

BOTANY

Ph.D Course Work Syllabus

Code	Course	Credit	Marks
BOT-RS-C101	Research methodology in life sciences	04	100
BOT-RS-C102	Research Proposal	04	100
Any one of the following Elective (Advances in Plant Sciences) Courses:			
BOT-RS-C103	Trends in Plant Biochemistry	04	100
BOT-RS-C104	Trends in Microbiology and Plant Pathology	04	100
BOT-RS-C104	Trends in Taxonomy, Biodiversity & Conservation	04	100
BOT-RS-C106	Trends in Ecology	04	100
BOT-RS-C107	Trends in Biotechnology	04	100
BOT-RS-C108	Trends in Natural Products and Ethnopharmacology	04	100
Total		12	300

BOT-RS-C101: RESEARCH METHODOLOGY (Common for School of Life Sciences)

Total Marks - 100

Total Credit – 04

UNIT I- RESEARCH DESIGN AND DATA COLLECTION

15 Hrs

Research methodology- definition, different types of research design. Basic principles of experimental designs. Sampling design- sample survey, steps in sample design, criteria of selecting a sampling procedure and different types of sample designs. Methods of Data Collection: Primary and secondary data.

Literature collection and citation, bibliography. Writing skills - Preparation of research report, presentations, and writing scientific paper. Impact factor, Citation factor, Plagiarism, ISBN, ISSN.

UNIT II- PROCESSING AND ANALYSIS OF DATA AND SAMPLING

15 Hrs

Processing operations, elements/types of analysis, statistics in research, measures of central tendency, dispersion, asymmetry, relationships. Simple regression analysis, multiple correlation and regression, partial correlation, association in case of attributes and other measures.

UNIT III- TESTING OF HYPOTHESES

15 Hrs

Basic concepts of testing of hypothesis, procedures for hypothesis testing. Hypothesis testing for differences between means, hypothesis testing for comparing two related samples, hypothesis testing of proportions. Testing the equality of variances of two normal populations, hypothesis testing of correlation coefficient. Chi square test

UNIT IV- ANALYSIS OF VARIANCE AND COVARIANCE

15 Hrs

Analysis of Variance and Covariance (basic principles of one-way ANOVA, two-way ANOVA and ANCOVA). Multivariate analysis techniques (Characteristics and applications, classification of Multivariate analysis, important multivariate techniques, important method of factor analysis). Ethics in research.

Reading List:

1. Bernard Rosner, B. 2005. *Fundamentals of Biostatistics*, 6th edition Duxbury Press.
2. Gerry, Q. P and Keough, M. J. 2002. *Experimental Design and Data Analysis for Biologists*. Cambridge Univ. Press.
3. Kothari, C.R. 2004. *Research Methodology, Methods & Techniques*. 2nd Revised Edition. New Age International Publisher, India.
4. Norman, N. G. and Streiner, D. 2008. *Biostatistics: The Bare Essentials*. 3rd edition, BC Decker Inc.
5. Paulson, D. S. 2008. *Biostatistics and Microbiology*. Springer.
6. Sokal, R. R. and Rohlf, F. J. 2008. *Introduction to Biostatistics*. Dover Publication.
7. Laake, P., Benestat, H.B. and Olsen, B.R. 2007. *Research Methodology in the Medical and the Biological Sciences*. Academic Press, UK.

COURSE-II: ADVANCES IN PLANT SCIENCES (ELECTIVES)

BOT-RS-C102: TRENDS IN PLANT BIOCHEMISTRY

**Total Marks - 100
04**

Total Credit –

UNIT-I: ENZYMOLOGY

15 Hrs

Extraction and purification of enzymes; application of enzymes in food and drink industries; enzymes and in-born errors in metabolism; preparation and application of immobilized enzymes; enzymes and recombinant DNA technology.

UNIT- II: HORMONES & SIGNAL TRANSDUCTION

15 Hrs

Hormonal regulation of plant growth and development, signal Transduction, Role of PGR in agriculture and horticulture, Auxin signal transduction pathway; Gibberellin signaling and its significance; ABA signal transduction pathway.

UNIT- III: PLANT STRESS RESPONSES

15 Hrs

Biotic and Abiotic stress; Physiological and Biochemical responses of plants to environmental stress; Plant responses to salinity and chilling stress; Abiotic stress and secondary metabolite production. Development of transgenic plants for abiotic stress tolerance; Stress Proteins in plants; biochemistry of plant defense reactions; plant responses to herbivory, control of plant pathogen by genetic engineering.

UNIT-IV: INSTRUMENTATION IN PLANT BIOCHEMISTRY

15 Hrs

Construction and principles of light, electron and scanning probe microscopy. Centrifugation: differential, density. Principles of spectrophotometry and spectroscopy; biomolecules separation, detection and estimation methods methods; HPLC

REFERENCES

1. L. Taiz and E. Zeiger (2002) Plant Physiology (Second Edition) Simauer Associates Inc Publishers Sunderlands, Massachusetts
2. H.W. Heldt (1997) Plant Biochemistry and Molecular Biology Oxford University Press
3. W.G. Hopkins (1985) Introduction to Plant Physiology John Wiley and Sons, Inc. New York
4. Methods in Enzymology Colowick and Caplan Academic Press, New York
5. Coombs, Hall, Long and Scurlik (1985) Techniques in Bioproductivity and Photosynthesis, Pergmon Press, Oxford
6. Hall, Scurlik, Bolhar, NordenKamf, Leagood and Long (1993) Photosynthesis and production in a Changing Environment. A Field and Laboratory Manual, Chapman and Hall Publication
7. Buchnan, B.B., Gruissem, W. and Jones, R.L.(2000) Biochemistry and Molecular Biology of Plants. I.K. International Pvt.Ltd., New Delhi, Mumbai, Bangalore

BOT-RS-C103: TRENDS IN MICROBIOLOGY AND PLANT PATHOLOGY

Total Marks - 100

Total Credit – 04

UNIT I: PLANT DISEASE MANAGEMENT

15 Hrs

Molecular techniques for Identification and classification of fungi. Recent concept of plant defence: Mechanism of sensing pathogenicity, Systemic Acquired Resistance (SAR), Biochemical defence, Biological control of plant diseases, chemicals in plant disease management. Uses of modern biotechnological tools in crop management. Testing for host resistance to diseases.

UNIT II: ADVANCES IN FOOD MICROBIOLOGY

15 Hrs

Genetically modified foods. Biosensors in food, Applications of microbial enzymes in dairy industry. Utilization and disposal of dairy by-product. Prebiotic and Probiotic. Functional foods- health claims and benefits, Development of functional foods; Food Safety and Molecular Detection.

UNIT III: FERMENTATION TECHNOLOGY

15 Hrs

Source of microbes, Isolation, selection and culture collection banks, Preservation of industrially important microbes; Sterilization techniques, Strain development (mutagenesis, metabolic engineering and recombinant DNA techniques). Types of fermentation processes: Solid state and submerged fermentation, Batch, fed-batch and continuous fermentation strategies and their application, Types of fermenters (airlift, stirred tank and bubble column fermenter) Isolation and genotypic identification of microorganisms associated with the foods.

UNIT IV: INSTRUMENTATION IN PLANT PATHOLOGY AND MICROBIOLOGY

15 Hrs

Laboratory practices: General safety measures, Chemical hazards, Physical hazards, Biological hazards, waste disposal. Chromatography techniques, Electrophoresis techniques, Centrifugation techniques. Microscopy: Principles and applications of Light and Electron microscopy. Dark field, Bright Field, Phase contrast, fluorescence, scanning & transmission electron microscopy. Fermenter, spectrophotometer, HPLC, PCR machines.

REFERENCES

1. Dennis, E.S. et al, 1992 Plant Gene Research: Basic knowledge and Application. Springer-Verlag Wien Publ. New York.
2. Gengopadhyay, S 1984 Clinical plant pathology, Kalyani Publ. New Delhi
3. Nane Y.1 and Thapliyal 1979, Fungicides in plant disease control. Oxford IBH, Publ. New Delhi.
4. Smith, J.E and D.R. Berry. 1978. The filamentous fungi. Vol-I Industrial mycology. Vol-II Development Mycologym, Edward Arnold Publ. London
5. Taiz, I, and E. Zeiger. 1998. Plant physiology, Sinauer Assoc Inc. Publ. New York.
6. Trehan. K.1994. Biotechnology, Wiley Eastern Ltd, New Delhi.
7. Vaidya, J.G 1995 Biology of the fungi, Satyajeet Prakashan, Pune.
8. Tamang, J.P. 2010. Himalayan Fermented Foods: Microbiology, Nutrition and Ethnic Values. CRC Press, Taylor and Francis Group, New York, USA.
9. Tamang, J.P. and Kailasapathy, K. 2010. Fermented Foods and Beverages of the World. CRC Press, Taylor and Francis Group, New York, USA.
10. Tamang, J.P. 2014. Health Benefits of Fermented Foods and Beverages. CRC Press, Taylor and Francis Group, New York, USA.

BOT-RS-C104: TRENDS IN TAXONOMY AND BIODIVERSITY CONSERVATION

Total Marks - 100

Total Credit – 04

UNIT-I: TAXONOMY AND BIODIVERSITY

15 Hrs

The principles and practices of Taxonomy. The role of Taxonomy. The Global biodiversity assessment, measures of biodiversity, diversity indices, biodiversity values, use and importance of biodiversity, threatened biodiversity, major causes of biodiversity loss. RET species.

UNIT-II: VARIATION, BIOSYSTEMATICS AND EVOLUTION

15 Hrs

Developmental, experimental and genetic variations; concepts of systematic botany; origin and early evolution of angiosperms, with reference to recent findings. Taxonomic literature, floras, taxonomic accounts, revisionary studies.

UNIT-III: PLANT CLASSIFICATIONS

15 Hrs

Phenetic methods, molecular systematics, cladistic methods, phylogenetic analysis, APG classification. Diagnostic features, systematic position and affinities of major groups of flowering plants recognized in APG classification: Basal angiosperms, Magnoliids, Monocots, Commelinids, Eudicots, Core Eustersids-II.

UNIT-IV: INSTRUMENTATION IN PLANT SYSTEMATICS

15 Hrs

Techniques in Botanical specimens preservation; Laboratory drawing; Basic of GPS and plant phenology; Microscopy and micrometry-light, electron, scanning probe; Centrifugation types; differential and density gradient; Principles of spectroscopy; different types of mass spectrometry methods. Principles of chromatography; Protein sequencing methods; DNA Bar coding and DNA fingerprinting, strategies for genome sequencing.

Reference books:

1. Ray Samit and A. K. Ray (ed.) 2006. Biodiversity and Biotechnology. New Central Book Agenc(p.) Ltd. Kolkata; India.
2. Singh Gurucharan 2010. Plant systematic: An Integrated approach. Science publisher. USA.
3. Judd, W.S., Campbell, C.S., Kollong, E.A., Stevens, P.F. and Donoghue M.J. 2008. Plant systematic: phylogenetic approach. Sircuier Associates, Inc.
4. Futuyma D.J. 2009. Evolution. Sinauer Associates, INC. Publishers, Sunderland. USA.
5. Groom, M.J., Meffe, G.K. and Carroll, C.R. 2006. Principles of conservation biology. Sircuier Associates, Inc.
6. Etelka leadlay and Stephen Jury (ed.). 2006. Taxonomy and plant conservation. Cambridge University press, UK.
7. David Briggs 2009. Plant microevolution and conservation in human influenced ecosystems. Cambridge University press, UK. John P. Bentley. (2004).
8. Principles of measurement systems (4th Edition). Pearson Education; 4th edition, ISBN-10: 0130430285.
9. H.W. Heldt (1997) Plant Biochemistry and Molecular Biology Oxford University Press.

BOT-RS-C105: TRENDS IN PLANT ECOLOGY

Total Marks - 100
04

Total Credit –

Unit-I: CURRENT SCENARIO OF ECOLOGY

15 Hrs

Globalization and ecology, Importance of ecology, Relationship between climate change and ecological studies, Effect of climate change and strategies of mitigation, CO₂ fertilization effect on plants, Ecosystem services and payment for ecosystem services (PES), Carbon trading, Ecological footprint, Image of Ecology Economics.

Unit-II: METHODS AND TECHNIQUES FOR ECOLOGICAL STUDIES 15 Hrs

Different methods used for ecosystem analysis- Qualitative and quantitative approaches, Methods of estimation of plant productivity, Tools to study global climate change, Tools to restore degraded ecosystems, Modern techniques and tools for ecological studies- GPS, GIS and remote sensing, Computer simulated models, Data loggers, soft wares and sensors.

Unit-III: ECOLOGICAL RESEARCH AND ACTS AND POLICIES

15 Hrs

National Forest policy 1988, National Biodiversity Policy 1998, National Biodiversity Act 2002, National policy on wetlands 2005, REDD⁺, Kyoto protocol, Rio Earth summit, G- Summits, Durban agreement 2011, Paris convention 2015

Unit-IV: INSTRUMENTATION IN ECOLOGY

15 Hrs

Centrifugation- high speed and ultra; Principles of spectroscopy-UV, visible, IR, FTIR, Raman, MS, NMR; Principles of spectrophotometer; Principles of chromatography- ion exchange, gel filtration, hydrophobic interaction, Radiobiology and uses. Calibration and maintenance of instruments. Demonstration of relevant techniques used in ecological research.

REFERENCES:

1. Comin F.A (Ed.) (2010). Ecological restoration - a global challenge. Cambridge University Press
2. De Blij, H.J. (2006). Human geography, sulture, society and space (7th edition). John Wiley and Sons
3. Akimasa Suni, Kensuke, F., and Ai, Hiramatsu.(2010). Adaptation and mitigation strategies for climate change. Springer. Burroughs
4. Mandal, F.B and Nandi, N.C. (2009). Biodiversity concept, conservation and bioculture. Asian Books Pvt. Ltd

JOURNALS:

1. Nature
2. Plant and soil
3. Ecology
4. International journal of Ecology and environmental sciences
5. Tropical Ecology
6. Plant Biology and Biochemistry

BOT-RS-C106: TRENDS IN PLANT BIOTECHNOLOGY

Total Marks - 100

Total Credit – 04

UNIT-I: THEORETICAL FRAMEWORK FOR PLANT BIOTECHNOLOGY 15 Hrs

Totipotency: Methods and applications; Transgenics: development, applications and ethical concerns; Molecular markers: development and analyses; DNA sequencing: Theory and applications; Functional genomics: Approach, analysis and applications, Genome editing: CRISPR etc., GLP; writing publications, grant proposals and reports.

UNIT-II: TOOLS & TECHNIQUES IN PLANT BIOTECHNOLOGY 15 Hrs

Plant Cell and Tissue culture: Laboratory organization, Laboratory contaminants- it's control measures, methods of sterilization, aseptic culture, culture of different explants; Isolation of nucleic acids, vectors and uses, PCR & RT-PCR, Genomic and cDNA library preparation, DNA and RNA hybridization, RNAi, Genome sequencing approaches, data collection preparation and analysis, softwares, experimental design, waste disposal.

UNIT-III: BIOINFORMATICS

15 Hrs

Major bioinformatic resources and search tools; Sequence and structure databases; Sequence analysis (file formats, scoring matrices, sequence alignment, phylogeny); Data mining and analytical tools for genomic and proteomic studies; Molecular dynamics and simulations (basic concepts including force fields, protein-protein, protein-nucleic acid, protein-ligand interaction).

UNIT-IV: INSTRUMENTATION IN BIOTECHNOLOGY

15 Hrs

Principles of microscopy-light, electron, fluorescent and confocal; Centrifugation- high speed and ultra; Principles of spectroscopy-UV, visible, IR, FTIR, Raman, MS, NMR; Principles of chromatography- ion exchange, gel filtration, hydrophobic interaction, Radiobiology and uses. Calibration and maintenance of instruments.

References:

1. Agarwal, S.K.(2007) Bioinformatics. APH Publishing Corporation, New Delhi. 240.p
2. Glick, B.R. and Pasternak, J.J. (1994) Molecular Biotechnology: Principles and Application of r-RNA Press, Washington.
3. Gupta, P.K. (2006) Cell and Molecular Biology, Third edition. Rastogi Publications, Meerut.
4. Kumar, S. and Flading M. (2005) Molecular Genetics and Breeding of Forest Trees. International Book Distributers, Lucknow. 436p.
5. Mandal, A.K. and Gibson, G.L. (2008) Forest Genetics and Tree Breeding. CBS Publishers and Distributers, New Delhi. 268p.

Journals:

1. Applied Microbiology & Biotechnology
2. Biotechnology Letters
3. Biotechnology Techniques
4. Indian Journal of Biotechnology
5. Biotechnology Journal

**BOT-RS-C107: TRENDS IN NATURAL PRODUCTS STUDY AND
ETHNOPHARMACOLOGY**

Total Marks - 100

Total Credit – 04

UNIT-I: NATURAL PRODUCTS

15 Hrs

Approaches available for drug development, role of natural products in new drug development. Bioactive compounds from bacterial and fungal sources. Natural products as a guide (leads) for design of new drugs. Bioassay-directed fractionation of natural products. Recent developments in plant based natural products for their activity as adaptogens, immunomodulators, memory enhancers, anti-inflammatory agents, anti-parasitics alongwith screening methods, isolation of active principle, mode of action and future prospects.

UNIT-II: ETHNOPHARMACOLOGY

15 Hrs

Definition, scope and applications in herbal medicines; Importance of ethnopharmacological studies. Plant chemicals in modern pharmacology: Biochemistry and pharmacology of atropine, caffeine, ephedrine, opioids, taxol, Vinca alkaloids; drug improvement by structure modification and biotransformation . Bioavailability and pharmacokinetics aspects of herbal drugs with examples. Phytoequivalence, pharmaceutical equivalence. WHO guidelines for assessment of herbal drugs; authentication and standardization of herbal raw materials.

UNIT-III: HERBAL TECHNOLOGY

15 Hrs

Introduction, concepts and prospects. Phyto-technology- value addition to biodiversity through chemo prospection. Medicinal mushrooms for healthy life. Natural dyes for cotton and silk industry. Scope and uses of essential oil from plants as perfumes and cosmetics. Preparation of perfumes from aromatic plants with special reference to the following Lemon grass, Palm-rosa, Lavender, Rose, and Vetiver. Incorporating the herbal extracts in various cosmetic formulations like Skin care preparations, Sunscreens, Hair care preparations.

UNIT-IV: INSTRUMENTATION IN NATURAL PRODUCTS STUDY **15 Hrs**

Principles of microscopy-light, electron, fluorescent and confocal; Centrifugation- high speed and ultra; Principles of spectroscopy-UV, visible, IR, FTIR, Raman, MS, NMR; Principles of chromatography- ion exchange, gel filtration, hydrophobic interaction, Radiobiology and uses. Calibration and maintenance of instruments.

Suggested Readings:

1. W.C.Evans & Trease, Pharmacognosy, 15th edn.2008, W.B. Saunders & Co.Ltd., London.
2. A.N. Kalia, Textbook of Industrial Pharmacognosy, 2005, CBS Publishers, New Delhi.
3. Dr.P.Mukherjee, Quality control herbal drugs, 2005, Business Horizons, New Delhi
4. Dillon, B.S., Tyagi, R.K., Lal, A. and Saxena, S. (Eds.). 2004. *Plant Genetic Resources Management*. Narosa Pub. House, New Delhi
5. Hurtmann, H.T., Kester, D.E., Davies, F.T. and Geneva, R.L. 2004. *Plant Propagation: Principle and Practice*. Prentice-Hall of India, New Delhi
6. Newman DJ, Cragg GM (2007) Natural products as sources of new drugs over the last 25 years. *Journal of Natural Products* 70, 461-477.
7. Dewick, P. M. (2009). *Medicinal Natural Products: A Biosynthetic Approach*. United Kingdom: John Wiley & Sons. 335-336.

BOT-RS-C108 : RESEARCH PROPOSAL PREPARATION

Total Marks - 100

Total Credit – 04

Objective: To understand the preparation of Research Proposal through survey of literature in the chosen field of research, identification of gaps in the knowledge and preparation of specific objectives to bridge the gaps with realistic budget requirement.

Activities:

- Sources of research material, literature survey, compiling records.
- Collection of source documents- research papers, review paper, book reviews, theses, and conference and project reports.
- Preparation of submission of proposal to funding agencies.
- Develop communication skills for presentation of proposal and justification of budget.
- To understand and follow ethical issues in research