DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,

CHHATRAATI SAMBHAJINAGAR - 431004

M. Sc. BOTANY SYLLABUS FOR OTHER CENTERS

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

Class: M. Sc. II year **ACADEMIC AUTONOMY** **Semester: IV**

Course code: BOT/MJ/OC/650 - (SAD266504T)

Course name: BIOPROSPECTING AND PLANT RESOURCE UTILIZATION

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: Bioprospecting: Definition, Introduction, Current practices in Bioprospecting for conservation of Biodiversity and Genetic resources.

Bioprospecting Act: Introduction, Phases of Bioprospecting, Exemption to Act. Fields of Bioprospecting.

Unit II: Marine Bioprospecting: Sources of marine planktons and their Bioprospecting, Isolation and cultivation of Marine bioresources, Isolation of Marine Yeast and its industrial applications, Bioactive chemicals from Seaweeds and their applications.

Unit III: Microbial Bioprospecting: Isolation of Microbial metabolites and their bio-activity. Endophytic microbial products as Antibiotics.

Unit IV: Origin, evolution, botany, cultivation and uses of Food, Fodder, Fibers, Oil yielding crops, wood and timber, Non-wood forest products (NWFPS): Bamboos, Gums, Dyes, Resins, Fruits etc.

Unit V: Botany, Chemistry, Properties and uses of Medicinal and Aromatic plants. Anti Covid – 19 and Immunity booster Herbs.

References

1. Anonymous 2000, "The Ayurvedic Formulary of India" - Part - ll, Govt. of India Publication, New Delhi.

2. Arora, R.K. and Nayar, E.R. (1984), Wild relatives of crop plants in India, NBPGR Science MonographNo.7.

3. Baker, H.G. (1978), Plants and civilization. Ill Ed. (A. Wadsworth, Belmount).

4. Bole, P.V. and Vaghani, Y. (T986). Field guide to common Indian trees, Oxford University Press, Mumbai.

5. CSIR (1986), The useful plants of India Publication and Information directorate, CSIR, New Delhi.

6. CSIR (1948 - 1976) The wealth of India, CSIR, New Delhi

7. Daniel, M. 2006, "Medicinal Plants - Chemistry and Properties" Oxford &IBM Publishing Co. Pvt. Ltd. New Delhi.

8. Desai W. G. 1975, *"Aushadhi Sangraha"* Rajesh Publication, Pune.

9. Garde G. K. 2009, (Revised Edition) "Sort/7 *Vagbhat - Ashtanghridayam",* Rajesh Publication, Pune.

10. Jain S. K. 1991, "Dictionary of Indian Folk Medicine and Ethnobotany" Deep Publication, New Delhi.

11. Kameshwara Rao C. 2000, "Material for the Database of Medicinal Plants" Karnataka state Council for Science and Technology for the Department of Forests, Environment and Ecology, Govt of Karnataka Publication.

12. Kirtikar K. R. and Basu B. D. 2001(Reprint) "Indian Medicinal Plants" Oriental enterprises Uttaranchal.

13. Kocchar, S.L. (1998). Economic Botany of the tropics, II Edn. MacMillan India Ltd.

14. Manilal K. S. 2001, "Van Rheed's Hortus Malabaricus" English Edition. University of Kerala Publication.

15. Nadkarni K. M. 1976, (Revised Edition) " Indian Materia Medica" Popular Prakashan, Mumbai.

16. Sharma, O.P. (1996). Hills Economic Botany, Tata McGraw Hill co., Ltd., New Delhi

17. Swaminathan, M.S. and Kocchar, S.L. (Es.) (1989). Plants and Society, MacMillan Publication Ltd.,

18. Sharma 0. P. 1996, "Hills Economic Botany" Tata McGraw Hill Publication, New Delhi.

19. Thakur, R.S., Puri, H.S. and Husain, A. (1969). Major medicinal plants of India, Central Institute of medicinal and aromatic plants, Lucknow.

20. Yoganarasimhan S. N. 1996, "Medicinal Plants of India" vol. I. Karnataka. Interline Publication Pvt. Ltd. Bangalore.

Course name: PHARMACOGNOSY

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: Introduction Definition. History and scope of Pharmacognosy. Indigenous system of medicine: Ayurveda, Homeopathy, Unani, traditional Chinese Medicine, Naturopathy, Yoga and Siddha. Classification of drug of natural origin. Adulteration/Substitution and drug evaluation. Significance of Pharmacopeial standards.

UNIT II: Plant constituents Occurrence, distribution, classification, isolation, identification test and pharmaceutical applications: Plant metabolites

a) **Alkaloids**: definition, properties, classification, alkaloidal drugs – Daturastramonium, Atropabelladona, opium, Cinchona, tea, ergot, *Rauvolfia, Holarrhena, Catharanthus* – alkaloidal constituents, uses.
b) **Phenolic compounds** produced by plants: types, biological activity, drugs – *Senna*, *Aloe*, *Hypericum*, *Capsicum*.
c) **Steroidal compounds:** different types, biological activities
d) **Pharmaceutically important Carotenoids:** chemistry, types, apocarotenoids, bioactivities.
e) **Volatile oils:** composition, drugs – clove, Mentha, Eucalyptus, Foeniculum, Cinnamomum, citronella, Resins: chemistry, different types, uses
f) **Lipids**: fatty acids, nomenclature, fats, fixed oils, waxes Section

UNIT III: Therapeutic Uses of Plants and Drugs Occurrence, distribution, organoleptic evaluation, chemical constituents including tests wherever applicable and therapeutic efficacy of following categories of drugs.

(a) **Laxatives**: Aloes. Rhuburb. Castor Oil. Ispaghula.
(b) **Cardiotonic**- *Digitalis*, *Terminalia* Arjuna.
(c) **Carminatives** and G.I. regulators. Umbelliferous fruits, Coriander, Cardamom, Ginger, Black pepper, Asafoetida, Nutmeg and Clove.

(d) **Astringents**: *Catechu*

(e) **Drugs acting on nervous systems** - *Belladonna*, *Aconite, Withania somnifera, Ephedra* and *Opium*.

(f) Anti diabetics- *Pterocarpus, Gymnema sylvestre*, *Syzygium cumini*

(g) Aphrodisiacs: *Withania somnifera, Chlorophytum borivilianum, Asparagus racemosus*

UNIT IV: Industrial uses of Medicinal Plants Perfumes and flavorings agents- peppermint oil, Lemon oil, Orange oil, Lemon grass oil and Sandal wood. Pharmaceutical aids- honey. *Arachis* oil, Starch, Kaolin, Pectin, Olive oil, Lanolin, Bees wax, Acacia, Sodium alginate, Agar, Algal products SCP (*Chlorella* and *Spirulina*), Guargum and Gelatin. Miscellaneous- liquorice, Garlic, *Picrorhiza*, *Dioscorea*, Linseed, Shatavari, Shankhapushpi, Pyrethrum and Tobacco, *Ganoderma*, Medicinal mushrooms.

UNIT V: Crude Plant Drugs Collection and preparation of crude drug for the market as exemplified by *Ergot*, *Opium*, *Rauwolfia, Digitalis* and *Senna*. Gross anatomical studies of *Acorus*, *Asparagus, Bacopa*, *Cinnamon*, Clove, *Datura*, *Fennel*, *Ginger*, *Justicea adhatoda*, *Terminalia arjuna*, Withania,

References:

1. Anonymous 2000, "The Ayurvedic Formulary of India" - Part - ll, Govt. of India Publication, New Delhi.
2. Anonymous, "Upchar Paddhati aur Pathya" Baidyanath Publication.
3. Biren Shah and A.k. Seth 2010. Textbook of pharamcognosy and Phytochemistry. 8th Edn. Reed Elsevier India Pvt. Ltd.
4. Daniel, M. 2006, Medicinal Plants -Chemistry & Properties Oxford &IBM Pub Co. Pvt. Ltd. New Delhi.
5. Daniel M. & Denni Mammen (2016) Analytical Methods for Medicinal Plants and Economic Botany, Scientific Publishers, Jodhpur,
6. Desai W. G. 1975, "Aushadhi Sangraha" Rajesh Publication, Pune.
7. Garde G. K. 2009, (Revised Edition) "Sort/7 Vagbhat - Ashtanghridayam", Rajesh Publication, Pune.
8. Gokhale S. B.. 2008. Pharmacognosy, Pragati Books Pvt. Ltd.

9. Horborne. J.B. 1983. Phyto chemical methods. Chapman and Hall. London.
10. Jain S. K. 1991, "Dictionary of Indian Folk Medicine and Ethnobotany" Deep Publication, New Delhi.
11. Kameshwara Rao C. 2000, "Material for the Database of Medicinal Plants" Karnataka state Council for Science and Technology for the Dept. of Forests, Environment & Ecology, Govt of Karnataka Publication.
12. Kirtikar K. R. and Basu B. D. 2001(Reprint) "Indian Medicinal Plants" Oriental enterprises Uttaranchal.
13. Kokate. C. K. 2008. Pharmacognosy 53rd Edn. Nirali publisher.
14. Manilal K. S. 2001, "Van Rheed's Hortus Malabaricus" English Edition. University of Kerala Publication.
15. Mohammed Ali. 2019. Textbook of Pharmacognosy 2Edn. CBS Publisher.
16. Nadkarni K. M. 1976, (Revised Edition) "Indian Materia Medica" Popular Prakashan, Mumbai.
17. Pharmacopoeia of India. Govt. of India. Ministry of health 1955 and 1966.
18. Sharma 0. P. 1996, "Hills Economic Botany" Tata McGraw Hill Publication, New Delhi.
19. Trease. G. E. and Evanes W. C. 2009. Pharmacognosy. 16th Edn. Elsevier.
20. Wallis T. E. 2005. Textbook of Pharmacognosy, 5th Edn. CBS publishers.
21. Yoganarasimhan S.N.1996, Medicinal Plants of India vol.I. Karnataka. Interline Publ Pvt. Ltd. Bangalore.

Course code: BOT/MJ/OC/652 - (SAD266524T)

Course name: PLANT PHYSIOLOGY AND METABOLISM

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

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

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

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

Unit V. Nitrogen Metabolism: Nitrification and denitrification, Nitrate assimilation, Biological nitrogen fixation, Biosynthesis of amino acids - reductive animation and transamination, Protein synthesis, classification of amino acids and proteins, amphoteric nature and zwitter ions, structure of proteins, protein denaturation, Isolation and purification of proteins.

Suggested Readings:

1. Plant physiology: Salisbury F.N. and C. W. Ross, CBS Publishers and Distributors, New Delhi.
2. Principles of Biochemistry, A. L. Lehninger, CBS Publishers and Distributors, New Delhi.
3. Plant physiology: Bidwell R. G. S., Mac Millan Publishers Co., New York.
4. Advnced plant physiology, Wilkins M. B., English Language Book Society, London.
5. Principles of plant physiology, Bormer, J. and Galston, A. W.
6. Introductory plant physiology, Noggle G. R. and Fritz, G.S., Prentice Hall, USA.
7. Plant Water Relationships, Slyter, R. O. Academic Press, New York.
8. Plant physiology, Hess D., Narosa Publishing House, New Delhi.
9. Elementary Biochemistry, Mertz, E. T. Vakils, Fetter and simsons Pvt. Ltd. Mumbai.
10. Essentials of Biological Chemistry, Fairley, J. L. and Kilgon, G. L., Altilised Earr west Press Pvt. Ltd., New Delhi.
11. Plant physiology, Devlin, R. M. and Hostan, F. H., CBS Publishers and Distributors, New Delhi.

12. Plant Physiology, Datta S. C., Willey Eastern Limited, Culcutta.
13. Plant Physiology, Mukharji S. , A. K. Ghosh, New Central Book Agencies, Kolkatta.
14. An Introduction to Biometry, Mungikar A. M., Sarswati Printing Press, Aurangbad.
15. Biostatical Analysis, Mungikar A. M., SarswatiPrinting Press, Aurangabad.
16. Laboratory Manual in Biochemistry, Jayraman, J., New Age International Publishers, Mumbai.
17. Experiment in Plant Physiology, Bajrachrys D., Narosa Publishing House, New Delhi

Course code: BOT/MJ/OC/653 - (SAD266504P)

(Practical based on BOT/MJ/OC/650)

Course name: Practical BIOPROSPECTING AND PLANT RESOURCE UTILIZATION

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. Food Crops: Morphology, anatomy, micro-chemical test for stored material: Wheat, rice, maize, chickpea, potato, sweet potato, sugarcane,
2. Study of any five important crops used for fodder / forage purpose: Jowar, Bajra, lucerne, Maize etc.
3. Plant fibers: Cotton, jute, sun hemp, coir, silk cotton: Morphology microscopic study anatomy of whole fibers, using appropriate staining methods.
4. Medicinal and aromatic plants: At least 5 medicinal and 5 aromatic plants and their morphology, anatomy, phyto-chemistry.
5. Oil yielding crops: Mustard, groundnut, soybean, coconut, sunflower, castor: Morphology, microscopy of oil yielding tissue, test for oil, acid, Iodine numbers.
6. Gum, resin, tannin, dye yielding plants.
7. Fire wood and timber yielding plants.
8. Antioxidant assay – NO free radical scavenging assay.
9. Antigenotoxicity assay – MTT assay.
10. Antiviral activities of plants – SRB assay.
11. Scientific visits to laboratories / Industries / Research Institutes and field and submission of report.

Course code: BOT/MJ/OC/654 - (SAD266514P)

(Practical based on BOT/MJ/OC/651)

Course name: Practical PHARMACOGNOSY

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. Phytochemical tests of common secondary metabolites – Tannins, Saponins, Alkaloids, Irridoids, Phenolics, Flavonoids etc.
2. Isolation of Phenolic compounds from plant materials.
3. Paper chromatography, Thin layer chromatography techniques used to confirm the chemical compounds.
4. Pharmacognostic procedures of Plant drug standardization: Morphology, Micromorphology, Anatomy, Palynology, Powder analysis, Maceration of medicinal plants mentioned in the syllabus.
5. Extraction of plant materials in the organic solvents by using Sauxhlet's apparatus.
6. Determination of Extractive values of the drugs in various solvents.
7. Determination of total Ash, acid soluble ash and acid insoluble ash.

Course code: BOT/MJ/OC/655 - (SAD266524P)

(Practical based on BOT/MJ/OC/652)

Course name: Practical PLANT PHYSIOLOGY AND METABOLISM

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. Separation of amino acids by paper and thin layer chromatography.
2. Chemical tests for proteins.
3. Estimation of proteins by Lawry's method.
4. Estimation of proteins by Biuret method.
5. Determination of Isoelectric point of Casein.
6. Determination of activity of nitrate reductase.
7. Immobilization of enzymes using sodium alginate.
8. Preparation of Leaf Protein Concentrate (LPC) by heat coagulation method.
9. Extraction/Estimation of crude fats using Sauxhlet's extractor.
10. Determination of Iodine number of fats and oils.
11. Determination of Saponification number of fats and oils.

Course Code: BOT/DSE/OC/656 - (SAD266534P)

Course Name: Practical GENETIC ENGINEERING AND BIOINFORMATICS

(Practical based on BOT/DSE/UD/657)

Course type: Major Mandatory Discipline Specific Course

Credits: 2, Contact Hours: 60, clock hours, 4 hours/ week

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

1) Different file formats – Genebank, Genpept, FASTA, EMBL, NBRF/PIR, , PDB file format.
2) Entrez and Literature Searches. PubMed, PubMed central, OMIM / OMIA.
3) Primary sequence Databases- NCBI, EMBL, DDBJ.
4) Protein Structure Database– PDB.
5) Prediction of secondary structure of proteins.
6) Visualization of tertiary structure of proteins in Rasmol.
7) Accessing existing databases on www.
8) Sequence alignment – BLAST.
9) Homology search tools like BLAST and modeller.
10) Genomics- Genome databases, Annotation of genome, Perdition of ORFs
    dbSNP and other SNP related database .
11) GENSCAN and GeneMark.

Course code: BOT/DSE/OC/657 - (SBD266544T)

Course name: ADVANCED GENETICS -II

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. FUNDAMENTAL PROCESSES:

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

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

Genetic code: Triplet code, deciphering the code, degeneracy, Translation: ribosomes, chain initiation, elongation and termination. Inhibitors of protein synthesis.

UNIT II. REGULATION OF GENE EXPRESSION:

Prokaryotic operon model, lac operon inducible system, CAP proteins and catabolic repression, his operon repressible system, Lac-operon attenuation control. Post transcriptional control, feedback inhibition and protein degradation, Eukaryotes: short term regulation, heat shock proteins, hormonal regulation, DNA methylation, Heterochromatin and gene inactivation.

UNIT III. HUMAN GENETICS:

A. Human Genetics: Human Genome Project, Human karyotype, Pedigree analysis, amniocentesis, twins: identical or monozygotic twins, fraternal or dizygotic twins, genetic counseling.

B. In born errors of metabolism -

Syndromes associated with genetic disorders and their Karyotypes:

1. Single Gene disorders: Severe combined immunodeficiency, Sickle cell anaemia, phenylketonuria, Alkaptonuria, Maple syrup urine, Galatosemia, PTC tasters, brachydactyly, Huntington's chorea, tongue rolling etc.
2. Chromosomal disorders: Cri-Du-Chat syndrome, Down's syndrome, William's syndrome, Turner's syndrome, 47 XXY Klinifilter syndrome,
3. Multifactorial disorders: Alzheimer's disease, Breast/ Ovarian cancer, Obesity, Hypothyroidism, Asthama, Heart disease, Hypertension, infertility etc.

UNIT IV. POPULATION GENETICS

Introduction, Gene Frequency, Genotype Frequency, Gene Pool, Hardy-Weinberg Law, Hardy-Weinberg Equilibrium, Migration, Mutation, Selection, Random Drift, Founder Principle.

UNIT V. CELL COMMUNICATION AND CELL SIGNALING

A) Host parasite interaction Recognition and entry processes of different pathogens like bacteria, viruses into animal and plant host cells, alteration of host cell behavior by pathogens, virus-induced cell transformation, pathogen-induced diseases in animals and plants, cell-cell fusion in both normal and abnormal cells.

B) Cell signaling Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two-component systems, light signaling in plants, bacterial chemotaxis and quorum sensing.

Suggested Reading:

1. Snustad, P.D. and Simmons, MJ. 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. 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

12. Chaitanya, K. V. 2022, Diagnostics and Gene Therapy for Human Genetic Disorders, CRC Press,

13. Rosco, I., C. S. Dowenes, Genes in Medicines Molecular Biology of Human Genetic Disorders, Elsevier Netherlands.

14. Evelyn B. Kelly, 2013, Encyclopaedia of Human Genetic Diseases, ABC

15. Dhavendra Kumar, 2004, Genetic Disorders of Indian Subcontinent, Springer Netherlands.

16. James Wynbrandt, Mark D. Ludman, 2010, The encyclopaedia of Genetic disorders and Birth effects, Facts on File Incorporated.

17. Aubrey Milunsky, Jeff M. Milunsky, 2021, Genetic disorders and the Fetus diagnosis,

Prevention and Treatment, Wiley Publisher.

18. Anne Gardner, Teresa Davies, 2009, Human Genetics, Scion Publisher

Course Code: BOT/DSE/OC/658 - (SBD266544P)
Course Name: Practical ADVANCED GENETICS - II

(Practical based on BOT/DSE/OC/657)

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. Agarose gel electrophoresis of DNA.
2. Isolation and quantification of total RNA and agarose gel electrophoresis.
3. Restriction and ligation reactions.
4. PCR amplification and RAPD marker.
5. Cytological effects of radiations and chemical mutagens in higher plants.
6. Human normal Karyotype
7. Human Karyotypes of Syndromes due to Genetic disorders
8. Phenotypic comparison of normal and syndromic individuals.

Course code: BOT/DSE/OC/659 - (SBD266554T)

Course name: MYCOLOGY AND PLANT PATHOLOGY - IV

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. Seed Pathology: Scope and importance; seed health testing; methods and procedures. Detection of seed borne-fungi, Bacteria and viruses. Contribution of Paul Neergaard, Storage fungi: Seed biodeterioration, Biochemical changes, Morphological abnormalities, loss in germiability, fungal pigment. Seed certification, Plant quarantine and Seed law. Control of Post-harvest spoilage of grains.

Unit II. Mycotoxins: Classifications of toxins, Fusaric acid, Lycomarasmin, Pirieularin, Alternaric acid, Tabtoxin, Phaseolotoxin, Victorin, Fusarium toxin and aflatoxins.

Unit III. Defense mechanism systems in plants Biochemical and physiological changes in plants due to infection, Preventive measures – physical, chemical and biochemical methods. Plant disease forecasting, postharvest pathology, Forest pathology and Aerobiology

Unit IV. Endophytic fungi

Endophytic fungi, beneficial interaction of endophytes with plants for growth and alleviation of stress condition. Secondary Metabolites.

Unit V. Introduction to Integrated Pest Management

IPM's definition and guiding principles; A historical perspective on pest control techniques; Significance of sustainable pest, Cost-benefit analysis of different pest

management strategies; Socio-economic implications of pest control methods; Environmental impact assessment in IPM; Climate change and its impact on pest management; New technologies and innovations in IPM; Global perspectives on IPM implementation; Evaluation of toxicity of pesticides; Constrains and strategies in implementation of IPM; Validation of IPM.

Suggested Readings:

Anonymous, 2009. Handbook of Agriculture. Indian Council of Agricultural Research, New Delhi.

Singh S. S., 2013. Handbook of Agricultural Sciences, Kalyani Publishers, New Delhi

Anonymous, 2004. Seed Science and Technology: International Rules for Seed Testing. International Seed Testing Association, Switzerland

Rattan LalAgarwal, 1999. Seed Technology. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi

Vijaya Kumar A., V. Krishnasamy, P. Balamurugan, D. Kalavathi, K. Sivasubramaniam, P. Athimuthu, G. Selvaraj, H. Philip and C. Palanisamy, 2003. Quality Seed Production in Vegetables, Tamil Nadu Agricultural University, Coimbatore

Chaudhary P, Agri U, Chaudhary A, Kumar A, Kumar G. Endophytes and their potential in biotic stress management and crop production. Front Microbiol. 2022, 17;13:933017.

Giovannetti M, Salvioli di Fossalunga A, Stringlis IA, Proietti S and Fiorilli V, Unearthing soil-plant-microbiota crosstalk: Looking back to move forward. Front. Plant Sci. 2023, 13:1082752.

Imran Afzal, Zabta Khan Shinwari, Shomaila Sikandar, Shaheen Shahzad,Plant beneficial endophytic bacteria: Mechanisms, diversity, host range and genetic determinants, Microbiological Research, 221,2019,36-49.

Kamran M, Imran QM, Ahmed MB, Falak N, Khatoon A, Yun BW. Endophyte-Mediated Stress Tolerance in Plants: A Sustainable Strategy to Enhance Resilience and Assist Crop Improvement. Cells. 202219;11 (20):3292.

Kerchev, Pavel I., et al. "Plant responses to insect herbivory: interactions between photosynthesis, reactive oxygen species and hormonal signalling pathways." *Plant, cell & environment* 35.2 (2012): 441-453.

Lanfranco, L., Fiorilli, V., Gutjahr, C. Partner communication and role of nutrients in the *arbuscular mycorrhizal* symbiosis. New Phytol. 2018, 220 (4), 1031–1046.

Lanver, Daniel, et al. "*Ustilago maydis* effectors and their impact on virulence." *Nature Reviews Microbiology* 15.7 (2017): 409-421.

Li, Juan, Chenggang Zou, Jianping Xu, Xinglai Ji, XuemeiNiu, Jinkui Yang, Xiaowei Huang and Ke-Qin Zhang. "Molecular mechanisms of nematode-nematophagous microbe interactions: basis for biological control of plant-parasitic nematodes." Annual review of phytopathology 53, 2015: 67-95

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

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

Paul Neergaard. Seed Pathology, Volume 1 and Volume 2.

Jha D. K. 1995. A text Book on Seed Pathology. Vikas Publishing House, New Delhi.

Jha D. K. 1995. Laboratory Manual of Seed Pathology. Vikas Publishing House, New Delhi.

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

Course Code: BOT/DSE/OC/660 - (SBD266554P)

Course Name: Practical MYCOLOGY AND PLANT PATHOLOGY - IV

(Practical based on BOT/DSE/OC/659)

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 Media, stains and Isolation of Fungi and identification of Pathogen.
2. Detection of seed borne-fungi and Bacteria from different crops, soil, and infected plants.
3. Study the biochemical due to fungi.
4. Study impact of fungi on seed germination.
5. Isolation of entophytic fungi from plants
6. Screening of secondary metabolites from fungi
7. Production and assay of different toxins.
8. Screening of Mycotoxin bioassay
9. Extraction and estimation of pigments in healthy and diseased plants.
10. Evaluation of toxicity of pesticides
11. Collection, submission of diseased Seed samples and storage fungi (Five Samples Each).
12. Visit to any Seed industry/Processing Unit and submission of report.

Course code: BOT/DSE/OC/661 - (SBD266564T)

Course name: TAXONOMY OF ANGIOSPERMS - IV

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 Biosystematics: Aims, objectives and steps in biosystematic studies, biosystematic categories, importance of biosystematic studies.

UNIT-II: Numerical Taxonomy: Principles of taxometrics, operational taxonomic units, taxonomic characters, measuring resemblances, cluster analysis, classification.

UNIT-III: Use of computers in angiosperms taxonomy, GPS and its applications, GIS and its aplications. Use of computer data bases for identification of plants with the help of websites – www.plantsoftheworldonline.org, www.ipni.org, www.efloraofindia.com, https://www.biodiversitylibrary.org, www.kew.org

UNIT-IV: Phytogeography: World vegetation, theories of plant distribution, vicarious areas, centers of origin, theory of tolerance. Phytogeographical zones in India, Characteristic features of Flora of India. Hotspots in the world and in India.

UNIT-V: Study of the following orders as per the APG IV system: Rosales, Malvales, Myrtales, Solanales, Lamiales, Apiales and Asterales.

Suggested Reasing:

1. AHMEDULLAH, M., AND M.P. NAYAR. 1987. Endemic Plants of the Indian Region. Vol. I. Botanical Survey of India. Howrah.
2. BENSON, L.D. 1962. Plant Taxonomy: Methods and Principles. Ronald Press, New York.
3. BHOJWANI, S. S. AND BHATNAGAR, S. P. 1984. Embryology of Angiosperms.Vikas Publ. House, New Dehli.
4. BILGRAMI, K.S. AND J.V. DOGRA. 1990. Phyto Chemistry and Plant Taxonomy. New Delhi, CBS Publishers
5. CRONQUIST, A. 1968. The Evolution and Classification of Flowering Plants.Houghton Mifflin. Boston.

6. CRONQUIST, A. 1981. An Integrated System of Classification of Flowering Plants. Columbia University Press, New York.
7. CRONQUIST, A. 1988. The Evolution and Classification of Flowering Plants (2nd ed.) Allen Press, U.S.A.
8. DANIEL, M. 2009. Taxonomy: Evolution at work. Narosa Publishing House Pvt. Ltd. New Delhi.
9. DAVIS, P.H., AND V.H. HEYWOOD. 1965. Principles of Angiosperm Taxonomy. Oliver & Boyd. Edinburgh.
10. DAVIS, P.H., AND V.H. HEYWOOD. 1991. Principles of Angiosperm Taxonomy. Today and Tomorrow Publications, New Delhi
11. DOBSON, A.P.1996. Conservation and Biodiversity.Scientific American Library. New York, U.S.A.
12. ERDTMAN, G. 1952. Pollen Morphology and Plant Taxonomy Angiosperms. Almquist and Wiksell. Stockholm.
13. ERDTMAN, G. 1986. Pollen Morphology and Plant Taxonomy : Angiosperms An Introduction to Palynology. Netherland, E.J.Brill, Leiden.
14. FORMAN, L. AND D. BRIDSON. 1989. The Herbarium Handbook. Royal Botanic Gardens, Kew, U. K.
15. GRAHAM, L. E. 1993. Origin of Land Plants.John Wiley & Sons.Inc. New York.
16. GREUTER, W., (Ed.). 2007. International Code of Botanical Nomenclature. (VIENNA CODE). Koeltz Botanical 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 Taxonomy. Oxford and IBH Publishing Co. New Delhi.
48. SOLTIS, D. E., P. S. SOLTIS, P. K. ENDRESS AND M. W. CHASE. 2005. Phylogeny and Evolution of Angiosperms. Sinauer Associates, Inc, Massachusetts, USA.
49. STACE, C. A. 1989. Plant Taxonomy and Biosystematics. Edward Arnold, London.
50. STUESSY, T. F. 2002. Plant Taxonomy.Bishen Singh Mahendra Pal Singh, Dehra Dun, India.
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. Upen Deka, Tapan Dutta, 2023, Plant Ecology and Phytogeography, Asian Humanity Press
55. WILEY, E.O. 1981. Phylogenetics: The Theory and Practice of Phylogenetic Systematics. New York, John Wiley & Sons.
56. Yadav Swapnil, 2021, Ecology and Phytogeography, Mahaveer Publication

www.plantsoftheworldonline.org,

www.ipni.org,

www.efloraofindia.com,

https://www.biodiversitylibrary.org,

www.kew.org

Course Name: Practical TAXONOMY OF ANGIOSPERMS - IV

(Practical based on BOT/DSE/OC/661)

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/OC/663 - (SBD266574T)

Course name: ADVANCED PLANT PHYSIOLOGY AND BIOCHEMISTRY - IV

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: Role of nucleic acids as carriers of genetic Information, transformation and transduction. Auto catalytic function of DNA-replication, Hetero catalytic functions -Transcription and translation, totipotency, differential gene activity and its regulation. Gene technology, Recombinant DNA, GM plants, Application of Gene technology in agriculture,

Unit II: Senescence and aging, cellular, tissue, organ and organism senescence, physiological changes

associated with senescence, Biological significance.

Unit-III: Microbial physiology, carbohydrate metabolism, energy production, substrate metabolism, utilization of sugar, starch, cellulose, pectin, hydro carbons, aromatic hydrocarbons and other compound, microbial biomass production, production of useful microbial metabolites -enzymes, organic acids, single cell protein, toxins, antibiotics, alcohol etc. Industrial microbiology.

Unit IV: Enzyme technology - Enzyme production, sources and uses of enzymes, microbial enzyme,

production, isolation and purification of enzymes, Applications of enzymes in various industrial processes, Immobilization of enzymes - techniques and advantages, Biocatalysis, Enzyme production and application.

Unit V: Productivity of crop plants, integrated fertilizer management, bio-fertilizers, productivity

potential and cultural practices for fiber plants (e.g. cotton), cereals (rice, wheat), millets (Sorghum, pearl millet), pulses (gram), oil seed crops (safflower, groundnut), commercial crops (sugarcane), vegetables, fodder crops (lucerne, hybrid Napier, maize).

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. an<! Ross. C.W., Plant Physiology CBS Publishers andDistributors, Ncw Delhi.

7. NoggIe, 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.

Course Code: BOT/DSE/OC/664 - (SBD266574P)

Course Name: Practical ADVANCED PLANT PHYSIOLOGY AND BIOCHEMISTRY - IV

(Practical based on BOT/DSE/OC/663)

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 and estimation of nucleic acids

2) Changes in chlorophyll content in leaf discs during senescence.

3) Biochemical changes during leaf senescence - sugars, protein -nitrogen, non-protein nitrogen, etc.

4) Effect of PGRs on senescence.

5) Chemical changes associated with fruit ripening.

6) Assey and chemical tests for enzymes, organic acids, antibiotics, toxins etc.

7) Estimation of the activities of hydrolytic enzymes - amylase, lipase, protease, cellulose etc.

8) Estimation of alcohol content in fermented plant material.

9) Immobilization of enzymes with wax.

10) Visit to the fields for studies on crop plants.

11) Estimation of proteins in pulse seeds.

12) Estimation of starch in seeds.

13) Estimation of fat content in seeds,