 1989. A laboratory text book for Microbiology. W.H. Freeman and Company. New York.

Dubey R C and Maheshwari D K. 2007. A textbook of Microbiology, S. Chand and Company, New Delhi.

Dubey R C and Maheshwari D K. 2002. A Text book of Microbiology, S.C .Chand and Company, Ltd. Ramnagar, New Delhi.

Sharma R. 2006. Text book of Microbiology. Mittal Publications. New Delhi.305pp.

Alexepoulos C. J. and Mims C W. 1989. Introductory Mycology, Wiley Eastern Ltd., New Delhi.

Allas R M. 1988. Microbiology: Fundamentals and Applications, Macmillan publishing co. New York.

Brook T D, Smith D W and Madigan M T. 1984. Biology of Microorganisms, 4th ed. Eaglewood Cliffts. N. J. Prentice-Hall. New Delhi.

Burnell JH and Trinci APJ. 1979. Fungal walls and hyphal growth, Cambridge University Press. Cambridge.

Jayaraman J. 1985.Laboratory Manual of Biochemistry, Wiley Eastern Limited. New Delhi.

Powar C B and Daginawala. 1991. General Microbiology, Vol –I and Vol –II Himalaya publishing house, Bombay.

Sullia SB and Shantharam S. 1998. General Microbiology. Oxford and IBH publishing Co. Pvt. Ltd. New Delhi.

Schlegel HG. 1986. General Microbiology. Cambridge. University Press. London, 587pp

Course Code: BOT/DSE/UD/610 - (SBD266053P)

Course Name: Practical MYCOLOGY AND PLANT PATHOLOGY – III

(Practical based on BOT/DSE/UD/609)

Course type: Discipline Specific Elective Course

Credits: 1, Contact Hours: 30, clock hours, 2 hours/ week

Marks: 25, Internal assessment: 10, External assessment: 15

1. Preparation of different Media and sterilization.
2. Isolation of Fungi and identification of Pathogen.
3. Detection of fungi and Bacteria from different crops, soil, and infected plants.
4. Microbial Preservation mineral oils.
5. Microbial Preservation lyophilisation.
6. Microbial Herbarium.
7. Study the effect of Physical factors on growth of fungi
8. Study the effect of Nutritional factors on growth of fungi
9. Evaluation of fungicide against plant pathogenic fungi.
10. Evaluation of Bio agents against plant pathogenic fungi.
11. Evaluation of antibiotics again pathogenic bacteria.
12. Antagonistic Activity of fungi and bacteria.
13. Collection, submission of fungal samples on different storage media (Five Samples Each).
14. Collection, submission of fungal Herbarium samples.
15. Cultural collection visit and tour report.

Course Code: BOT/DSE/UD/611 - (SBD266063T)

Course Name: TAXONOMY OF ANGIOSPERMS -III

Course type: Discipline Specific Elective Course

Credits: 3, Contact Hours: 45 clock hours, 3 hours/ week

Marks: 75, Internal assessment: 30, External assessment: 45

UNIT-I: Phylogeny of Angiosperms: Isoetes-monocotyledone theory, Coniferales-amentiferae theory, Gnetales-angiosperms theory, anthostrobilus theory, Bennettitalean theory, Caytonialean theory, Stachyspory-phyllospermae theory, pteridosperm theory, Pentoxylales theory and Durian theory; Co-evolution of insect and plants.

UNIT-II: Study of fossil angiosperms: Malvaceae: Sahniocarpon; Myrtaceae: Sahnipushpam; Soneratiaceae: Sahnianthus, Enigmocarpon; Palmae: Palmoxylon.

UNIT-III: Taxonomic tools: Serological and molecular techniques, Taxonomic keys: Construction and use of keys: types of keys.

UNIT-IV: Molecular Biology: Acquisition of Molecular Data, sources of DNA sequence data, Plant genomes, Polymerase Chain Reaction (PCR) analysis, DNA Sequencing Reaction, Types of DNA Sequence Data, Generation and analysis of DNA Sequence Data, Restriction Fragment Length Polymorphism analysis (RFLP), allozymes, micro-satellite DNA, Random Amplified Polymorphic DNA (RAPDs), Amplified Fragment Length Polymorphism (AFLPs).

UNIT-V: Recent system of classification: Angiosperm Phylogeny Group (APG IV) system. Study of the following orders as per the APG IV system: Magnoliales, Liliales, Asparagales, Zingiberales, Poales, Fabales

Suggested Readings:

1. AHMEDULLAH, M., AND M.P. NAYAR. 1987. Endemic Plants of the Indian Region. Vol. I. Botanical Survey of India. Howrah.

2. BENSON, L.D. 1962. Plant Taxonomy: Methods and Principles. Ronald Press, New York.

3. BHOJWANI, S. S. AND BHATNAGAR, S. P. 1984. Embryology of Angiosperms.Vikas Publ. House, New Dehli.

4. BILGRAMI, K.S. AND J.V. DOGRA. 1990. Phyto Chemistry and Plant Taxonomy. New Delhi, CBS Publishers

5. CRONQUIST, A. 1968. The Evolution and Classification of Flowering Plants.Houghton Mifflin. Boston.

6. CRONQUIST, A. 1981. An Integrated System of Classification of Flowering Plants. Columbia University Press, New York.

7. CRONQUIST, A. 1988. The Evolution and Classification of Flowering Plants (2nd ed.) Allen Press, U.S.A.

8. DANIEL, M. 2009. Taxonomy: Evolution at work. Narosa Publishing House Pvt. Ltd. New Delhi.

9. DAVIS, P.H., AND V.H. HEYWOOD. 1965. Principles of Angiosperm Taxonomy. Oliver & Boyd. Edinburgh.

10. DAVIS, P.H., AND V.H. HEYWOOD. 1991. Principles of Angiosperm Taxonomy. Today and Tomorrow Publications, New Delhi

11. DOBSON, A.P.1996. Conservation and Biodiversity.Scientific American Library. New York, U.S.A.

12. ERDTMAN, G. 1952. Pollen Morphology and Plant Taxonomy.Angiosperms.Almquist and Wiksell. Stockholm.

13. ERDTMAN, G. 1986. Pollen Morphology and Plant Taxonomy : Angiosperms An Introduction to Palynology. Netherland, E. J. Brill, Leiden.

14. FORMAN, L. AND D. BRIDSON. 1989. The Herbarium Handbook. Royal Botanic Gardens, Kew, U.K.

15. GRAHAM, L.E. 1993. Origin of Land Plants.John Wiley & Sons.Inc. New York.

16. GREUTER, W, (Ed.). 2007. International Code of Botanical Nomenclature. (VIENNA CODE).KoeltzVesentific Books. Germany.

17. GROOMBRIDGE, B, (Ed.). 1992. Global Biodiversity: Status of The Earth's Living Resources. Chapman and Hall. London.

18. HENRY, A.N., M.CHANDRABOSE. 1980. An Aid to International Code of Botanical Nomenclature. Today & Tomorrow's Printers and Publishers. New Delhi.

19. HESLOP-HARRISON, J. 1953. New Concepts in Flowering Plant Taxonomy.Heinemann Ltd. London.

20. HEYWOOD, V.H. 1967. Plant Taxonomy. Edward Arnold Ltd. Great Britain.

21. HEYWOOD, V.H. 1995. Global Biodiversity Assessment.Cambridge University Press, Cambridge, U.K.

22. HUTCHINSON, J. 1973. The Families of Flowering Plants.3rd Edition.Oxford University Press. Oxford.

23. JAIN, S.K. and R.R. RAO. 1977. A Handbook of Field and Herbarium Methods. Today and Tomorrow's Printers and Publishers, New Delhi.

24. JOHRI, B.M. 1994. Botany in India: History and Progress. Vol-I. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.

25. JONES, S.B., AND A.E. LUCHSINGER. 1987. Plant Systematics. 2nd Edition. McGraw-Hill Book Company. New York.

26. JUDD, W. S, C. S. CAMPBELL, E. A, KELLOG, P. F. STEVENS AND N. J. DONOGHUE. 2008. Plant Systematics. Sinauer Associates, INC,Publishers.Sunderland, Massachusetts, USA.

27. LAWRENCE, G.H.M. 1951. Taxonomy of Vascular Plants.The Macmillan Company. New York.

28. MABBERLEY, D.J. 2005. The Plant-Book, A portable dictionary of the vascular plants. Cambridge University Press, United Kingdom

29. MANILAL, K. S. AND M. S. MUKTESH KUMAR [ed.] 1998. A Handbook of Taxonomic Training. DST, New Delhi.

30. MINELLI, A. 1993. Biological Systematics: The State of the Art. London, Chapman & Hall.

31. MONDAL, A.K. 2005. Advanced Plant Taxonomy.New Central Book.Agency Pvt. Ltd. Kolkata.

32. MOORE, R., W.D. CLARK, K.R. STERN AND D. VODOPICH. 1995. Botany: Plant Diversity. Wm. C. Brown Publishers. London.

33. NAIK, V. N. 2000. Taxonomy of Angiosperms. Tata McGraw – Hill Publishing Company Limited, New Delhi.

34. Nair, P. K. K. 1966. Pollen morphology of Angiosperms.Periodical Expert Book Agency, New Delhi.

35. NAYAR, M.P., 1996. "Hot Spots" of Endemic plants of India, Nepal and Bhutan. Tropical Botanic Garden and Research Institute, Thiruvananthapuram, India.

36. NAYAR, M.P., AND R.K. SASTRY. 1987-1990. Red Data Book on Indian Plants.Vols.I - III.Botanical Survey of India. Howrah.

37. QUICKE, D. L. J. 1993. Principles and Techniques of Contemporary Taxonomy.Chapman and Hall. London.

38. RADFORD, A.E., W.C. DICKISON, J.R. MASSEY, AND C.R. BELL. 1974. Vascular Plant Systematics. Harper & Row. New York.

39. RAVEN, P.H., R.F. EVERT, AND S.E. EICHHON. 1992. Biology of Plants. 5th Edition.Worth Publishers. New York.

40. SANTAPAU, H. 1955. Botanical Collector's Manual. Botanical Survey of India.

41. SANTAPAU, H. AND H.A. HENRY. 1994. A dictionary of the flowering plants in India, CSRI, New Delhi.

42. SHARMA A. AND A. SHARMA. 1980. Chromosome Technique: Theory and Practices (3rd ed.) Butterworths, London.

43. SHIVANNA, K. R. AND N. S. RANGASWAMY. 1992. Pollen Biology- A Laboratory Manual. Springer-Verlag

44. SIMPSON, M. G. 2006. Plant Systematics. Elsevier Academic Press, California, USA.

45. SIMPSON, M.G. Plant Systematics. Elsevier Academic Press. Burlington, U.S.A.

46. SINGH, G. 2005. Plant Systematics – Theory and Practice. Oxford and YBH Publishing Co. Pvt. Ltd., New Delhi.

47. SIVARAJAN, V.V. 1989. Introduction to Principles of Plant Taxono¬my.Oxford and IBH Publishing Co. New Delhi.

48. SOLTIS, D. E., P. S. SOLTIS, P. K. ENDRESS AND M. W. CHASE. 2005. Phylogeny and Evolution of Angiosperms. Sinauer Associates, Inc, Massachusetts, USA.

49. STACE, C. A. 1989. Plant Taxonomy and Biosystematics. Edward Arnold, London.

50. STUESSY, T. F. 2002. Plant Taxonomy.Bishen Singh Mahendra Pal Singh, Dehra Dun, India.

51. SUBRAMANIAM, N. S. 1995. Modern Plant Taxonomy.Vikas Publishing House. New Delhi.

52. TAKHTAJAN, A. 1997.Diversity and Classification of Flowering Plants. Bishen Singh and Mahendra pal Singh, Dehra Dun, India.

53. TAYLOR, D. V. AND L. J. HICKEY. 1997. Flowering Plants: Origin, Evolution and Phylogeny. CBS Publishers & Distributers, New Delhi.

54. WILEY, E.O. 1981. Phylogenetics : The Theory and Practice of Phylogenetic Systematics. New York, John Wiley & Sons.

Course Code: BOT/DSE/UD/612 - (SBD266063P)

Course Name: Practical TAXONOMY OF ANGIOSPERMS – III

(Practical based on BOT/DSE/UD/611)

Course type: Discipline Specific Elective Course

Credits: 1, Contact Hours: 30, clock hours, 2 hours/ week

Marks: 25, Internal assessment: 10, External assessment: 15

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

Course Code: BOT/DSE/UD/613 - (SBD266073T)

Course Name: ADVANCED PLANT PHYSIOLOGY AND BIOCHEMISTRY –III

Course type: Discipline Specific Elective Course

Credits: 3, Contact Hours: 45 clock hours, 3 hours/ week

Marks: 75, Internal assessment: 30, External assessment: 45

Unit I. Plant water relations: molecular structure of water, water potential, Absorption of water by land plants, transpiration and its significance, physiology of stomatal movements, anti-transpirants.

Unit II Stress physiology: Biotic and abiotic environmental stresses, effect on plant metabolism and growth, high temperature stress, water stress, chilling stress, thermogenesis, salinity and salt stress, salt respiration, salinity and agriculture.

Unit III Seed germination, seedling growth, seed dormancy, light and temperature sensitive seeds, Biochemical changes associated with seed germination, Hormonal regulation, conditions for seed germination, Mobilization of reserve food material, longevity of seed and seed viability.

Unit IV Organic farming, mixed farming, crop rotation and inter-cropping, weed management and control, Herbicides, weed biomass as green manure, organic matter recycling and preparation of compost / vermicompost, Production of crop plants under organic and conventional farming system, Bio-fertilizers, Bio-methylation

Unit V Biostatistics: Collection and tabulation of data, Frequency distribution, normal curve, location, dispersion, normal distribution, tests of significance, t test, F test, chi square test, correlation and regression. Experimental designs, Analysis of data: RBD, LSD, Factorial and split plot RBD.

Suggested Reading:

1. Mukharji S and A. K. Ghosh. Plant Physiology - New Central Book Agency, Kolkatta.

2. Mertz, E. T. Elements Biochemistry Vakils, Fe Her and Simson Pvt Ltd, Bombay.

3. Fains, J. L. and Kilgour, G. L. Essentials of Biological Chemistry, Affiliated East - West Press, Pvt. Ltd., New Delhi.

4. Moat, A. G., Foster, J. W. and Spectok, M. P. Microbial Physiology, Wilesy Liss, A. John Wiley and Sons, Inc., Singapore.

5. Trevan, M. D., Botey, S., Goulding, K. H. and Stanburn, P.Biotechnology. The Biological principles. Tata Me Craw Hill Publishing Company Limited, New Delhi.

6. Salisbury. I. B. and Ross. C. W., Plant Physiology CBS Publishers andDistributors, Ncw Delhi.

7. Noggle, G. R. and Fritz, G. S. Introductory Plant Physiology. Printice Hall, USA.

8. Styter, R. O. Plant water relationship, Academic Press, New York.

9. Hess, D. Plant Physiology, Narosa Publishing House, New Delhi.

10. Devlin, R. M. and Hostan, F.H. Plant Physiology, CBS publishers and Distributors, New Delhi.

11. Mukhcrji, S. and Ghosh A. K., Plant Physiology, Tata Me Graw Hill Publishing Company Ltd., New Delhi.

12. Datta, C. S. Plant Physiology, Wiley Eastern Limited, New Age International Ltd., New Delhi.

13. Vaidya, V. G., Sahasrabuddhe, K. R. and Khupse, V. S. Crop production and field experimentation, Continental Prakashan, Pune - 30.

14. Mungikar, A.M. An Introduction for Biometry, Saraswati Printing Press, Aurangabad. 74

Course Code: BOT/DSE/UD/614 - (SBD266073P)

Course Name: Practical TAXONOMY OF ANGIOSPERMS – III

(Practical based on BOT/DSE/UD/613)

Course type: Discipline Specific Elective Course

Credits: 1, Contact Hours: 30, clock hours, 2 hours/ week

Marks: 25, Internal assessment: 10, External assessment: 15

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