GURU GHASIDAS VISHWAVIDYALAYA

(A central University)

Bilaspur (CG)

SYLLABUS

(Pre Ph.D Course)

Department of Botany
School of Life Science

Ph.D. Programme in Botany
(2021-22)

D.V.B. Khan
DEAN,
School of Life Science
Guru Ghasidas Vishwavidyalaya
BILASPUR (C. G.)

10/1/2021
विभागाध्यक्ष
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ABOUT THE PROGRAM

The Ph.D course work course comprises compulsory course (04 credits; A), discipline-specific courses (04 credits; B) and research theme-specific courses (04 credits; C). Since PhD students come from different educational backgrounds, relevant courses will be chosen in consultation with the concerned DRC/RAC to compliment the previous education, improve specific skills required for thesis and subsequent career. The compulsory Courses (CC), and Discipline-Specific Courses are compulsory for all students registered in the Ph.D program in botany. Whereas, a research scholar will select elective courses (i.e., Research Specific Courses as suggested by the concerned DRC/RAC.

Common course

Course code	Title (credit)	Credit/Marks
BODATT1	Research Methodology and Publication Ethics	04/100

Discipline-specific courses

Course code	Title (credit)	Credit
BODATT2	Instrumentation and techniques in Plant Sciences	04/100

Discipline Specific Elective (students select any one of these)

Course code	Title (credit)	Credit/Marks
BODATD1	Bio-resource application & Herbal technology Review of literature and Seminar presentation	04/100
BODATD2	Bio-atmospheric Interactions and Green remediation Review of literature and Seminar presentation	
BODATD3	Environmental Ecology Review of literature/Seminar presentation	
BODATD4	Advance Bacterial Genetics Review of literature and Seminar presentation	
BODATD5	Medical Botany Review of literature and Seminar presentation	
BODATD6	Plant Ecology, Diversity, Uses and Conservation Review of literature and Seminar	

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	presentation	
BODATD7	Ethnobotany and medicinal plants Review of literature and Seminar presentation	
BODATD8	Molecular stress physiology Review of literature and Seminar presentation	
BODATD9	Plant systematic and evolutionary biology Review of literature and Seminar presentation	

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Research Methodology and Publication Ethics

Course code: BODATT1

(Credits- 04; contact hour-60h; maximum marks - 100)

Unit I:

Literature Review, Defining the research questions, Approaches and Methodology for Scientific research, Documentation and presentation of data, Analysis and interpretation of data, manuscript preparation.

Unit II:

Statistics in Research, Measures of Central Tendency, Dispersion, Asymmetry, Relationship. Regression Analysis, Multiple correlation and Regression, Partial Correlation, Association in case of Attributes. Testing of Hypothesis. Chi-Square test: Applications, Steps, characteristics, limitations. Analysis of Variance and Covariance.

Unit III:

Scientific Conduct

1. Ethics with respect to science and research
2. Intellectual honesty and research integrity
3. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
4. Redundant publications: duplicate and overlapping publications, salami slicing
5. Selective reporting and misrepresentation of data

Publication Ethics

1. Publication ethics: definition, introduction and importance
2. Best practices / standards setting initiatives and guidelines: COPE, WAME, etc.
3. Conflicts of interest
4. Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types
5. Violation of publication ethics, authorship and contributorship
6. Identification of publication misconduct, complaints and appeals
7. Predatory publishers and journals

Unit IV: Practice

Open Access Publishing

Open access publications and initiatives

1. SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies
2. Software tool to identify predatory publications developed by SPPU
3. Journal finder/ journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer

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Journal Suggester, etc

Publication Misconduct

A. Group Discussions

1. Subject specific ethical issues, FFP, authorship
2. Conflicts of interest
3. Complaints and appeals: examples and fraud from India and abroad

B. Software tools

Use of plagiarism software like Turnitin, Urkund and other open source software tools

Databases and Research Metrics

A. Databases
1. Indexing databases
2. Citation databases: Web of Science, Scopus, etc.

B. Research Metrics
1. Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score
2. Metrics: h-index, g index, ilO index, altmetrics

Suggested reading:

1. Kothari, C.R., Research Methodology (Methods and Techniques), New Age Publisher
2. Fundamentals of modern statistical methods By Rand R. Wilcox
3. Power Analysis for Experimental Research A Practical Guide for the Biological, Medicaland Social Sciences by R. Barker Bausell, Yu-Fang Li Cambridge University Press
4. Design of Experiments: Statistical Principles of Research Design and Analysis, by Robert O. Kuehl Brooks/Cole
5. Study and Communication Skills for the Biosciences by Stuart Johnson and JonScott, Oxford University Press
6. Write and Publish a Scientific Paper by Robert A. Day Oryx Press
7. Scientific Easy when you know how by Jennifer Peat BMJ Books
8. Research Projects and Research Proposals A Guide for Scientists Seeking Funding by Paul G. Chapin Cambridge.
9. Critical conversation about Plagiarism: Ed: Michael Donnelly et al, Parler press 2012
10. Bird, A. (2006). Philosophy of Science. Routledge.
11. MacIntyre, Alasdair (1967) A Short History of Ethics. London.

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12. P. Chaddah, (2018) Ethics in Competitive Research: Do not get scooped, do not get plagiarized. ISBN:978-9387480865

13. National Academy of Sciences, National Academy of Engineering and Institute of Medicine. (2009). On Being a Scientist: A Guide to Responsible Conduct in Research: Third Edition. National Academies Press.

14. Resnik, D. B. (2011). What is ethics in research & why is it important. National Institute of Environmental Health Sciences, 1-10. Retrieved from https://www.niehs.nih.gov/research/resources/bioethics/whatis /index.cfrn Beall, J. (2012). Predatory publishers are corrupting open access. Nature, 489(7415), 179-179. https://doi.org/10.1038/489179a

15. Indian National Science Academy (INSA), Ethics in Science Education, Research and Govemance(2019) , ISBN:978-81-939482-I- 7. http://www.insaindia.res.in/pdf/Ethics Book.pdf

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Instrumentation & Techniques in Plant Sciences

Course code: BODATT2

(Credits- 04, contact hour-60h, maximum marks - 100)

Unit I:

Basic technique in plant Science: staining techniques, herbaria techniques. Principles and applications of phase contrast, fluorescence, confocal, scanning and transmission electron microscopy.

Unit II:

Analytical Techniques: Principles and applications of UV-Visible, atomic absorption and fluorescence spectrophotometers, NMR spectroscope. Centrifugation: Principle and types of centrifuges, ultracentrifugation, density gradient centrifugation and continuous centrifugation. Chromatography: Principle and application of TLC, Gas chromatograph, HPLC.

Unit III:

Cultural Techniques: Microbial culture techniques: Sterilization, culture media, types of cultures- batch and continuous, culture preservation. Plant tissue culture techniques: Media preparation, sterilization, in vitro regeneration

Unit IV:

Molecular Techniques: Proteomics: Gel electrophoresis (native, SDS and 2-D), isoelectric focusing, Gel documentation system. Genomics: Isolation of genomic and plasmid DNA, PCR, RT-PCR, AFLP, RFLP, blotting techniques,

Suggested Readings:

1. Chromatography - Concepts & Contrasts, JM Miller (2005), John Wiley & Sons, New Jersey, USA.
2. Modern Practice of Gas Chromatography, RL Grab & EF Barry (2004), fourth edition, John Wiley & Sons, New Jersey, USA.
3. High Performance Liquid Chromatography- Fundamental Principles and Practices, WJ Ough & IW Wainer (1995), Blackie Academic & Professional, Glasgow, Scotland.
4. Gel Electrophoresis of Protein- A Practical Approach, BD Hames (2002), Oxford University Press Inc., New York, USA.
5. Principles and Techniques of Biochemistry and Molecular Biology, K Wilson & J Walker (2010), 7th edition, Cambridge University Press.

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6. Applications of Infrared, Raman and Resonance Raman Spectroscopy in Biochemistry, FS Parker (1983), Plenum Press, New York, USA.
7. Centrifugal Seperation in Biotechnology, Woon-Fong Leung (2007), Elsevier.
8. Biotechnology: A Laboratory Course, JM Becker, GA Caldwell, EA Zachgo (1996), second edition, Academic Press, California.
9. Phytochemical Methods - A Guide to Modern Techniques of Plant Analysis, JB Harborne (1998), Chapman & Hall, London, UK.
10. Biochemical Methods, S Sadasivam & A Manickam (2005), New Age International Private Ltd, New Delhi.
11. Analytical Techniques for Atmospheric Measurements, D Heard (2006), Blackwell Publishing Ltd, UK.

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Bio-resource application & Herbal technology

Course code: BODATD1

(Credits- 04, contact hour-60h, maximum marks - 100)

Unit I: Microbes:

Their isolation, purification & maintenance. Screening of useful strain, Strain improvement through random mutation (random & rational selection), strain improvement. Fermentation technology, fermentation media and Downstream Processing. Application of microbes in various fields.

Unit II: Bioremediation:

Biodegradability of Petroleum hydrocarbons, Halocarbons, Chlorophenols, Nitroaromatics; Solid waste and solid waste management. Microorganisms as biofertilizers and biopesticides. Principles and mechanism of biological control, Commercial production of biofertilizers and biopesticides. Biofuels: From organic residue (ethanol), fuel from algae and cyanobacteria. Single cell proteins and mushroom based protein.

UNIT III: Phytochemical analyses

Steps, solvents & equipments used for phytochemical analyses; Techniques used for extraction, separation, purification and *in vitro* and *in vivo* analyses of phytochemicals; Herbal extract preparations and storage methods. Application of bioactive phytochemicals in industry and healthcare.

Unit IV: Intellectual Property Rights (IPR)

Patents, Trademarks, Copyrights. Introduction to Patenting of Microbiological materials and GMO, implication of patenting, current issues, patenting of genes and DNA sequences.

Suggested Reading:

1. Reed G (1997). Industrial Microbiology. CBS Publishers (AVI Publishing Co.)
2. Stanbury PF, Whitekar A. and Hall (1995). Principles of Fermentation Technology. Pergaman. McNeul and Harvey.
3. Rehm and Reed (1983). Biotechnology. Verlag Chemie.
4. Bhosh, Fiecht er and Blakebrough (1999). Advances in Biochemical Engineering. Springer Verlag Publications.
5. Creuger and Creuger (2001). Biotechnology- A textbook of Industrial Microbiology. Sinaeur Associates.

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6. Casida LE (1997). Industrial Microbiology. Wiley Eastern
7. Agrios, GN (1997) Plant Pathology. Academic Press, San Diego.
8. Cook RJ and Baker KF (1983). The Nature and practice of Biological Control of plant pathogens. Amereca Phytopathological Society Press, St. Paul, MN.
9. Butt, TM, Jackson CW and Magan N (2001). Fungi as Biocontrol agent. CABI Publishing, UK
10. Maier RM, Pepper IL and Gerba CP (2000). Environmental Microbiology. Academic Press. USA
11. Pepper IL,Gerba CP and Brusseau ML (2006). Environmental and Pollution Science. Academic Press. USA
12. Baker KH and Herson DS (1994). Bioremediation. MacGraw Hill Inc. N.Y.

Review of literature and Seminar presentation

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Bio-atmospheric Interactions and Green remediation

Course code: BODATD2

(Credits- 04, contact hour-60h, maximum marks - 100)

UNIT I:

Mass and energy exchange between the biosphere and atmosphere: Exchange of carbon (CO_2) between the biosphere and atmosphere, deposition of nutrients and heavy metals to the plants and their fate

UNIT II:

Plant-atmosphere exchange of trace gases: Biogenic Volatile organic compounds (BVOCs) and climate change. Impact of eco-physiological factors on the exchange of trace gases.

UNIT III:

Green remediation: Core elements, strategies for environmental (air, water, and soil) clean-up, waste management, effects of remedy implementation, sustainability of site remediation, case studies

UNIT IV:

Biochar: Biochar for environmental management, Biochar for agricultural soil amendment, Biochar for atmospheric carbon sequestration, Biochar's Potential and Pitfalls

Suggested Readings

1. Adger, W. N. 2005. Adapting to climate change. Wiley Publication. UK.
2. Biosphere-Atmosphere Exchange of Pollutants and Trace Substances, Publisher: Springer-Verlag Berlin and Heidelberg GmbH & Co. KG, ISBN: 9783540617112
3. Lehmann, J. 2009. Biochar for Environmental Management: Science and Technology. Earthscan Publishers, UK
4. Bell and Treshow 2002. Air Pollution and Plant Life. Willey Publication. UK
5. Green Remediation: Incorporating Sustainable Environmental Practices into Remediation of Contaminated Sites, US EPA, 2008.
6. Koppmann, R. 2007. Volatile Organic Compounds in the Atmosphere. Blackwell Publishing Ltd, Print ISBN:9781405131155.

Review of literature and Seminar presentation

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Environmental Ecology

Course code: BODATD3

(Credits- 04, contact hour-60h, maximum marks - 100)

UNIT I:

Metal Contamination (of Air, Water and Soil) - Assessment of Metals Toxicity; Various Bioassay for Metal Contaminations; Ground Water Pollution-Fluoride and Arsenic Contamination.

UNIT II:

Problems of Mining Industries (Aluminium Toxicity and Acid Mine Drainage); Bioremediation of Pollutants (metals), Reclamation of Degraded Wastelands (mine sites)

UNIT III:

Global Climate Change- Global Warming; Ozone Pollution and its Impact on Plants; Ocean Acidification- Causes and Implications; Light Pollution and its Ecological Impact.

UNIT IV:

Forest - Structure and Regeneration; Sacred Groves and Biodiversity Conservation; Natural Resources - Management and Sustainable Development

Suggested Readings:

1. Larcher, W. 2003. Physiological Plant Ecology. Springer-Verlag Berlin Heidelberg.
2. Adger, W. N. 2005. Adapting to climate change. Wiley Publication. UK.
3. Bell and Treshow 2002. Air Pollution and Plant Life. Willey Publication. UK
4. Pepper, Ian. 2003. Environmental chemistry. Wiley Publication. UK
5. Gerrish G.A, Morin J.G., Rivers T.J., Patrawala Z. 2009. Darkness as an ecological resource: the role of light in partitioning the nocturnal niche. Oecologia. 160:525-536.
6. Rich C., Longcore T. 2006a. Introduction. In: Rich C, Longcore T, editors. Ecological consequences of artificial night lighting. Washington: Island Press; p. 1-13.

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Advanced Bacterial Genetics

Course code: BODATD4

(Credits- 04, contact hour-60h; maximum marks - 100)

Unit1 (Basics of microbial genetics)

Transcription, Translation, Regulation of gene expression (Operons and regulons, repression and activation of Lac operon, feedback inhibition and regulation of virulence genes in pathogenic bacteria), DNA/gene manipulating enzymes: Endonuclease, Exonuclease, Ligase, polymerase, phosphatase, transcriptase, transferase, topoisomerase

Unit 2 (Recombinant DNA Technology and Microbes)

Application of microbe in recombinant DNA Technology, Cloning vectors, Transformation, Construction of genomic and cDNA libraries, Screening and characterization of clones, Recombineering with single and double stranded DNA; detection of gene expression changes using various reporter genes

Unit 3 (Extra-chromosomal elements and mutagenesis)

Role of plasmids (in genetic engineering, pathogenesis, environmental cleaning etc),

Site directed and transposon- mediated mutagenesis, construction of Knock-out mutants,Modern approaches to the generation and analysis of genes: Cre - lox system, Crispr - Cas system, Signal transduction in microbes

Unit 4 (Microbial Genetics in Research)

In vitro production of recombinant proteins in *E. coli*, Promoters and regulators, Other microbial systems of overexpression (S. cerevisiae, Baculovirus)

Analytical techniques used in microbial genetics: Gel retardation assay, DNA footprinting, yeast one-hybrid and two-hybrid assays, ChIP-chip assays, Co-immunoprecipitations, pull-downs and Far-Westerns, Host-microbe interaction

Suggested Readings:

Snyder, L., Peters, L., Henkin, T.M. and Champness, W. 2013. Molecular Genetics of Bacteria, 4th edition, American Society for Microbiology, Washington, D. C.

Miller, J.R. 1992. A Short Course in Bacterial Genetics: Lab Manual, Cold Spring Harbor Laboratory Press.

Sambrook and Russell. 2001. Molecular Cloning. 3rdEdn. CSHL Press. USA

Brown, T. A.2016. *Gene cloning and DNA analysis: an introduction* —7th ed. Wiley-Blackwell Publishing. UK.

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Primrose and Twyman. 2010. Principles of Gene manipulation and Genomics. Wiley-Blackwell Publishing. UK.

Krebs, J. E., Goldstein, E. S., Kilpatrick, S.T 2011. Lewin's Gene X. Jones and Bartlett Publisher. USA.

Review of literature and Seminar presentation

Medical Botany

Course code: BODATD5

(Credits- 04, contact hour-60h, maximum marks - 100)

Unit I:

Botanicals as a source of drugs: Study of some medicinally important families. Diagnostic features and medicinal uses only: Meliaceae, Myrtaceae, Apiaceae, Asclepiadaceae, Solanaceae, Lamiaceae, Euphorbiaceae, Zingiberaceae, Musaceae and Poaceae.

Unit II:

Pharmacognosy: Definition, history and scope of pharmacognosy including indigenous system of medicine. Various system of classification of drugs of natural origin.

significance of pharmacopoeial standards. Occurrence, distribution, Organoleptic evaluation, Microscopical evaluation, chemical constituents including tests and therapeutic efficacy of drugs (Some examples).

Unit III:

Herbal Formulations: Principle, methods, single herb formulation, poly-herbal formulation & their merits and demerits. Standardization of various herbal formulations. Methods of drug identification.

Unit IV:

Natural products as markers for new drug discovery: The Role of natural products as potential new drug discovery. The Role of natural products chemistry in drug discovery. Selection and optimization of lead compounds for further development. Contribution of national research laboratories (CDRI, CIMAP, RRC and NBRI) in medicinal plants Research, A general account of IBPGR and NBPGR.

Suggested readings:

1. GMP for Botanicals - Regulatory and Quality issues on Phytomedicine, Businesshorizons, New Delhi, First edition, 2003. Robert Verpoorte, Pulok K Mukharjee.
2. W.C.Evans & Trease, Pharmacognosy, 15th edn.2008, W.B. Saunders & Co.Ltd., London.
3. Guidelines for the Assessment of herbal medicines, 1991,WHO Report, Geneva.
4. Quality Control Methods for Medicinal Plant material, 1992, WHO Guidelines.

5. Indian Pharmacopoeia, 1996, Govt of India, Ministry of Health and family welfare, Delhi
6. Dr C K, Kokate, Practical Pharmacognosy, 1988, Vallabh Prakashan, Delhi.
7. Dr P Mukherjee, Quality control herbal drugs, 2005, Business Horizons, New Delhi
8. Trease and Evans Pharmacognosy, W.C. Evans.
9. Harborne - Comparative Biochemistry of Flavonoids.
10. Advances in Natural Product Chemistry, extraction and isolation of biologically active compounds. S. Natori et al., Wiley, New York.
11. Standardization of Botanicals by V. Rajpal, Vol. I and Vol II, Eastern Publishers, New Delhi.
12. Practical Evaluation of Phytopharmaceuticals by K.R. Brain and T.D. Turner, Wright-Scientechnica, Bristol.
13. Houghton P, Mukherjee PK. Evaluation of Herbal Medicinal Product, Pharmaceutical Press, London, 2009.
14. Henry, R. J. 1997. Practical Applications of Plant Molecular Biology. Chapman &Hall, London, UK.
15. Raghavan, V. 1997. Molecular Biology of Flowering Plants. Cambridge UniversityPress, New York, USA.
16. Plant molecular biology, Grierson and S.N. Convey, 1988. Blackie
17. Methods in Plant molecular biology. A laboratory course manual by (Ed.) Oak Nakuga, 1995. Cold Spring Harbour Laboratory Press.
18. Pharmacognosy Vol I & II by Mohammed Ali CBS Publications, New Delhi.
19. Nakanishi -Natural Products Chemistry, Vol. 1 & Vol. 2
20. Practical Evaluation of Phyto pharmaceuticals by K. r. Brain, T.D. Turner.
21. The Chemistry of Natural Products, Edited by R.H. Thomson, Springer
22. International Edn. 1994.
23. Natural Products from Plants, 1st edition, by Peter B. Kaufman, CRC Press, New
24. York, 1998.
25. Cutler, Stephen J.; Cutler, Horace G. (2000). *Biologically active natural products: pharmaceuticals*. CRC Press.
26. Newman DJ, Cragg GM (2007) Natural products as sources of new drugs over the last 25 years. Journal of Natural Products 70, 461-477.

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27. Quality control of herbal drugs: an approach to evaluation of botanicals by P. K. Mukherjee.

28. Herbal Drug Technology by S.S. Agrawal & M. Paridhavi.

Review of literature and Seminar presentation

Plant Ecology, Diversity, Uses and Conservation

Course code: BODATD6

(Credits- 04; contact hour-60h; maximum marks – 100)

Unit I. Plant Ecology and diversity:

Plant Ecology – Introduction, Scope and Importance, Plant Diversity and its scope, Types, Plant association, Phyto-sociology, Ecological factors,Aquatic plants diversity, Plant diversity as herbs, Shrubs, Trees and climbers. Plant Population and community. Physico-chemical characters of water/Soil, Phytoremediation, Eutrophication.

Unit II. Plants as a source of Traditional medicine:

Medicinal plantsDiversity and uses of Medicinal plants based on their utility for treatment of various disorders, Ethnobotany basic concepts and significance, Tribes and Medicinal plants, Traditional healers and baigas, Herbal preparation and utilization, CGMPB AND NMPB,

Unit III. Plant Diversity Loss and Conservation:

Reason for loss of plant diversity, Conservation – Need, types and importance, IUCN, Significance of plant diversity. Role of tribes for conserving Medicinal plants, TKDL, Hot spots, Alien invasive plant species.

Unit IV. Medicinal plants research:

Botanical gardens/Herbal gardens, CIMAP. NBPGR, NBRI, Phytochemicals,Ethnobotanical survey, Questionnaire.Plant materials extractors, Extraction techniques.

Suggested readings –

1. Krishnamurthy, K. V. (2004). An advanced text Book of Biodiversity – Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.
2. Trivedi P. C. and Sharma N. 2010. Plant resource utilization and conservation, Pointer Publishers. Jaipur.
3. Singh J. S. Singh S. P. and Gupta S. R. 2006. Ecology, Environment and resource conservation, Anamya Publication, New Delhi.
4. Das A. P. and Pandey A. K. 2007. Advances in Ethnobotany, Bishen Singh Mahendra Pal Singh, Dehradun.
5. S. K. Jain 1989. Methods and Approaches in ethnobotany. Society of ethnobotanists, Lucknow India.

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6. S. K. Jain 1990. Contributions of Indian Ethnobotany, Scientific publishers, Jodhpur
7. P. D. Sharma, Ecology and environment, Rastogi Publications, Meerut.

Review of literature and Seminar presentation

Ethnobotany and Medicinal Plants

Course code: BODATD7

(Credits- 04; contact hour-60h; maximum marks - 100)

Unit: I

Ethnobotany: Principal and applications: Introduction and scope of research in Central India with special reference to Chhattisgarh.The relevance of ethnobotany in the present context. Tribes of Chhattisgarh, Sources of ethnobotany in Chhattisgarh. Important ethnobotanical plants of Chhattisgarh and their bioprospecting. Ethnomedicinal plants used by tribes in various diseases.

Unit: II

Ethnobotanical research tools: Survey, Data collection and sampling, Documentation, compilation of data, presentation of data.

Unit: III

Traditional systems of medicine: History and uses of traditional medicinal plants; Introduction and types of indigenous systems of medicines. Interdisciplinary approaches in ethnobotany; Collection of ethnic information. Definition and importance of Traditional Knowledge (TK), Traditional Knowledge Resource Classification (TKRC), Traditional Knowledge Digital Library (TKDL)

Unit: IV

Naturalproducts-based drug discovery: Characteristics of natural products that make them appropriate material in discovery new of drugs. Role of ethnobotany in modern medicine with examples;Medico-ethnobotanical sources in India;Significance of medicinal plants in ethno-botanical practices along with their habitat and morphology. Ethnobotany and legal aspects: Ethnobotany as a tool to protect interests sharing of wealth concept with few examples from India. Biopiracy, Intellectual Property Rights (IPR) and Traditional Knowledge (TK). Contribution of research institutes (CDRI, CIMAP and NBRI) in medicinal plants research.

Suggested readings:

1. Acharya, D., Jose Luis Rios, Rai, M. (2011) Ethnomedicinal Plants Revitalizing of Traditional Knowledge of Herbs, CRC Press, USA.
2. Chopra, R.N., Nayar, S.L. and Chopra, I.C., (1956). Glossary of Indian Medicinal Plants, CSIR, New Delhi.

3. Das, A.P. and Pandey, A.K., (2007). Advances in Ethnobotany, Bishen Singh and Mahendra Pal Singh, Dehradun.

4. Dutfield, G. (2000) Intellectual Property Rights Trade and Biodiversity, Earthscan, London, United Kingdom

5. Gary J. Martin, G.J. (2014) Ethnobotany: A Methods manual, U.K.

6. Hatfield, G. (2004). Encyclopedia of Folk Medicine: Old World and New World Traditions. United Kingdom: ABC-CLIO.

7. Jadhav, D., (2008) Medicinal Plants of Madhya Pradesh and Chhattisgarh, Publisher: Daya Publishing House, New Delhi.

8. Jain, A.K., (2016) Indian Ethnobotany: Emerging Trends, Scientific Publishers, Jodhpur.

9. Jain, S. K. (1991). Dictionary of Indian Folk Medicine and Ethnobotany, Deep Publications, New Delhi.

10. Jain, S. K. and Rao, R.R. (1977). A Handbook of field and herbarium method, Today and tomorrows, Printers and publisher, New Delhi, India.

11. Jain, S.K., (1995) Manual of Ethnobotany, Scientific Publishers, Jodhpur.

12. Kirtikar, K. R. and Basu, B. D. (1998). Indian Medicinal Plants, Part I to IV, (Reprint) (Bishen Singh Mahendra Pal Singh, Dehradun).

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14. Martin, G.S., (1995). Ethnobotany Chapman and Hall, London.

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17. Quigley, D., Srivastrava, V. (1999). Tribes of India. Hong Kong: Odyssey Poets.

18. Sarin, Y.K. (1996). Illustrated Manual of Herbal Drugs Used in Ayurveda (CSIR/ICMR), NISCOM, and New Delhi.

19. Sengupta, N. (2019) Traditional Knowledge in Modern India Preservation, Promotion, Ethical Access and Benefit Sharing Mechanisms, Springer India.

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21. The Tribes of Madhya Pradesh (1964). India: Department of Tribal Welfare, Government of M.P.

22. Trivedi, P.C., (2006). Medicinal Plants: Ethnobotanical Approaches, Agrobios, India

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Molecular Stress Physiology

Course code: BODATD8

(Credits- 04, contact hour-60h, maximum marks - 100)

Unit I

Stress environment: Abiotic factors, water, temperature, light, pH, and salinity.

Unit II

Stress damages: Cell structure, proteins, nucleic acids, lipids and membranes, physiological processes, protein synthesis.

Unit III

Physiological, cellular, and biochemical mechanisms of abiotic stress in plants. Mechanism of stress adaptations: Molecular responses to stress: stress perception, signal transduction, expression of stress responsive gene and significance of gene product.

Unit IV

Arabidopsis thaliana: as a model for functional genomics of plant abiotic stress responses. Functional genomic approaches to introduce abiotic stress tolerance in plant.

Suggested readings:

1. Plant Physiology and Development, Sixth Edition by Lincoln Taiz, Eduardo Zeiger, Ian M. Møller, and Angus Murphy, published by Sinauer Associates.
2. Biochemistry and Molecular Biology of Plants, Second Edition. Bob B. Buchanan, Wilhelm Gruissem, Russell L. Jones, published byAmerican Society of Plant Physiologists.
3. Plant Stress Tolerance (Methods and Protocols) by RamanjuluSunkar, Published by Humana Press.
4. Plant Stress Physiology, Second Edition by Sergey Shabala, Published by CABI, Oxford.

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Plant Systematics and Evolutionary Biology

Course code: BODATD9

(Credits- 04; contact hour-60h; maximum marks - 100)

Unit I. History of developments in plant classification

Linnaean to post-Linnaean era; phenetic methods, molecular systematics, cladistic methods, phylogenetic analysis, APGclassification. Diagnostic features, systematic position and affinities of major groups offlowering plants recognized in APG classification: Basal angiosperms, Magnoliids,Monocots, Commelinids, Eudicots, Core Euasterids-II.Concept ofLead Botanical Gardens and Biodiversity Parks.

Unit II. Species concept and molecular evolution

Species concepts and the processes of speciation. Drivers of speciation. Evolutionary mechanisms. Postzygotic and prezygotic isolation in allopatry and sympatry; reinforcement; character displacement. Hybrid speciation; hybrid zones. Molecular evolution: Neutral theory. Pairwise distances and molecular divergence. Molecular models; dating phylogenetic events.

Unit III. Evolutionary concept of Angiosperm origin

A critical study of the current ideas on the origin of Angiosperms with special reference to their ancestral state, time and place of origin. The concept of primitive angiosperm flower. Origin and evolution of flower; co-evolution of flowers vis-à-vis pollinators. Origin and evolution of structure and morphology of stamens, nectaries and nectar. Origin and evolution of carpels; different types- concept of foliar origin of carpels; types of ovary; evolution of placentation types- inferior ovary, - foliar and axial concepts. Role of floral anatomy in interpreting the origin and evolution of flower and floral parts.

Unit IV. Inferring phylogenies

Phylogenetic trees, reading and using trees. Gene trees, species trees.

Suggested readings:

1. Angiosperm Phylogeny Group (2016). An update of the Angiosperm Phylogeny Group Classification for the orders and families of flowering plants: APG IV. Botanical Journal of the Linnaean Society 181: 1-20.
2. Baum DA and Offner S(2008). Phylogenies and tree thinking. American Biology Teacher 70: 222-229.

3. Crawford DJ (2003). Plant Molecular Systematics. Cambridge University Press, Cambridge, UK.

4. Cronquist A (1981). An integrated system of classification of flowering plants. Columbia University Press, New York.

5. Briggs D(2009). Plant microevolution and conservation in human influenced ecosystems. Cambridge University Press. UK

6. Futuyma DJ(2009). Evolution. Sinauer Associates, Inc. Publishers, Sunderland.

7. Hall BK and HallgrÅ-msson B (2014). Strickberger's Evolution (4th Edition). Jones & Bartlett.

8. Judd WS, Campbell CS, Kollogg EA, Stevens PF and Donoghue MJ (2008). Plant systematics: Phylogenetic approach. Sinauer Associates, Inc. Massachusetts.

9. Lawrence GHM (1951). Taxonomy of Vascular Plants. New York: Macmillan, 823 pp.

10. Nei M and Kumar S (2000). Molecular Evolution and Phylogenetics. Oxford University Press, New York. ISBN 0 19 513584 9.

11. Page RDM and Holmes EC (1998). Molecular Evolution: A Phylogenetic Approach, Blackwell.

12. Radford AE (1986). The fundamentals of plant systematics. Harper & Row. New York, NY. 498 pp.

13. Semple C and Steel MA (2003). Phylogenetics. Oxford University Press, Oxford.

14. Simpson MG (2006). Plant Systematics. Elsevier, Amsterdam.

15. Stuessy TF (2008). Plant Taxonomy: The systematic Evaluation of Comparative Data. Columbia University Press, New York.

16. Swafford DL (2001). PAUP*. Phylogenetic analysis using parsimony (* and other methods), version 4.Sinauer Associates, Sunderland.

17. Singh G (2010). Plant systematics: An Integrated approach. Science Publisher. USA.

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