DEPARTMENT OF FORESTRY

COURSE STRUCTURE FOR Ph.D. PROGRAMME

YEAR-2022

TOTAL CREDIT: 16, TOTAL MARKS: 400

TOTAL MARKS=400	**COMPULSORY PAPERS**		TOTAL CREDIT=16	
SEMESTER	COURSE NO.	COURSE TITLE	CREDIT	MARKS
I	FORP-101	Research Methodology	4	100
	FORP -103	Literature Review & Report Writing	4	100
	FORP -104	Ethics in Research and Publication	4	100

Semester	**ELECTIVE PAPERS** [CANDIDATES CAN SELECT ANY ONE PAPER (FORP-102.A/B/C/D)]			
I	FORP-102. A	Wood Science & Technology	4	100
	FORP -102. B	Forest Bio-energy		
	FORP -102. C	Medicinal and Aromatic Plants		
	FORP -102. D	Forest Ecology & Biodiversity conservation		
	Total		16	400

[FORP-101]: RESEARCH METHODOLOGY

Unit-1: Identification of problems and formulation research questions/hypothesis: hypotheses testing: Null hypothesis and Alternative hypothesis, research design: concept and importance of research – features of a good research design, exploratory research design; concept, types and uses, descriptive research designs: concept, types and uses. Experimental design, concept of independent and dependent variables.

Unit-2: Sampling: Concept of statistical population, sampling frame, sampling error, sample size, non response, Characteristics of a good sample. Probability sample – simple random sample, systematic sample, stratified random sample and multi-stage sampling. Determining size of the sample – practical considerations in sampling and sample size, data analysis: data preparation; and Chi-square test including testing hypothesis of association.

Unit-3: Interpretation of data and paper writing, General layout of a Research paper, research paper, review paper and short communications, Preparation of synopsis: Selection and generation of research problems, Stating objectives of research study, literature survey, hypothesis formulation, work plan. Writing project proposal, preparation of thesis/ dissertations/research project report and development of scientific articles for publication.

Unit-4: Use of tools / techniques for research: methods to search required information effectively, Reference Management software like Zotero/Mendeley, software for paper formatting like MS Office, software for detection of plagiarism and similarity index

SUGGESTED READING

1. Nicholas, W. (2011). Research methods: the basics. *Published in the USA and Canada by Routledge, New York*.
2. Kothari, C. R. (2004). *Research methodology: Methods and techniques*. New Age International.
3. Flick, U. (2015). *Introducing research methodology: A beginner's guide to doing a research project*. Sage.
4. Denzin, N. K., & Lincoln, Y. S. (2005). The Sage handbook of qualitative research. *London, Stage Publication*.

[FORP-103]: LITERATURE REVIEW & REPORT WRITING

Review of literature – 50 Marks

Proposal writing (synopsis) – 30 Marks

Seminars – 20 Marks

[FORP: 104]: ETHICS IN RESEARCH AND PUBLICATION

Unit – I: Introduction to philosophy: definition, nature and scope, concept, branches; Ethics: definition, moral philosophy, nature of moral judgments and reactions; Ethics in science and research; Intellectual honesty and research integrity.

Unit – II: Scientific misconducts: Falsification, fabrication and plagiarism, types, Image plagiarism; Redundant publications: duplication and overlapping publications; Selective reporting and misrepresentation of data; Use of plagiarism software like Turnitin, Ithenticate, Plagiarism Checker X and other subscription based and open-source software tools.

Unit – III: Publication ethics: definition, introduction and importance; Best research practices; Conflicts of interest; Publication misconduct: definition, concept, problems that lead to unethical behavior, violation of publication ethics, authorship and contributor ship; Identification of publication misconduct, complaints and appeals; Predatory publishers.

Unit - IV

A. Indexing databases, citation databases: Web of Science, Scopus, etc.; Impact factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score; Metrics: h-index, g index, i10 index etc.

B. Group Discussions: Subject specific ethical issues, authorship; Conflicts of interest; Complaints and appeals: examples and fraud from India and abroad. Open access Publications and Initiatives. Software tools to identify predatory publications, Journal Finder viz., JANE, Elsevier and Springer Journal suggester.

Suggested Readings

1. Bird, A. 2006. Philosophy of Science. Routledge.

2. Mac Intyre, Alasdair 1967. A Short History of Ethics. London.

3. Chaddah, P. 2018. Ethics in Competitive Research: Do Not get scooped, do not get plagiarized.

4. National Academy of Sciences, National Academy of Engineering and Institute of Medicine. 2009. On Being a Scientist: A Guide to Responsible Conduct in Research: 3rd edn. National Academies Press.

5. Beall, J. 2012. Predatory publishers are corrupting open access. Nature, 489(7415), 179- 179. Doi: 10.1038/489179a.

[FORP-102-A]: WOOD SCIENCE & TECHNOLOGY

Unit-1: Ultra-structure and composition of softwoods and hardwoods, chemical composition of wood, cell wall constituents; cellulose, hemicelluloses, lignin and pectic substances. Physical and Mechanical Properties of Wood.

Unit-2: Need and importance of wood seasoning; general principles of seasoning, methods of wood seasoning, air and kiln seasoning. Wood preservation; concept of durability and factors affecting durability of wood, wood preservatives and their properties, wood preservation processes, composite wood and improved wood, bioactive wood polymer composites

Unit-3: Major wood-based industries; match industry, paper and pulp industry, pencil industry, plywood industry, packing case industry, furniture industry, sports good industry etc. Status of supply of raw materials to wood-based industries. Commercial plantations for industrial wood production – present status andfuture prospects

Unit-4: Wood asa chemical and bioenergy feedstock, wood as a feedstock for futuristic biorefineries, fermentation of lingo-cellulosic woody biomass for bio-alcohol production, pyrolysis of wood, gasification of woody biomass, important wood extractives, wood plastics, wood refinery techniques.

SUGGESTED READING

1. Mehta T. 1981. A Hand book of Forest Utilization. Periodical Expert Book Agency.
2. Ramesh Rao, K., & Juneja, K. B. S. (1992). Field identification of fifty important timbers of India.
3. Sharma LC. 1977. Development of Forests and Forest-based Industries. Bishen Singh Mahender Pal Singh, Dehradun.
4. Trotter, H., & Troup, R. S. (1940). Manual of Indian forest utilization.
5. WadooMS.1992. Utilization of Forest Resources. IDRIS Publications

[FORP-102-B]: FOREST BIOENERGY

Unit-1: New and renewable energy sources, concept of biomass and bioenergy, global bioenergy scenario, classification of biomass, characterization of biomass - ultimate and proximate analysis, biochemical constituents-cellulose, hemicelluloses, lignin and pectin, biomass estimation and techniques for general introduction to the bio-based economy concept.

Unit-2: Thermo-chemical conversion: Direct combustion, incineration-incinerator design, pyrolysis - type, factors affecting pyrolysis, properties of pyrolytic bio-oil, biochar as a carbon sequestering agent, gasification and Fischer-Tropsch's synthesis, liquefaction. Biochemical conversion: transesterification (acidic, alkali and enzyme catalyzed) and biodiesel production.

Unit-3: General Introduction to the biorefinery platform biorefineries, outline of an integrated biorefinery and the various (upstream and downstream) unit operations involved, microbial biorefineries Vs plant based biorefineries, algae as vessels for photosynthetic biorefineries, life cycle assessment in the realm of biorefining, cellulosic biorefinery for bio-ethanol production, futuristic biorefineries.

Unit-4: General introduction to energy forestry, energy plantations with special emphasis on short rotation forestry and short rotation coppice, energy plantations and waste land reclamation, energy plantations and power generation.

SUGGESTED READING

1. Dahiya, A, 2014. Biomass to biofuels, 1st edition
2. Kellomäki, S., Kilpeläninen, A., & Alam, A. (2013). Forest bioenergy production. Springer, New York, Heidelberg, Dordrecht, London.
3. Thiffault, E., Smith, C. T., Junginger, M., & Berndes, G. (Eds.). (2016). Mobilisation of forest bioenergy in the boreal and temperate biomes: Challenges, opportunities and case studies. Academic Press.

[FORP-102-C]: MEDICINAL AND AROMATIC PLANTS

Unit-1: Introduction to the Ethnobotany concept, MAP: importance, origin, distribution, area, production, climatic, soil requirements, nutritional and water requirements. Endangered MAPs and their conservation status in the Indian context with particular focus on the state of Nagaland

Unit-2: Secondary plant metabolites, types of secondary metabolites in plants- flavonoids, terpenoids, alkaloids- chemical structure, extraction, production and applications, *in vitro* production of secondary metabolites by tissue culture approach, applications of secondary metabolites, therapeutical uses of phytoconstituents such as gums, anthraquinones, steroidal and triterpenoidal glycosides, phenolic compounds, lipids etc.

Unit-3: Therapeutic and pharmaceutical use of major medicinal plants; pepper, cardamom, clove, ginger, turmeric, betelvine, periwinkle, Rauvolfia, Dioscorea, Ammi majus, belladonna, Cinchona, pyrethrum and other species relevant to local conditions. Therapeutic and pharmaceutical use of aromatic plants: Citronella grass, khus grass, sweet flag (bach), geranium, patchouli, bursera, mentha, muskdana (musk mallow), and other species relevant to the local conditions.

Unit-4: Plant protection, harvesting and processing of important medicinal and aromatic plants. Procedures involved in the extraction of phytoconstituents/phytochemicals from medicinal plants. Essential oils: Extraction and production methods of natural essential oils. Chemical composition of essential oils, bioactivity (antibacterial, antifungal, anti-tumor, anti- oxidant etc.) of various essential oils and their storage.

SUGGESTED READING

1. Khan, I. A., & Khanum, A. (1998). Role of biotechnology in medicinal and aromatic plants.
2. Gupta AK, Tandon N & Sharma M. 2008. Quality Standards of Indian Medicinal Plants, ICMR
3. Johnson C Band Franz C, 2005. Breeding Research on Aromatic and Medicinal Plants. International Book Distributors
4. Sharma R, 2004. Agro-techniques of Medicinal Plants. Daya Publications

[FORP – 102 - D]: FOREST ECOLOGY AND BIODIVERSITY CONSERVATION

UNIT 1- Concept of forest and forest ecosystem, Significance of forest, forest ecosystem structural and functioning, forest diversity indices (alpha diversity, beta diversity, gamma), Ecological niche, Forest community composition and methods for measuring forest composition, Nutrient cycling in forest; nutrient uptake, retention and return, source of nutrients organic matter decomposition, nutrient conservation strategies in forest, Forest biogeochemistry with emphasis on carbon and nitrogen cycling in tropical forest, Primary and secondary succession, Forest disturbances, Forest degradation and restoration.

UNIT 2- Introduction, scope and principle of forest management, Forest working plan and working schemes. Management of forest plantations and commercial forests, forest cover monitoring, Measurement of tree diameter and girth, tree height measurements, Measurement of weight and biomass factors affecting weight, Forest inventory-types of enumeration, sampling methods, sampling intensity,

UNIT 3- Concept, type and pattern of biodiversity; value and importance of biodiversity; Causes and consequences of biodiversity loss; Mega-diversity countries and hotspots of biodiversity; Assessment of Biodiversity: IUCN threat categories and endangered flora and fauna with emphasis on Indian context.

UNIT 4- Biodiversity conservation strategies- *In-situ* (Biosphere reserves, National parks, Wildlife sanctuaries, Tiger reserves, Wetlands, Mangroves, Sacred groves, etc) and *Ex-situ* (Botanical gardens, Zoos, Aarboretum, Orchidarium, Gardens); gene bank, tissue culture and micro propagation; institutions involved in biodiversity conservation; WPA, CITES, TRIPS, National biodiversity Act 2002 and Rule 2004.

SUGGESTED READING

1. Thomas, P.A. and Packham, J. R. 2007. Ecology of woodlands and forests. Cambridge University Press. Cambridge, UK. ISBN:978-0-521-54231-9.
2. Aggarwal, K. C. 2002. Global biodiversity. Nidhi Publishers. Dhyani S N. 1994. Wildlife Management. Rawat Publisher
3. Sharma L C.1980. Forest Economics, Planning and Management. International Book Distributors, Dehradun
4. Hosetti, B. B. Concepts of Wildlife Management. Daya Publishing House James A Bailey. Principles of Wildlife Management. John Wiley & Sons Ltd.