

**GENERAL INSTRUCTIONS  
&  
COURSE CURRICULUM**

**FOR**

**Ph.D. Botany**  
*(Effective from Academic Session 2024-25 onwards)*



**DEPARTMENT OF BIOSCIENCES**

**HIMACHAL PRADESH UNIVERSITY**  
**(NAAC Accredited "A" Grade University)**  
**SUMMERHILL, SHIMLA, 171005**  
**HIMACHAL PRADESH, INDIA**

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- (3) A Ph.D. scholar must obtain a minimum of 55% marks or its equivalent grade in the UGC 10-point scale in the course work to be eligible to continue in the programme and submit his or her thesis.

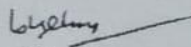
HIMACHAL PRADESH UNIVERSITY  
(NAAC ACCREDITED "A" GRADE UNIVERSITY)  
OFFICE OF THE DEAN OF STUDIES  
SHIMLA-171005

No. 1-60/2023-HPU(DS)-

Dated: Shimla-5, the 09<sup>th</sup> May, 2023

**NOTIFICATION**

On the recommendations of the Standing Committee of Academic Council vide item No.1 in its meeting held on 04.02.2023, the Executive Council vide Additional Supplementary Item No.6 of its meeting held on 06.04.2023 has approved the adoption of University Grants Commission ( Minimum Standards and Procedures for Award of Ph.D. Degree) Regulations, 2022 dated 07.11.2022 and 10.11.2022 (Annexure "A") in toto for its implementation in HP University from the session 2023-24.

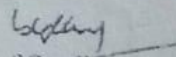
  
Dean of Studies

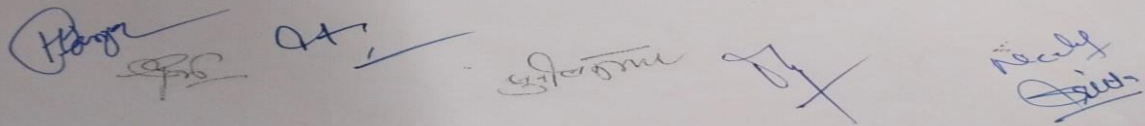
Endst. No.: 1-60/2023-HPU(DS)-

Dated : Shimla-5, the 9<sup>th</sup> May, 2023

Copy for Information and necessary action to:-

1. All the Deans of Faculties, HPU, Shimla-5.
2. All the Chairpersons/Directors, Teaching Departments/Institutes, HPU, Shimla-5.
3. The Principal, H.P. University centre for Evening Studies, HPU, Shimla-5.
4. The Dean Students' welfare, HPU, Shimla-5.
5. The Director, International Students' Welfare, HPU, Shimla-5.
6. The Controller of Examinations, HPU, Shimla-5.
7. The Chief Warden, HPU, Shimla-5.
8. The Director ICDEOL/DIS, HPU, Shimla-5.
9. Director, H.P.U Regional Centre Khaniara, (Dharamshala), Distt. Kangra.
10. The Deputy Registrar (Secrecy), HPU, Shimla-5.
11. The Assistant Registrar (Admn) & Assistant Registrar (Academic), HPU, Shimla-05.
12. The Web Admn H.P University, Shimla-5 with the request to upload the same on the University website.
13. The Spl. P.S. to the Vice-Chancellor, HPU, Shimla-5 for the kind information of the latter please.

  
Dean of Studies



## Annexure-I

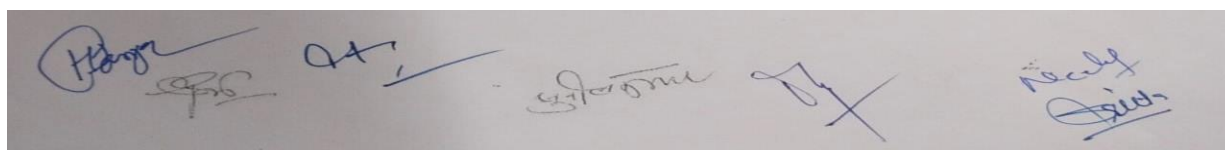
**DEPARTMENT OF BIOSCIENCES  
HIMACHAL PRADESH UNIVERSITY  
SUMMER HILL, SHIMLA-171005  
Ph.D. BOTANY PROGRAMME**

**GENERAL INSTRUCTIONS/GUIDELINES FOR EXECUTION OF CURRICULUM**

1. All candidates admitted to the Ph.D. program at the Department of Biosciences have to complete a minimum of 12 credits.
2. There will be four (4) courses in Ph.D. Botany Programme. The students have to take 3 compulsory courses [PhDBT-101, PhDBT-102, PhDBT-103] and at least one additional course out of **elective courses [PhDBT-104(i-vii)]**.
3. A Ph.D. scholar must obtain a minimum of 55% marks or its equivalent grade in the UGC 10-point scale in the course work to be eligible to continue in the program and submit his or her thesis.
4. The detailed syllabi for the courses offered by the Department are appended with a list of suggested readings.

**Outline of the Course Work for Ph.D. in Botany**

Code	Title of Paper	Max Marks	Credits
PhDBT-101 (Common with all disciplines under Faculty of Life Sciences)	Research Methodology	100	4 Credits
PhDBT-102 (Common with all disciplines under Faculty of Life Sciences)	Research and Publication Ethics	50	2 Credits
PhDBT-103 (Common with Zoology)	Techniques in Biological Research	50	2 Credits
<b>Elect any one of the following i.e. PhDBT-104 (i-vii) (Elective)</b>		100	4 Credits
PhDBT-104(i)	Advances in Mycology		
PhDBT-104(ii)	Advances in Plant Pathology		
PhDBT-104(iii)	Advances in Microbiology and Biotechnology		



PhDBT-104(iv)	Wood Science, Forest Biodiversity and Plant Resources		
PhDBT-104(v)	Advances in Plant Physiology		
PhDBT-104(vi)	Advances in Biodiversity, Bioprospecting, Ethnobotany and Sustainable Utilization of Plant Resources		
PhDBT-104(vii)	Phytochemistry and Palynology		
	Total Marks/Credits	300	12 Credits

# Ph.D. Botany (Compulsory Courses)

## RESEARCH METHODOLOGY

<b>Course Code: PhDBT-101</b>	<b>Credits: 4</b>	<b>MM: 100</b>	<b>L(4): T(0): P(0)</b>	<b>60Hours</b>
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### Course objectives:

To provide basic framework and guidelines for researchers to clearly and define research problems, hypotheses, and objectives

### Course learning outcomes:

- Will help the researchers to identify the most appropriate research design, sampling technique, and data collection and analysis methods.
- Researchers will be able to understand and comprehend the basics of research methodology and apply them in their research.

### NOTE: Instructions for setting question paper

The examiner will **set nine** questions in total covering the entire syllabus. However, there will be **one compulsory** question containing twenty parts [One mark each], besides two questions from each of the four Units. The students will attempt **five questions** in total by selecting one question from each unit and the compulsory question. All questions shall carry equal marks (20 marks each).

### Course Content

#### UNIT-I (15 Hours)

**Foundations of Research:** Meaning, objectives of research; criteria of good research; basic steps of research; types of research.

**Problem Identification & Formulation:** selection of research problem.

**Hypothesis:** Qualities of a good Hypothesis, Null & Alternative Hypothesis, Hypothesis Testing, Logic & Importance

**Review of related literature:** Meaning, necessity and sources.

#### UNIT-II (15 Hours)

**Research Process and Experiment Design:** Concept and Importance in Research, features of a good research design, Exploratory Research Design concept, types and uses, Descriptive Research Designs concept, types and uses, Concept of Independent & Dependent variables.

**Research Report:** Writing preliminaries, main body of research, references and bibliography

**Research and Development of Projects:** Project formulation, National and international funding agencies for R & D projects, proposal submission, Intellectual Property Right (IPR).

#### UNIT-III (15 Hours)

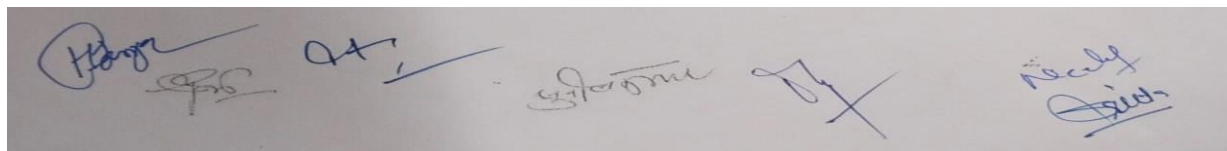
**Sampling:** Meaning and types of sampling; Probability and Non-Probability, Practical considerations in sampling and sample size.

**Tools and Techniques of Data Collection:** questionnaire, schedule, interview, observation, case study, survey *etc.* statistics and its significance in research.

**Data Analysis:** Frequency distribution, measures of central tendency, measures of dispersion, correlation, regression analysis, test of significance (Z-test, t-test, Chi-square test, F-test).

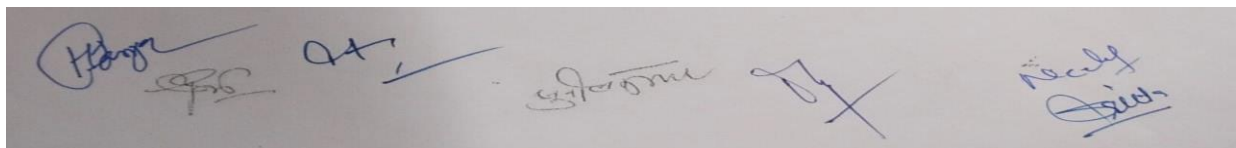
#### UNIT-IV (15 Hours)

**Use of Tools / Techniques for Research:** Search engines: NCBI, PubMed, Google Scholar, Thomson Reuters, SCI *etc.* Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office. Bioinformatics tools and applications



### **Suggested Readings**

1. Council of Biology Editors –CRE Style Manual, American Institute of Biological Sciences, Washington. D.C.
2. Effective Writing for Engineers, Managers, Scientists: Tichy AJ.
3. Scientific and Technical papers: Tribcase SF.
4. How to write and publish a scientific paper: Day RA.
5. Kothari, C. R. (2004). Research Methodology- Methods and Technique (New Age International, New Delhi)





# RESEARCH AND PUBLICATION ETHICS

Course Code: PhDBT-102 Credits: 2 MM: 50 L(2):T(0): P(0) 30 Hours

## Course objectives:

- To provide students with the fundamental knowledge of basics of philosophy of science, ethics in research and publication.
- Concept and understanding of predatory publication, indexing, citation databases, open-access publications and research matrices such as citations, h-index, i-index, impact factor, research interest score etc.
- Guide and mentor students in using plagiarism checking tools for a valid and ethical research.
- To prepare an evaluation report of a manuscript/ article.

## Course learning outcomes:

The students will be able to know and practice ethical principles involved in research work and in publication that will help in maintaining integrity and credibility of scientific literature.

## NOTE: Instructions for setting question paper

The examiner will set **nine** questions in total covering the entire syllabus. However, there will be **one compulsory** question containing ten parts [One mark each], besides two questions from each of the four Units. The students will attempt **five questions** in total by selecting one question from each unit and the compulsory question. All questions shall carry equal marks (10 marks each).

## Course Content

### UNIT-I (8 Hours)

**Philosophy, ethics and scientific conduct:** Introduction to philosophy: definition, nature and scope, concept, branches

**Ethics:** Definition, moral philosophy, Nature of moral judgements and reaction;

**Scientific conduct:** Ethics with respect to science research, intellectual honesty and research integrity; Scientific misconduct: Falsification, fabrication and plagiarism; Redundant publications: Duplicate and overlapping publications, salami slicing; Selective reporting & misrepresentation of data.

### UNIT-II (7 Hours)

**Publication ethics:** Definition, introduction and importance, best practices/ standards setting initiatives and guidelines [COPE, WAME etc.], conflict of interest.

**Publication misconduct:** Definition, concept, problem that lead to unethical behaviour and vice versa, and types; conflict of interest; violation of publication ethics, authorship and contribution ship.; Identification of publication misconduct, complaints and appeals.

### UNIT-III (8 Hours)

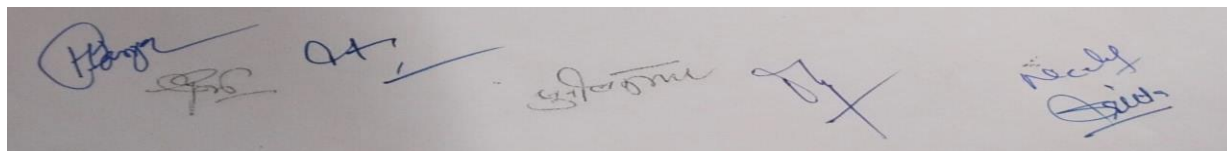
**Open-access Publishing & publication misconduct:** Open-access publications and initiatives, SHERPA/ RoMEO online resource to check publisher copyright and self-archiving policies, software tools to identify predatory publications developed by SPPU; journal finder/ journal suggestion tools viz. JANE, Elsevier Journal finder, Springer Journal *etc.*

**Publication misconduct:** Group discussion: Subject specific ethical issues, FFP, authorship; Conflict of interest; complains and appeals: Examples and fraud from India and abroad.

**Software tools:** Use of plagiarism check software's like Turnitin, Urkund and other open-source software tools

### UNIT-IV (7 Hours)

**Databases and Research Matrices:** Databases - Indexing databases, and Citation databases: Web of Science, Scopus *etc.*

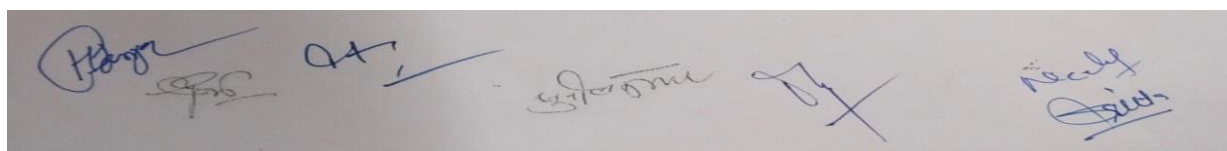


**Research Matrices:** Impact factor of a journal as per citation report, SNIP, SJR, IPP, Cite Score & Research Interest (Research Gate).

**Matrices:** H-index, I-Index *etc.*

**Suggested Readings**

1. The Ethics of Teaching and Scientific Research by Miro Todorovich; Paul Kurtz, Sidney Hook.
2. Research Ethics Publication Approaches by Brbara H Stanley; Joan E, Sieber; Gary R. Midbow.
3. Research Methods in Applied Sciences: An Integrated Approach to Design and Analysis by; Morgan Lawrence Erlbaum Associates.
4. Ethics and Values in Industrial –Organizational Psychology by Joel Lefkowitz. Wiley Publishers.





## TECHNIQUES IN BIOLOGICAL RESEARCH

**Course Code: PhDBT-103      Credits: 2   MM:50      L(2): T(0): P(0)      30 Hours**

### Course objectives:

- i. To develop a deeper understanding of the principles involved behind the working of different instruments used in research.
- ii. To make researchers able to utilize scientific learning to expand their research aptitude

### Course learning outcomes:

- i. Students will be able to learn all the basic and advanced techniques used in research.
- ii. By using various tools, students will be able to identify, characterize, and quantify biomolecules with precision

### NOTE: Instructions for setting question paper

The examiner will **set nine** questions in total covering the entire syllabus. However, there will be **one compulsory** question containing ten parts [One mark each], besides two questions from each of the four Units. The students will attempt **five questions** in total by selecting one question from each unit and the compulsory question. All questions shall carry equal marks (10 marks each).

### Course Content

#### **Electron Microscopy and Electrophoresis (8 Hours)**

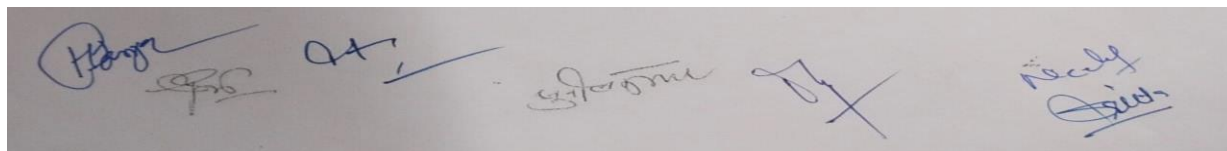
Working principles, basic operation and application of Electron Microscopy  
Scanning Electron Microscopy (SEM)  
Transmission Electron Microscopy (TEM)  
Principle of electrophoresis  
Agarose gel electrophoresis and its limitations  
Polyacrylamide gel electrophoresis and Cellulose acetate membrane electrophoresis  
Isoelectric focusing (IEF), 2-D gel electrophoresis and Pulse field electrophoresis,

#### **Histochemistry (7 Hours)**

Historical perspective and Importance of histochemistry in biological research.  
Principles of fixation; types of fixatives and their application  
Principles and methods of histochemical localization of carbohydrates, lipids, proteins, nucleic acids and some enzymes (phosphorylase, sidolase, SDH, LDH-ases and lipase).

#### **Immunological Techniques (8 Hours)**

Radial immunodiffusion  
Radioimmuno assay  
Haemagglutination  
Enzyme linked immunosorbent assay (ELISA)  
Immunofluorescence



## Remote Sensing

(7 Hours)

History, evolution and mechanism of Remote Sensing

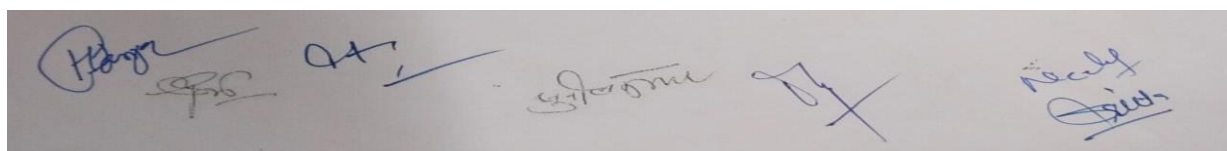
Advantages of Remote sensing and limitation of Remote sensing

LIDAR Remote Sensing and their different application in terrestrial and vegetation mapping

### Suggested Readings:

1. Wilson, K. and Walker, J. Principles and Techniques of Practical Biochemistry Cambridge University Press.
2. Freifelder D., Physical Biochemistry, Application to Biochemistry and Molecular Biology, W.H. Freeman and Company, San Fransisco.
3. Holmeand, D. and Peck, H. Analytical Biochemistry. Longman
4. Scopes, R. Protein Purification - Principles and Practices. Springer Verlag
5. Bisen and Mathew. Tools and Techniques in Life Sciences. CBS Publishers and Distributors.
6. Thomas Lille sand & R.W. Keifer. Remote Sensing and Image interpretation. John Wiley and Sons.
7. Nandi, D. and Chatterjee, T. Text Book of Remote Sensing & Cartography. Kalyani Publication
8. Sabins, F. Remote Sensing: Principles and Interpretation. Freeman Publication

## Ph.D. Botany (Elective Courses)



## ADVANCES IN MYCOLOGY

PhDBT-104(i)

Credit: 4 MM: 100

L(4): T(0): P(0)

60 Hours

### Course objectives:

- i To acquire detail knowledge about microbial interactions with biotic and abiotic components.
- ii To get whole idea about microbial importance and their benefits in industry and bioconservation of waste material.
- iii To garner knowledge about mycorrhizae and their prominent role in agriculture, horticulture and forestry.
- iv To receive intimate understanding about effects of phytopathogenic and other fungi on human being.

### Course learning outcomes:

- i Students will be able to gain deep understanding about microbial ecology.
- ii Know the microbial significant in industry, agriculture, horticulture and forestry.
- iii Utilise different waste material for the cultivation of fungi.

### NOTE: Instructions for setting question paper

The examiner will set **nine** questions in total covering the entire syllabus. However, there will be **one compulsory** question containing twenty parts [One mark each], besides two questions from each of the four Units. The students will attempt **five questions** in total by selecting one question from each unit and the compulsory question. All questions shall carry equal marks (20 marks each).

### Course Content

#### Unit-1

(20 Hours)

Concepts in microbial ecology, microbe-microbe Interactions, microbe- plant interactions, microbe-animal interaction, carbon cycle, nitrogen cycle, sulphur cycle, phosphorous cycle, transformation of other ions, degradation of man-made compounds.

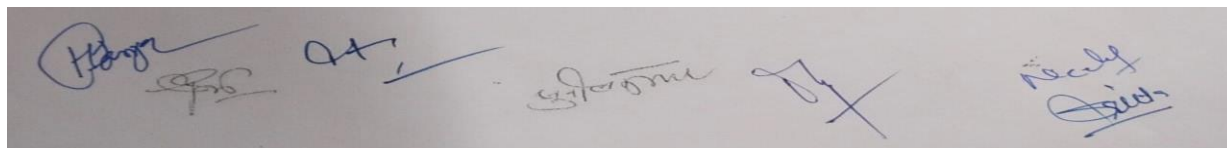
#### Unit-2

(20 Hours)

Fungi in fermentation technology, in the production of antibiotics immunoregulators, antitumor and antiviral agents, in transformation, in mineral biotechnology, in coal solubilization and paper industry, biosorption, bioremediation, detoxification of pesticides, in treatment of industrial effluents.

#### Unit-3

(10 Hours)



Type, structure and function of mycorrhizae

Role of mycorrhizae in agriculture, horticulture and forestry.

**Unit-4**

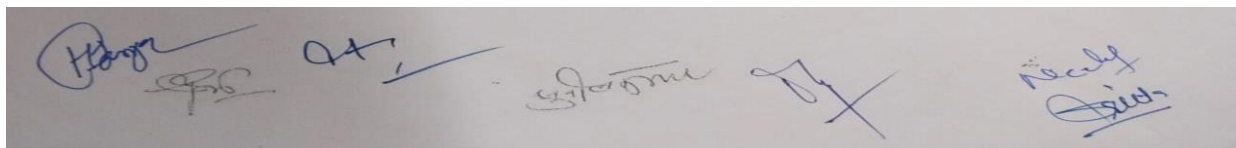
**(10 Hours)**

Bioconversion of waste material through cultivation of fungi

Effect of plant parasitic and other fungi on man.

**Suggested Readings**

1. Ainsworth G.C. and Sussman, A. S. The fungi Academic Press. Now York. 1968.
2. Alexopoulos, C.J. and Mims, C, W. 1979. And Blackwell, M. Introductory Mycology. Wiley Eastern Limited, New Delhi.
3. Burnett, J. H. 1976. Fundamentals of Mycology. Edw and Arnold London.
4. Alexopoulos, C.J., Mims, C, W. and Blackwell, M. Introductory Mycology. John Wiley and Sons.
5. Deacon, J. W. Introduction to modern mycology, ELBS.
6. Horsfall, J.G. and Cowling, E.B. Plant Diseases Vol. I-V. Academic Press, New York.



## ADVANCES IN PLANT PATHOLOGY

PhDBT-104(ii)

Credit: 4

MM: 100

L(4): T(0): P(0)

60 Hours

### Course objectives:

- i To understand the nature, origin and evolution of parasitism.
- ii To provide knowledge about plant pathogen interaction up to molecular level.
- iii To acquaint with importance of information technology in plant pathology.

### Course learning outcomes:

- i Students will be able to develop a comprehensive understanding on the various types of plant diseases due to unfavourable abiotic factors.
- ii understand the molecular plant pathology and students also become well versed with use of information technology in plant pathology.
- iii Develop critical understanding on mechanism of action of fungicides and antiviral agents.

### NOTE: Instructions for setting question paper

The examiner will **set nine** questions in total covering the entire syllabus. However, there will be **one compulsory** question containing twenty parts [One mark each], besides two questions from each of the four Units. The students will attempt **five questions** in total by selecting one question from each unit and the compulsory question. All questions shall carry equal marks (20 marks each).

### Course Content

#### Unit-1

(20 Hours)

Nature, origin and evolution of parasitism.

Parasitic and phanerogamic diseases of plants, effect of atmospheric impurity and lightening, diseases due to unfavourable temperature and light, soil moisture disturbances and nutritional deficiency diseases due to excess of nutrients.

#### Unit-2

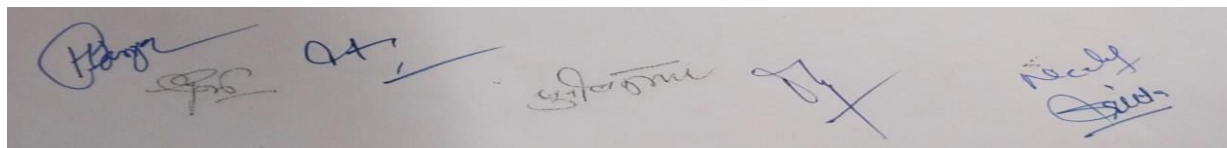
(15 Hours)

Molecular plant pathology: Molecular diagnosis; identification of genes and specific molecules in disease development; molecular manipulation of resistance.

#### Unit-3

(15 Hours)

Application of information technology in plant pathology: Simulation of epidemics, program for diagnosis, remote sensing and image analysis for ecosystem level effects, prediction of disease control decisions.



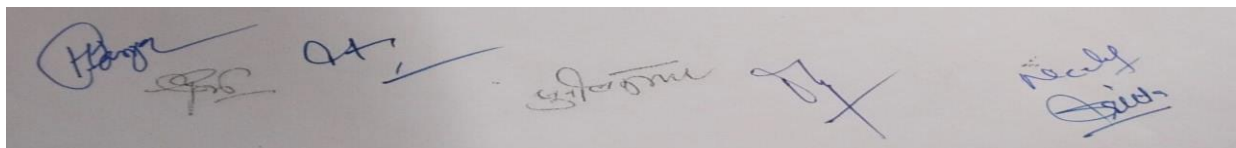
#### Unit-4

(10 Hours)

Mechanism of action of fungicides, antiviral agents and chemotherapy.

#### Suggested Readings

1. Agrios, G.N. Plant Pathology, Academic Press, 1988.
2. Baker, F. and Cooks, R.J. 1974. Biological Control of Plant Pathogens: W.H. Freeman & Co. San Francisco.
3. Bilgrami, K.S. and Dubey, H.C. text Book of Modern Plant pathology, Vikas, New Delhi; 1980.
4. Horsfall, J.G. and Dimond, AE. Plant Pathology -An Advanced Treatise. Vol-III Academic Press, New York
5. Horsfall, J.G. and Cowling, EB. Plant Disease. Vol. I-V. Academic Press, New York.



# ADVANCES IN MICROBIOLOGY AND BIOTECHNOLOGY

PhDBT-104(iii)

Credit: 4

MM: 100

L(4): T(0): P(0)

60 Hours

## Course objectives:

- i To enrich students with the knowledge of the different disciplines of microbiology such as medical microbiology, immunology, biocatalyst and fermentation technology.
- ii To provide deep knowledge about application of microbes in genetic engineering.
- iii Laboratory skills in addition to theory are included to prepare students for careers in the industry, agriculture and applied research where microbiology is increasingly employed.

## Course learning outcomes:

- i Students will be able to gain wide knowledge about biocatalyst and fermentation technology.
- ii Get deep insights regarding genetic engineering along with cell and tissue culture technique.
- iii Understand the immunology and mechanism of drug resistance in microorganisms.

## NOTE: Instructions for setting question paper

The examiner will **set nine** questions in total covering the entire syllabus. However, there will be **one compulsory** question containing twenty parts [One mark each], besides two questions from each of the four Units. The students will attempt **five questions** in total by selecting one question from each unit and the compulsory question. All questions shall carry equal marks (20 marks each).

## Course Content

### Biocatalyst Technology

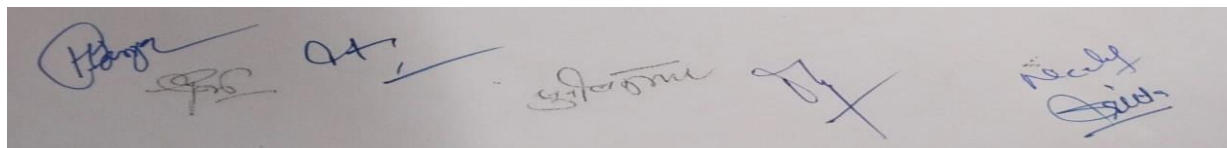
(15 Hours)

1. Sterilization of Biocatalysts.
2. mobilization of Biocatalysts.
3. Biocatalysis in organic synthesis.
4. Enzyme reactions in organic solvents
5. Enzymes as biosensors.

### Tissue Culture and Genetic Engineering

(15 Hours)

1. Products from animal and plant tissue culture.
2. Animal and plant reactor technology
3. Expression of foreign DNA in E. coli.





4. Gene cloning and expression in Yeast.
5. Gene cloning in animal cells.
6. Techniques in plant genetic engineering.
7. Site detected mutagenesis.

### **Fermentation Technology**

**(15 Hours)**

1. Microbial growth kinetics.
2. Design and analysis of bioreactors
3. Operation of fermentation processes.
4. Energy and food from industrial and forest wastes.
5. Techniques of product recovery,

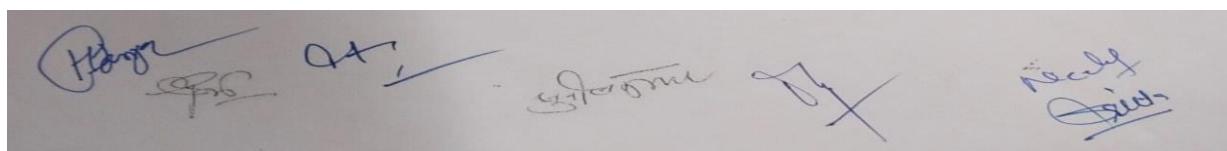
### **Immunology and Medical Microbiology**

**(15 Hours)**

1. Interferons, interferon like substances and vaccines.
2. Oncogenes.
3. Tissue organ transplantation.
4. Mechanism of drug resistance in microorganisms.

### **Suggested Readings**

1. Jay, J.M. 1987. Modern Food Microbiology. CBS Publishers and Distributors, New Delhi.
2. Casida, L.E. 1968. Industrial Microbiology. Wiley & Mo Millan Publishers.
3. Joshi, K R. and Osamo; N.O. 1992. Immunology, Agrobotanical publishers (India) Bikaner.
4. Walker, J. M. and Gun gold, E.B. Molecular Biology and Biotechnology. Royal Society of Chemistry, Cambridge., 1990.
5. Kumar, H.D. A text Book of Biotechnology. East West Pvt Ltd, New Delhi, 1993.
6. Kuby, J. Limmunology. W.H. Freeman and Company, New Delhi.
7. Frazier, W.C. and Wsthoff, D.C. Food microbiology Company ltd. New Delhi, 1995.



## WOOD SCIENCE, FOREST BIODIVERSITY AND PLANT RESOURCES

PhDBT-104(iv)

Credit: 4

MM: 100

L(4): T(0): P(0)

60 Hours

### Course objectives:

- i To understand the anatomical and physical properties of various wood species.
- ii To explore wood processing techniques and their applications.
- iii To promote sustainable practices in wood production and evaluate advancements in wood-based materials

### Course learning outcomes:

- i Students will be able to understand the structure and properties of different wood types.
- ii Understanding of economic and medicinal uses of plants and sustainable cultivation techniques.
- iii Learning the wood processing techniques and to evaluate their impacts on wood quality

### NOTE: Instructions for setting question paper

The examiner will set **nine** questions in total covering the entire syllabus. However, there will be **one compulsory** question containing twenty parts [One mark each], besides two questions from each of the four Units. The students will attempt **five questions** in total by selecting one question from each unit and the compulsory question. All questions shall carry equal marks (20 marks each).

### Course Content

#### Unit-1

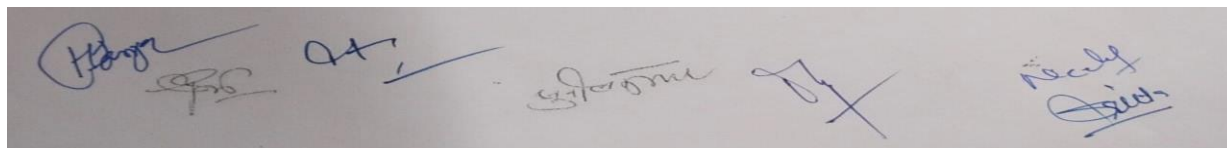
(15 Hours)

1. General Characteristics and Anatomical Features of Normal and Compression Wood of Gymnosperms
2. General Characteristics and Anatomical Features of Normal and Tension Wood of Angiosperms
3. Differences between Manoxylic and Pycnoxylic Woods; normal and Polyxylic Woods; Sapwood and Heartwood; Stored and Non stored Woods; Porous and Non porous Woods; Ring porous and Diffuse porous Woods; and between Compression Wood and Tension Wood.

#### Unit-2

(15 Hours)

1. Some important physical properties of woods namely moisture content, specific gravity, wood density and fuel value of wood.
2. A general account of the properties of wood in relation to its structure.
3. Wild Plant Resources: A LIST of economically important wild plants of Himachal Pradesh



(Emphasis is not to be placed on the study of individual plants).

**Unit-3**

**(15 Hours)**

1. Plant Resources for Pulp and Paper: A general account of plant fibers with particular reference to the effect of fibro morphology, chemical composition and wood properties on pulp and paper.
2. Plant Resources for the Sericulture: A LIST of important food plants of mulberry, tassar, oak tassar, eri, muga and wild silkworms (Emphasis is not to be placed on the study of individual plants). Status of sericulture industry in Himachal Pradesh.
3. Causes and Remedies for the Loss of Forest Genetic Materials.

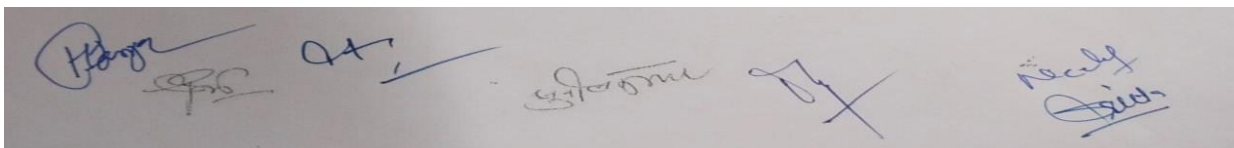
**Unit-4**

**(15 Hours)**

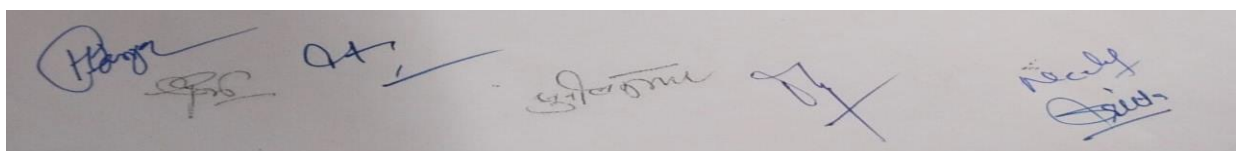
1. Phytogeography and Biodiversity: A general concept of phytogeography and biodiversity; an outline of the classification of the types of climatic zones, vegetation zones and forest types of India with particular reference to Himalayas and Himachal Pradesh (DETAILS ARE NOT REQUIRED AT THE LEVEL OF INDIA, BUT ONLY AT THE LEVEL OF HIMACHAL PRADBSH).
2. Conservation through law: A LIST of important acts and bills passed with reference to Environment, Forest, Wild Life, Biodiversity, Conservation and Patents in India and Himachal Pradesh.
3. Legal provisions regarding duties of the State and Citizens to protect the Environment. Sovereign Rights and Intellectual Property Rights.

**Suggested Readings**

1. Agrawal, H.O. and Seth, M.K. 2000. Sericulture in India. Vols. I-IV. Bishem Singh Mahendra Pal Singh, Dehradun, 984 pp.
2. Bawa, R and Khosla, P.K. 1998. Biodiversity of Forest Species (A Community Forestry Approach): Bishem Singh Mahendra Pal Singh, Dclradud, 218pp.
3. Carlquist, S.1988. Comparalivo Wood Anatomy-Systematic, Ecological and Evolutionary Aspects of Dicotyledonous Woods. Sprrioger Verlog, BerlIn.
4. Dhar,U (Ed). 1993. Himalayan Biodiversity. Him Vikas Publication No.3, Gyanodya Prakashan, Nainital, 543pp.
5. Hoywood,V.H. and Watson, R.T. 1995. Global Biodiversity Assessment, UNEP, Cambridge University Press, Cambridge, U.K.
6. Jane, F.W. 1970. The Structure of Wood. Adan and Charles Blanck, London.



7. Kothari, A 1997. Understanding Biodiversity: Life Sustainability and Equity. Orient Longman
8. Krattiger, A.F. et al. (Eds.). 1994. Widening Perspectives on Biodiversity. Natraj Publishers, Dehradun, 473pp.
9. Nair, M.N.B. 1998. Wood Anatomy and Major Uses of Woods. Faculty of Forestry University Malaysia, 434 PM Serdang, Selangor, Malaysia.
10. Nair, M.N.B. et al. (Eds.) 1998. Sustainable Management of Nonwood Forest Products. Faculty, Universiti Putra Malaysia, 434004 PM Serdang, Selangor, Malaysia
11. Panshin, A.J. and de Zeeuw, C. Textbook of Wood Technology. Vol. I. McGraw Hill Book Co., New York.
12. Rao, R.R. 1994. Biodiversity in India (Floristic Aspect). Bishen Singh Mahendra Pal Singh, Dehradun, 31pp.
13. Seth, M.K. 2002. Trees and Their Economic Importance.
14. Timell, T.E. 1986. Compression Wood in Gymnosperms, Vols. I-III. Springer-Verlag, Tokyo.



## ADVANCES IN PLANT PHYSIOLOGY

PhDBT-104(v)

Credit: 4 MM: 100

L(4): T(0): P(0)

60 Hours

### Course objectives:

- i To understand the physiological effects and mechanisms of action of different plant growth regulators and elicitors.
- ii To have a comprehensive understanding of biotic and abiotic plant stresses and plant's responses and tolerance mechanisms to mitigate them.
- iii To gain a pervasive knowledge about the impacts of heavy metal toxicity on plants and mechanisms of metal tolerance.

### Course learning outcomes:

- i Students will be able to understand the effects of plant growth regulators and elicitors on plant physiology and development.
- ii the detailed mechanism of nitrogen fixation and intricate regulation of transcription and translation, focusing on key enzymes and regulatory proteins.
- iii the complexities of signal transduction pathways in plant cells, covering receptors, secondary messengers, and subsequent cellular responses.
- iv the physiological and molecular responses of plants to various abiotic stresses, supported by recent research findings.
- v understanding of how plants manage heavy metal toxicity through detoxification mechanisms, enhancing their grasp of plant resilience strategies in challenging environments.

### NOTE: Instructions for setting question paper

The examiner will **set nine** questions in total covering the entire syllabus. However, there will be **one compulsory** question containing twenty parts [One mark each], besides two questions from each of the four Units. The students will attempt **five questions** in total by selecting one question from each unit and the compulsory question. All questions shall carry equal marks (20 marks each).

### Course Content

#### Plant Growth Regulators and Inhibitors

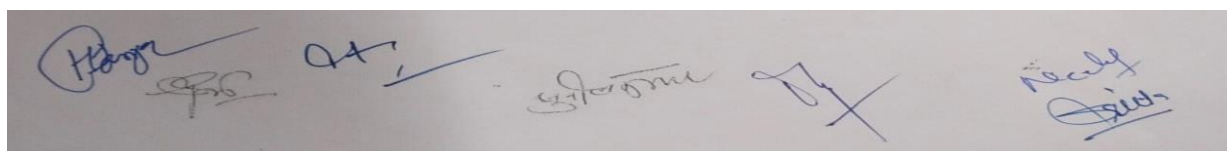
(20 Hours)

Auxins- Structure, activity, metabolism, IAA transport, mechanism of rapid and long-term responses, synthetic auxins - application in agriculture and horticulture.

Gibberellins- Structure, activity, biosynthesis, molecular mechanism of amylase induction in aleurone tissue.

Abscisic acid- Structure, biosynthetic pathways, catabolism and conjugation, mechanism of action of rapid responses (stomatal closure) including the role of calcium ions as second messenger and of long-term responses; role of ABA in drought tolerance and in the regulation of seed germination and dormancy- evidences from mutants.

Physiological effects and mechanism of action of ethylene, polyamines, brassinosteroids,



jasmonic acid, salicylic acid and phenolics.

**Nitrogen Fixation and Protein Synthesis**

**(10 Hours)**

Range of nitrogen fixing organisms, molecular mechanism of nitrogen fixation, protein synthesis - transcription and translation.

**Signal Transduction**

**(15 Hours)**

Overview, receptors and G- proteins, phospholipid signalling, role of cyclic nucleotides, calcium-calmodulin cascade, diversity in protein kinases and phosphatases, sucrose-sensing mechanism.

**Stress Physiology and Heavy Metals**

**(15 Hours)**

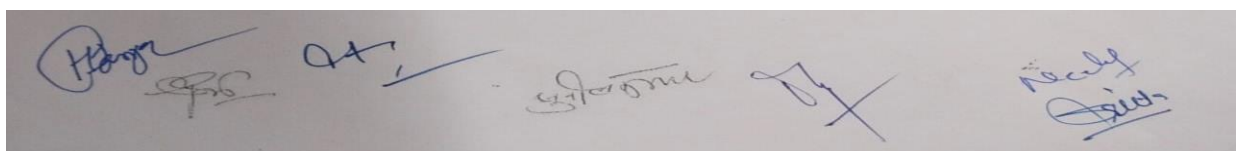
Concept of biological stress and strain; plant responses to abiotic stresses, mechanisms of abiotic stress tolerance - water deficit and drought resistance, salinity stress, freezing and heat stress, oxidative stress.

Toxicity; detoxification methods, phytochelatins and related peptides- their structure, synthesis and role in metal tolerance.

**Suggested Readings**

1. Annual Reviews of Plant Physiology
2. Annual Reviews of Biochemistry
3. Buchanan, B.B., Gruissem, W. and Jones, RL. 2003. Biochemistry and Molecular Biology of plants. American Society of Plant Physiologists, Maryland, USA.
4. Leopold A C. Plant growth and Development S. Levitt, J. Responses of plants of environmental stresses, Academic Press, N.Y. G. Moore, T.C. 1989. Biochemistry and physiology of plant hormones (2ed ed), Springer-Verlag, New York, USA
7. Paleg, L.G. & Aspinall, D. 1981. Physiology and Biochemistry of drought resistance in plants. Academic press, N.Y.
8. Purohit, S.S. (ed.). Hormonal regulation of plant growth and development vol I- IV, Agro Botanical Publ. India.
9. Singh, R & Sawhney, S.K. Advances in frontier areas of plant biochemistry, Prentice Hall, India
10. Teiz, L. & Zeiger, E. 1998. Plant Physiology (2" ed.). Sinauer Associates Inc. Publishers, Massachussetts, USA.
11. Wilkins, M.B. (ed.) 1984. Advanced Plant Physiology. ELBS, Longman, UK.

**ADVANCES IN BIODIVERSITY, BIOPROSPECTING, ETHNOBOTANY AND**



## SUSTAINABLE UTILIZATION OF PLANT RESOURCES

PhDBT-104(vi)

Credit: 4

MM: 100

L(4): T(0): P(0)

60 Hours

### Course objectives:

- i To get an insight into ethnobotany and its interdisciplinary approaches.
- ii To study various ethnic groups of India and their dependance on plants.
- iii To make students understand the role of ethnobotany in healthcare management, biodiversity conservation and economic growth of local societies.

### Course learning outcomes:

- i Students will be to develop understanding about ethnobotany, biodiversity and sustainable development.
- ii Students will be able to collect data from the field by using appropriate methodology.

### NOTE: Instructions for setting question paper

The examiner will **set nine** questions in total covering the entire syllabus. However, there will be **one compulsory** question containing twenty parts [One mark each], besides two questions from each of the four Units. The students will attempt **five questions** in total by selecting one question from each unit and the compulsory question. All questions shall carry equal marks (20 marks each).

### Course Content

#### Unit-1 (15 Hours)

1. Ethnobotany
2. Definition; What makes a good ethnobotanist?
3. Its scope and various subdisciplines
4. Interdisciplinary approaches in ethnobotany

#### Unit-2 (15 Hours)

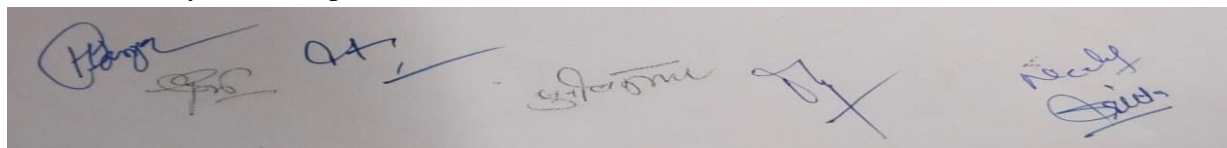
1. Ethnobotany: mindsets, externalities and challenges
2. Ethnic groups of India: distinctive features of the various tribes
3. Ethnoagriculture: Use of plants by tribals as food and fodder
4. Etnobotany in Modem India

#### Unit-3 (15 Hours)

1. Traditional Phytochemistry
2. Plants in folk religion and mythology
3. Plants in material culture

#### Unit-4 (15 Hours)

1. Ethnobotany in development and conservation of resources





2. Biodiversity Hot Spots
3. Role of satellites in the mapping of plant resources
4. Information systems and databases for the conservation of medicinal Plants.

### **Suggested Readings**

Baker, H.G. 1978. Plant and Civilization. Wadsworth, Belmont.

Chrispoels, M. J. & Sadaya, D. 1977. Plants, Food and People. Freeman, San Francisco

Frankel, O. H, Brown, AHD. & Burden, J. J. 1995. The Conservation of plant diversity. Cambridge Univ. Press, Cambridge.

Gadgil, M. & Guha, R. 1996. Ecology and Equity: Use and abuse of nature in Contemporary India Penguin, New Delhi.

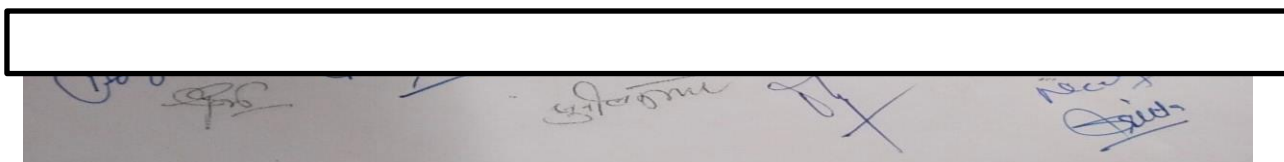
Pimentel, D. & Hall, C. W. (eds.) 1989. Food and Natural Resources. Acad. Press

Schery, R. W.1972. Plants for Man. Englewood, Prentice Hall.

Sood, S.K., Kumar, S. and Lakhanpal T.N. Sacred Plants for Sustenance of Mankind. Daya Publishing House.

Walter, KS. & Gillett, H.J. 1998. IUCN. Red List of Threatened Plants. IUCN, the World Conservation Union, Switzerland, U.K.

## **PHYTOCHEMISTRY AND PALYNOLOGY**



**Course objectives:**

- i To understand the classification of phytochemical constituents and their chemical screening methods.
- ii To identify and isolate similar Bio-active compounds from plants
- iii To identify and describe the structures, functions, and types of pollen and spores, and understand their ecological and evolutionary significance.
- iv To demonstrate proficiency in collecting, processing, and analyzing pollen and spore samples using various microscopic and analytical techniques.

**Course learning outcomes:**

- i Students will be able to select the correct and efficient method of screening of chemical content of plants.
- ii Identify Phytopharmaceuticals.
- iii Isolate and purify Phytopharmaceuticals.
- iv Basic knowledge of pollen structure and utility of biostatistical methods.
- v Design and execute experiments or field studies related to pollen and spore analysis, and interpret the resulting data.

**NOTE: Instructions for setting question paper**

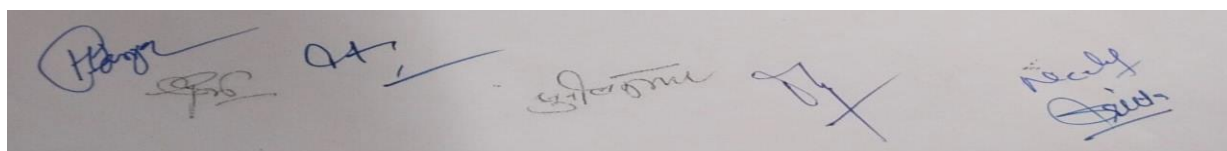
The examiner will set **nine** questions in total covering the entire syllabus. However, there will be **one compulsory** question containing twenty parts [One mark each], besides two questions from each of the four Units. The students will attempt **five questions** in total by selecting one question from each unit and the compulsory question. All questions shall carry equal marks (20 marks each).

**Course Content****Phytochemistry****(15 Hours)**

1. Introduction to phytochemistry, a brief history of modern phytochemistry, the relation of phytochemistry with other sciences. Skills and expertise required for a phytochemistry. Computer-aided phytochemical studies.
2. Classification of phytochemicals, sources of phytochemicals, biological effect of phytochemicals, and function of phytochemicals in living organisms.
3. Major group of phytochemicals sources, pharmaceutical, and medicinal importance: Alkaloids, Terpenoid, Coumarins, Flavonoids, and Steroids.

**Biosynthetic Pathways and Techniques****(15 Hours)**

1. Pathways of commercially important phytochemicals: Forskololn, Taxol, Vincristin, and vinblastine.



2. Techniques involved in the isolation of biomolecules/ phytochemicals of medicinal importance, Solvent extraction, chemical separation, Steam distillation, soxhlet extraction, Chromatography, HPLC, TLC and UV.

### **Palynology: Pollen Morphology and Pollen Chemistry**

**(15 Hours)**

1. Palynology: Definition, its branches, scope and its application in agriculture taxonomy and forensic science. Application of Indian work on Palynology, Palynology center in India, and scopes of palynology.
2. Spore-pollen morphology: Symmetry, shape, size, aperture patterns, NPC system for numerical expression of apertural details, exine stratification, surface structures and sculptures of sporoderm; LO-analysis and edge-analysis.
3. Pollen Chemistry: Introduction, Chemical constituents of pollen (including carbohydrates, mineral contents, organic acid, pigments, vitamins etc.), Chemistry of pollen wall (sporopollenin, pollen wall proteins, origin of pollen wall proteins).

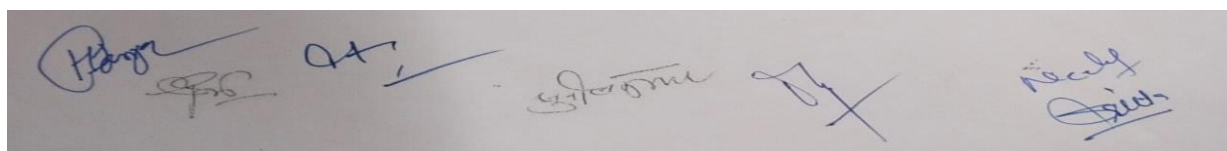
### **Palynotaxonomy, Aeropalynology and Melissopalynology**

**(15 Hours)**

1. Palynotaxonomy: Systematic palynology, and evolutionary trends among pollen grains based on palynotaxonomical work.
2. Aeropalynology: Define aeropalynology, Methods of trapping air-borne pollen grains.
3. Pollen allergy: Some important pollen allergic diseases and their symptoms. List of some plants showing allergic pollen grains. Mechanism of Allergic Hypersensitivity type -1 caused by pollens. Pollen calendar.
4. Melissopalynology: Introduction, Honey, Types of Honey, How honey is produced, chemical characteristics of honey, color aroma, and flavor of honey. Honey bees, Bee pasturage, Bee products, Granulation in honey, Pollen grains in honey, Physical characteristics of honey, and Adulation in honey.

### **Suggested Readings:**

- Erdltman, G. (1952). Pollen Morphology and Plant Taxonomy, Angiosperms. Almquist and Wiksell, Stockholm.
- Maheshwari, P. (1950). An Introduction to the Embryology of Angiosperms.
- Heslop-Harisson, J. (1971). Pollen Development and Physiology.
- Shivanna, K.R. (2003). Pollen Biology and Biotechnology
- Nayar, T.S. (1990). Pollen Flora of Maharashtra State, India.



- Thanikaimoni, G. (1970). Mangrove Palynology.
- Nair, P.K.K. (1970). Pollen Morphology of Angiosperms.
- Bhattacharya, K. (2006). A Text Book of Palynology.
- Hutchinson, J. (1973). The Families of Flowering Plants 2 Vols. Oxford University Press, Oxford.
- Takhtajan, A.L. (1997). Diversity and Classification of Lowering Plants. Columbia University Press, New York.
- Bhojwani, S.S. and Bhatnagar, S.P. (2000). The Embryology of Angiosperms. Vikas Publ. House, New Delhi.
- Shivanna, K.R. and Sawhney, V.K. (1997). Pollen Biotechnology for Crop Production and Improvement. Cambridge Univ. Press.
- Buchanan, B.B. Greuisssem, W. and Jones, R.L. (2000). Biochemistry and Molecular Biology of plants.
- Robinson, T. (1968). The Biochemistry of Alkaloids. Springer Verlag, Berlin.
- Heywood, V.H. and Watson, R.T. (1995). Global Biodiversity Assessment. Paroda.
- Frankel, O.H. Brown, A.D.H. and Burdon, J.J. (1995). The Conservation of Plant Diversity.
- Perry, D.A. (1994). Forest Ecosystems.

