

New SYLLABUS
PRE- Ph. D. COURSE IN BOTANY

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Annexure IV

CORE COURSE

PBC 101 Research Methodology in Plant Sciences

(4 Credits)

PBC 102 Research and Publication Ethics

(3 Credits)

OPTIONAL COURSE

(8 Credits)

The students may select any two of the following optional courses:

PBE 101 Biodiversity, Resource Botany and Ethnobotany

PBE 102 Habitat Ecology, Environment and Natural Resource Management and Remote
Sensing

PBE 103 Basic and Applied Palynology

PBE 104 Biosystematics, Ecobiology, Cultivation of Mushrooms and Plant Health
Management

PBE 105 Genetic Engineering

Unit 1: Philosophy, Ethics and Scientific Conduct

Introduction to philosophy: definition, nature and scope, concept, branches

Ethics: definition, moral philosophy, nature of moral judgments and reactions, Ethics with respect to science and research, Intellectual honesty and research integrity, Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP), Redundant publications: duplicate and overlapping publications, salami slicing, Selective reporting and misrepresentation of data

Unit 2: Publication Ethics

Publication ethics: definition, introduction and importance

Best practices/ standard setting initiatives and guidelines: COPE, WAME, etc.

Conflicts of interest, Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types, Violation of publication ethics, authorship and contributionship, Identification of publication misconduct, complaints and appeals, Predatory publishers and journals

Practice

Unit 3: Open Access Publishing and Publication Misconduct

Open access publications and initiatives, SHERPA/RoMEO online course to check publisher copyright & self-archiving policies, Software tool to identify predatory publications developed by SPPU, Journal finder/ journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

Unit 4: Publication Misconduct

Group Discussion:

Subject specific ethical issues, FFP, authorship

Conflict of interest

Complaint and appeals: example and fraud from India and abroad.

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

Unit 5: Database and research metrics

Databases, Indexing databases

Citation databases: Web of Science, Scopus, etc.

Research Metrics, Impact factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score

Metrics: h-index, g-index, i-10 index, almetrics.

Unit 6: Intellectual Property Rights (IPR)

Introduction to IPR: types of IP and IPR, Salient features of Indian and International laws of IPR,

Protection of plant and microbial resources, Patenting process for genes and transgenic plants,

Case studies related to IPR breaching

CORE COURSE**PBC 101 Research Methodology in Plant Sciences****Unit I: Plant Sciences: An Overview**

Plant diversity in Himalayan perspective, Structure and function of plant cell and tissues, Plant metabolism, Functions of biological molecules, Emerging trends in plant Sciences

Unit II Research Methodology and Experimental designing

Definition and components of research methodology, research methods, difference between research methodology and methods, Research designing: Basic principles of experimental designs, features of a Good Design, important concepts relating to research design.

Unit III Data collection and interpretation

Sampling and sampling methods, Data Tabulation, Diagrammatic representation and Interpretation, Test of Significance and Goodness of fit, Statistical Hypotheses, Parametric and Non-Parametric Hypotheses, Null Hypothesis, Statistical Significance, Levels of Significance, Degrees of Freedom, Student's 't'-test, Goodness of Fit, Chi Square -Test, F-test and ANNOVA, Regression and correlation. Application of Computer in experimental designing and data analysis

Unit IV Scientific writing and presentation

Fundamentals of scientific writing: Steps to better writing, flow method, organization of material and style, drawing figures, graphs, tables, footnotes, references etc. in a scientific write up.

Types of scientific write-ups: Research papers, Review, short communications, editorial, abstract.

Funding proposals: funding agencies and key features of a funding proposal

Presentations: Workshop, Seminar, Conference and Symposium; preparation of powerpoint presentation (which includes text, graphs, pictures, tables, references etc.)

Effective communication skills in presentation: eye to eye contact, facing to audience, question and answer sessions etc.

Unit V Theoretical Foundation for Experiments and Instrumentation

Microtomy: Techniques and applications.

Microscopy: Compound Microscope, Bright and dark field microscopy, Phase contrast and fluorescent microscopy, Electron microscopy- Transmission and Scanning electron microscopy.

Colorimetry- Beer Lamberts Law and its limitations, Spectrophotometry, Mass spectrophotometry, Absorption spectra.

Autoradiography and Tracer techniques

Chromatography- Absorption column chromatography, thin layer and gas liquid chromatography; Centrifugation density gradient and differential centrifugation.

Electrophoresis: AGE and PAGE and electrofocussing.

PBE 101 BIODIVERSITY, RESOURCE BOTANY AND ETHNOBOTANY

Unit I

1. Biodiversity: Concept, biodiversity of major groups including microbial biodiversity, distribution, maintenance and loss of biodiversity.
2. Concepts of species in relation to biodiversity and systematics.
3. Biodiversity in India. Species and genetic biodiversity with reference to Himalaya.

Unit II

1. Taxonomic tools in the study of biodiversity: Nomenclature, herbaria, floras, monographs, histological, cytological, phytochemical, and serological and biochemical techniques.
2. Plant collection and preservation techniques.
3. Dynamics of floristic diversity: Concept of phytogeography: Endemism, hotspots; invasions and introduction.
4. Plant exploration in India with special reference to North-West Himalaya.

Unit III

1. Concept of threatened categories (rare, endangered, vulnerable), Red Data Book.
2. Conservation of Biodiversity: Concept, Environmental policies, Biosphere Reserves, National Parks, Sanctuaries, Botanical Gardens, Pollen storage and Seed Banks, Tissue culture and role of biotechnology in conservation of biodiversity; Cryopreservation. CITES, IUCN, The criteria for assessment of rare plant conservation; Environmental awareness and people's participation in conservation of biodiversity.

Unit IV

1. Identification and evaluation of biodiversity particularly with reference to plant resources:
 - a. Cultivated: brief account of cultivated plant diversity
 - b. Wild: Detailed account of wild plant diversity with reference to food, fodder, timber, medicine, dyes, tannins, beverages, essential oils and aesthetics with particular reference to north-west Himalaya; Wild relatives of cultivated plants, weeds and aliens.

Unit V

1. Ethnobotany: concept, methods of study and analysis, linkage with other sciences, world perspectives, Indian perspectives. Traditional knowledge in natural resource utilization and conservation with particular emphasis on germplasm conservation.
2. Basic knowledge of Intellectual Property Rights (IPR).

PBE 102. HABITAT ECOLOGY, ENVIRONMENT AND NATURAL RESOURCE MANAGEMENT AND REMOTE SENSING

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Unit I

Habitat Ecology: Introduction to Habitat Ecology, Ecological and evolutionary perspectives and concepts; Major habitats, deserts, grasslands and forests, wetlands; Classification, functions and values; Factors affecting wetlands habitats.

Factors influencing terrestrial habitats: drought, floods, tides, soil erosion, grazing, lopping, felling, fire, encroachment, pollution, developmental projects, successional changes and wild life habitats.

Unit II

Natural Resource Management: Natural resources- introduction, classification, utilization, consumption pattern with emphasis on sustainability of natural resources. Policies and strategies for appropriate sustainable resource management and its potential to livelihood security.

Unit III

Environment Management: Concept of environment management; Environmental protection and fundamental rights; Man and environment.

Environment Impact Assessment (EIA); Planning and significance; EIA Reports and environment management plans; Case study.

Disaster Management, Classification; Concepts of land slides and earthquakes in Uttarakhand Himalaya and its mitigation.

Global warming and climatic change; Indicators and consequences, loss of biodiversity. Impact of climatic change on natural resources and strategies for mitigation.

Unit IV

Applied Ecology: Forest types of Uttarakhand and other Himalayan provinces, Forest heritage in Garhwal Himalaya; Classification; forest products (NTFPs, medicinal and aromatic plants, fibre, etc.); Ethnobotanical heritage (traditional health care and knowledge system).

Wildlife, Protected area management.

Introduction to Silviculture, Floriculture and Pomology.

Unit V

Remote Sensing: Principles and Practical applications of Remote Sensing techniques. Interpretation of photographs and imagery; Digital analysis of imagery.

Geographic Information System; Principles and basics of GIS; Applications in terrestrial and aquatic habitats.

Basics of Global Positioning System, GPS satellite and GPS utility.

SUGGESTED READINGS:

1. Barbour, M.G., Burk, J.H. and Pitts, W.D. 1987. Terrestrial Plant Ecology. Benjamin/ Cummings Publication Company, California
2. Begon, M., Harper, J.L. and Townsend, C.R. 1996. Ecology. Blackwell Science, Cambridge, USA
3. Chapman, J.L. and Reiss, M.J. 1988. Ecology: Principles and Applications. Cambridge University Press, Cambridge, U.K.
4. Heywood, H.V. 1995. Global Biodiversity Assessment.
5. Lochwood, M., Worboys, G.L. and Ashish, K. 2006. Managing Protected Areas: A Global Guide.
6. Odum, E.P. 1983. Basic Ecology. Saunders, Philadelphia
7. Smith, R.L. 1996. Ecology and Field Biology. Harper Collins, New York.



Unit I

Palynology: General Introduction and history, Importance of Palynology in plant taxonomy, pollen biotechnology, aerobiology and pollen allergy, forensic palynology, melissopalynology, palaeopalynology and in hydrocarbon exploration.

Unit II

Microspores tetrads and polarity of spores and pollen grains. Pollen spore morphology: symmetry, shape, size. Exine stratification, NPC system for numerical expression, Apertural details, exine stratification, surface structure and sculpture of sporoderm, LO analysis and edge analysis, chemical nature of sporopollenin, development of pollen wall, ubisch body and exineless pollen grains.

Unit III

Melissopalynology: Definition, history and scope. Melissopalynological research in India.

Honey: definition, composition, chemical and physical characteristics, deterioration, heavy metal contamination and adulteration. Bee products.

Methods in Melissopalynology: Qualitative and quantitative analysis (According to International Commission for Bee Botany), Estimation of absolute number of plant elements in honey.

Botanical and geographical origin of honey.

Unit IV

Apiculture: Definition, history and scope. Apicultural research in India.

Different species of bees, morphology, anatomy, colony organization and life cycle, social behaviour of bees, reproduction, queen rearing.

Unit V

Bee keeping equipment, Seasonal management, Bee enemies and bee diseases.

Role of bees in increasing the productivity of agro-horticultural crops in Indian Economy.

Recent trends in Apiculture. Role of bee keeping in rural development.

SUGGESTED READINGS:

1. Crane, Eva., Walker, Penelope and Day Rosemany. 1984. Directory of Important World Honey Sources: International Bee Research Association, London.
2. Erdtman, G. 1952. Pollen Morphology and Plant Taxonomy, Angiosperms; Almquist and Wiksell, Stockholm.
3. Nair, P.K.K. 1966. Essentials of Palynology; Asia Publication House, Lucknow.
4. Wodehouse, R.P. 1935. Pollen Grains: Hafner Publication Co.

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**PBE 104. BIOSYSTEMATICS, ECOBIOLOGY, CULTIVATION OF MUSHROOMS
AND PLANT HEALTH MANAGEMENT**

Unit I

Biodiversity of mushrooms, diversity of mushroom flora in India, belowground diversity of mushrooms (Truffles). Distribution pattern of mushrooms flora in the world. Ethnomycological approach of mushroom specially in Uttarakhand Himalayn.

Unit II

Introduction to mushroom groups, taxonomic study of order Agaricales, dark spored group- systematics of dark spored families: Cortinariaceae, Coprinaceae, Bolbitaceae, Gompidiaceae, Boletaceae, Bondarzewiaceae. Systematics of light spored families: Tricholomataceae, Amanitaceae, Hygrophoraceae, Pluteaceae, Agaricaceae. Order Aphyllorales: Introduction and systematics; Cantharelloid forms; Thelephoroid forms, cupuloid forms, Clavarioid forms, Hydroid forms and Poroid forms. Gasteromycetes: Introduction and systematic; order Podaxales, Hymenogastrales, Sclerodermatales, Lycoperdales, Phallales, Nidulariales.

Unit III

Ecology of mushrooms, role of mushrooms in forest ecosystems, Mycorrhiza: VAM fungi, ectomycorrhiza and forest ecosystem. Tissue culture of wild mushrooms; media preparation, solid and liquid culture media preparation: pure culture techniques, techniques used in maintenance of mushroom cultures.

Unit IV

Preparation of herbarium: methods of collection, identification and preserving wild mushrooms. Cultivation of edible and medicinal mushrooms: *Volvariella*, *Agaricus*, *Pleurotus*, *Lentinus*, *Ganoderma*.

Unit V

Nature, causes and classification of plant pathogen; Dissemination and methods of preservation and control of plant diseases, Host-parasite relationship; mode of infection, pathogenesis strategies –fungus, bacteria, nematodes, nonhost pathogens, viruses, subviral agents viroids. Initial establishment, multiplication and spread of pathogens, symptoms, host ranges.

Fungal diseases of field crops- rice, wheat, maize, sugarcane, cotton and groundnut; fruit crops- apple, peach, mango, citrus and grapes; vegetable crops- crucifers, tomato, potato and brinjal; other crops- tobacco, turmeric and coriander.

Bacterial diseases of field crops, vegetables, fruits and other economically important plants.

Viral diseases of field crops, vegetables, fruits and other economically important plants.

Nematode disease of plants: A knowledge of some important nematode diseases of economically important crops.

Suggested Readings:

1. Singer, R. 1986. The Agaricales in modern Taxonomy (4th ed.) Bishen Singh Mahendra Pal Singh, Dehradun.
2. Bakshi, B.K. 1974. Mycorrhiza and its role in forestry. Forest Research Institute, Dehradun.
3. Largent, D.L. 1977. How to identify mushrooms to genus I: Macroscopic features. Mad River Press Inc. Eureka.
4. Largent, D.L., Johnson, D. and Walting, R. 1977. How to identify mushrooms to genus III: Microscopic features. Mad River Press Inc. Eureka.
5. Mehrotra, R.S. 1980. Plant Pathology. Tat McGraw-Hill Publishing Company Limited. New Delhi.
6. Singh, R. S. 1998. Plant Disease. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
7. Bilgrami, K.S. and Dubey, H.C. 1976. Vikas Publishing House Pvt. Ltd., New Delhi.

Unit I

Scope of Genetic Engineering: Milestones in Genetic Engineering - Isolation of enzymes, DNA sequencing, synthesis and mutation, detection and separation, cloning, gene expression

Unit II

Molecular Tools in genetic engineering: Restriction enzymes, ligases, *si* nuclease, terminal deoxynucleotides, transferases, Poly A polymerases, Reverse transcriptase, Alkaline phosphatase etc., modification enzymes, DNA, and RNA markers.

Unit III

Nucleic acid Sequencing. Gene cloning vectors; Plasmids, bacteriophages, phagemids, cosmids, Artificial chromosomes; cDNA synthesis and cDNA library preparations. Cloning mRNA enrichment, reverse transcription, DNA primers, linkers, adaptors and their chemical synthesis, Library construction and screening; Genomic libraries (complete sequencing projects). Site-directed Mutagenesis and Protein Engineering

Unit IV

How to Study Gene Regulation? DNA transfection, Northern blot, Primer extension, *S1* mapping, RNase protection assay, Reporter assays. Expression Strategies for Heterologous Genes Vector engineering and codon optimization, host engineering, In vitro transcription and translation, expression in bacteria, expression in Yeast, expression in mammalian cells, expression in plants. Processing of Recombinant Proteins Purification and refolding.

Unit V

Phage Display T-DNA and Transposon Tagging Role of gene tagging in gene analysis, T-DNA and transposon tagging, Identification and isolation of genes through T-DNA or transposon. Transgenic and Gene Knockout Technologies; Targeted gene replacement. Gene Therapy; Vector engineering. Strategies of gene delivery, gene replacement/augmentation, gene correction, gene editing, gene regulation and silencing.

Suggested Readings:

1. Molecular and Cellular Methods in Biology and Medicine, P.B. Kaufman, W. Wu. D. Kim and L.J. Cseke, CRC Press, Florida, 1995.
2. Methods in Enzymology vol. 152, Guide to Molecular Cloning Techniques, S.L. Berger and A.R. Kimmel, Academic Press, Inc. San Diego, 1998
3. Methods in Enzymology Vol 185, Gene Expression Technology, D.V. Goeddel, Academic Press, Inc., San Diego, 1990.
4. DNA Science. A First Course in Recombinant Technology, D.A. Mickloss and G.A. Froyer. Cold Spring Harbor Laboratory Press, New York, 1990.
5. Molecular Biotechnology (2nd Edn.), S.B. Primrose. Blackwell Scientific Publishers, Oxford, 1994
6. Milestones in Biotechnology. Classic papers on Genetic Engineering, J.A. Davies and W.S. Reznikoff, Butterworth-Heinemann, Boston, 1992.
7. Route Maps in Gene Technology, M.R. Walker and R. Rapley, Blackwell Science Ltd., Oxford, 1997.
8. Molecular Cloning: a Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York, 2000.
9. DNA Cloning: a Practical Approach. M. Glover and B.D. Hames, IRL Press, Oxford, 1995.