# Mangalore University

## M.Sc. BOTANY (CBCS)

### Course pattern and scheme of Examination

| I Semester | | | | | | | |
|---|---|---|---|---|---|---|---|
| Code | Title of the Course | Instruction hrs/ week | Duration of Exam (hrs) | Marks | | | Credits |
| | | | | IA | Exam | Total | |
| **Hard Core** | | | | | | | |
| BOH401 | Plant Morphology and Taxonomy- I | 4 | 3 | 30 | 70 | 100 | 4 |
| BOH402 | Plant Biochemistry | 4 | 3 | 30 | 70 | 100 | 4 |
| BOH403 | Microbiology | 4 | 3 | 30 | 70 | 100 | 4 |
| BOP404 | Plant Morphology and Taxonomy - Lab- I | 4 | 3 | 30 | 70 | 100 | 2 |
| BOP405 | Plant Biochemistry - Lab | 4 | 3 | 30 | 70 | 100 | 2 |
| BOP406 | Microbiology - Lab | 4 | 3 | 30 | 70 | 100 | 2 |
| **Soft Core** | | | | | | | |
| | **One Course to be selected by the student** | 4 | 3 | 30 | 70 | 100 | 3 |
| BOS407 | Plant Pathology | | | | | | |
| BOS408 | Plant Microbe interaction | | | | | | |
| BOS409 | Anatomy & Histochemistry | | | | | | |
| | ***to be selected by the student** | 4 | 3 | 30 | 70 | 100 | 2 |
| BOP410 | Plant Pathology - Lab | | | | | | |
| BOP411 | Plant Microbe interaction - Lab | | | | | | |
| BOP412 | Anatomy & Histochemistry - Lab | | | | | | |
| | Total | | | | | 800 | 23 |

| II Semester | | | | | | | |
|---|---|---|---|---|---|---|---|
| Code | Title of the Course | Instruction hrs/ week | Duration of Exam (hrs) | Marks | | | Credits |
| | | | | IA | Exam | Total | |
| **Hard Core** | | | | | | | |
| BOH451 | Plant Morphology and Taxonomy- II | 4 | 3 | 30 | 70 | 100 | 4 |
| BOH452 | Plant Physiology | 4 | 3 | 30 | 70 | 100 | 4 |
| BOP453 | Plant Morphology and Taxonomy - Lab- II | 4 | 3 | 30 | 70 | 100 | 2 |
| BOP454 | Plant Physiology - Lab | 4 | 3 | 30 | 70 | 100 | 2 |
| **Soft Core** | | | | | | | |
| | **Two Courses to be selected by the student** | 4x2 | 3 each | 30x2 | 70x2 | 100x2 =200 | 3x2=6 |
| BOS455 | Molecular plant pathology | | | | | | |
| BOS456 | Applied Microbiology | | | | | | |
| BOS457 | Ethnobotany & IPR | | | | | | |
| BOS458 | Reproductive biology of Angiosperms and Plant Morphogensis | | | | | | |
| | ***to be selected by the student** | 4x2 | 3x2 | 30x2 | 70x2 | 100x2 =200 | 2x2=4 |
| BOP459 | Molecular plant pathology - Lab | | | | | | |
| BOP460 | Applied Microbiology - Lab | | | | | | |
| BOP461 | Ethnobotany & IPR - Lab | | | | | | |
| BOP462 | Reproductive biology of Angiosperms and Plant Morphogensis - Lab | | | | | | |
| **Open Elective** | | | | | | | |
| BOE463 | Medicinal Plants | 4 | - | - | - | 100 | 3 |
| | Total | | | | | 900 | 25 |

| III Semester | | | | | | | |
|---|---|---|---|---|---|---|---|
| Code | Title of the Course | Instruction hrs/ week | Duration of Exam (hrs) | Marks | | | Credits |
| | | | | IA | Exam | Total | |
| **Hard Core** | | | | | | | |
| BOH501 | Plant Ecology & Environment | 4 | 3 | 30 | 70 | 100 | 4 |
| BOH502 | Cytogenetics and Molecular Biology | 4 | 3 | 30 | 70 | 100 | 4 |
| BOP503 | Plant Ecology & Environment - Lab | 4 | 3 | 30 | 70 | 100 | 2 |
| BOP504 | Cytogenetics and Molecular Biology - Lab | 4 | 3 | 30 | 70 | 100 | 2 |
| **Soft Core** | | | | | | | |
| | **Two Courses to be selected by the student** | 4x2 | 3 each | 30x2 | 70x2 | 100x2 =200 | 3x2=6 |
| BOS505 | Plant Tissue Culture | | | | | | |
| BOS506 | Seed Technology | | | | | | |
| BOS507 | Economic Botany | | | | | | |
| BOS508 | Phytochemical methods | | | | | | |
| | ***to be selected by the student** | 4x2 | 3x2 | 30x2 | 70x2 | 100x2 =200 | 2x2=4 |
| BOP509 | Plant Tissue Culture Lab | | | | | | |
| BOP510 | Seed Technology - Lab | | | | | | |
| BOP511 | Economic Botany - Lab | | | | | | |
| BOP512 | Phytochemical methods - Lab | | | | | | |
| **Open Elective** | | | | | | | |
| BOE513 | Plant Propagation | 4 | - | - | - | 100 | 3 |
| | Total | | | | | 900 | 25 |

| IV semester | | | | | | | |
|---|---|---|---|---|---|---|---|
| Code | Title of the Course | Instruction hrs/ week | Duration of Exam (hrs) | Marks | | | Credits |
| | | | | IA | Exam | Total | |
| **Hard Core** | | | | | | | |
| BOH551 | Plant Breeding | 4 | 3 | 30 | 70 | 100 | 4 |
| BOH552 | Plant Biotechnology | 4 | 3 | 30 | 70 | 100 | 4 |
| BOP553 | ***Project work | 4 | - | 30 | 70 | 100 | 4 |
| BOP554 | Plant Breeding - Lab | 4 | 3 | 30 | 70 | 100 | 2 |
| BOP555 | Plant Biotechnology - Lab | 4 | 3 | 30 | 70 | 100 | 2 |
| **Soft Core** | | | | | | | |
| | **One Course to be selected by the student** | 4 | 3 | 30 | 70 | 100 | 3 |
| BOS556 | Post Harvest Technology | | | | | | |
| BOS557 | Biodiversity & conservation | | | | | | |
| | Total | | | | | 600 | 19 |

*Practicals of the respective subject chosen by the student.

Soft core papers will be offered depending on the expertise available in the Department.
IA for theory will be based on two tests and one seminar.

IA for practicals will be based on the class records and one practical test.

## MANGALORE UNIVERSITY

## M.Sc., BOTANY (CBCS)

| Course Code | Title of the Course | HC/SC/E/P | Hrs | credits |
|---|---|---|---|---|
| BOH401 | Plant Morphology and Taxonomy- I | HC | 4 | 4 |
| BOH402 | Plant Biochemistry | HC | 4 | 4 |
| BOH403 | Microbiology | HC | 4 | 4 |
| BOP404 | Plant Morphology and Taxonomy - Lab- I | HC | 4 | 2 |
| BOP405 | Plant Biochemistry - Lab | HC | 4 | 2 |
| BOP406 | Microbiology - Lab | HC | 4 | 2 |
| | **One Course to be selected by the student** | SC | 4 | 3 |
| BOS407 | Plant Pathology | | | |
| BOS408 | Plant Microbe interaction | | | |
| BOS409 | Anatomy & Histochemistry | | | |
| | ***to be selected by the student** | SC | 4 | 2 |
| BOP410 | Plant Pathology - Lab | | | |
| BOP411 | Plant Microbe interaction - Lab | | | |
| BOP412 | Anatomy & Histochemistry - Lab | | | |
| BOH451 | Plant Morphology and Taxonomy- II | HC | 4 | 4 |
| BOH452 | Plant Physiology | HC | 4 | 4 |
| BOP453 | Plant Morphology and Taxonomy - Lab- II | HC | 4 | 2 |
| BOP454 | Plant Physiology - Lab | HC | 4 | 2 |
| | **Two Course to be selected by the student** | SC | 4x2 | 3x2=6 |
| BOS455 | Molecular plant pathology | | | |
| BOS456 | Applied Microbiology | | | |
| BOS457 | Ethnobotany & IPR | | | |
| BOS458 | Reproductive biology of Angiosperms and Plant Morphogensis | | | |
| | ***to be selected by the student** | SC | 4x2 | 2x2=4 |
| BOP459 | Molecular plant pathology - Lab | | | |
| BOP460 | Applied Microbiology - Lab | | | |
| BOP461 | Ethnobotany & IPR - Lab | | | |
| BOP462 | Reproductive biology of Angiosperms and Plant Morphogensis - Lab | | | |

| | | | | |
|---|---|---|---|---|
| BOE463 | Medicinal Plants | E | 4 | 3 |
| BOH501 | Plant Ecology & Environment | HC | 4 | 4 |
| BOH502 | Cytogenetics and Molecular Biology | HC | 4 | 4 |
| BOP503 | Plant Ecology & Environment - Lab | HC | 4 | 2 |
| BOP504 | Cytogenetics and Molecular Biology - Lab | HC | 4 | 2 |
| | **Two Course to be selected by the student** | SC | 4x2 | 3x2=6 |
| BOS505 | Plant Tissue Culture | | | |
| BOS506 | Seed Technology | | | |
| BOS507 | Economic Botany | | | |
| BOS508 | Phytochemical methods | | | |
| | ***to be selected by the student** | SC | 4x2 | 2x2=4 |
| BOP509 | Plant Tissue Culture - Lab | | | |
| BOP510 | Seed Technology - Lab | | | |
| BOP511 | Economic Botany - Lab | | | |
| BOP512 | Phytochemical methods - Lab | | | |
| BOE513 | Plant Propagation | E | 4 | 3 |
| BOH551 | Plant Breeding | HC | 4 | 4 |
| BOH552 | Plant Biotechnology | HC | 4 | 4 |
| BOP553 | ***Project work | P | 4 | 4 |
| BOP554 | Plant Breeding - Lab | HC | 4 | 2 |
| BOP555 | Plant Biotechnology - Lab | HC | 4 | 2 |
| | **One Course to be selected by the student** | SC | 4 | 3 |
| BOS556 | Post Harvest Technology | | | |
| BOS557 | Biodiversity & conservation | | | |

*Practicals of the respective subject chosen by the student

Soft core papers will be offered depending on the expertise available in the Department
IA for theory will be based on two tests and one seminar

IA for practicals will be based on the class records and one practical test

**MANGALORE UNIVERSITY**

**DEPARTMENT OF BOTANY**

## Scheme for M.Sc., CBCS Course

| Semester | No. of Courses | Hard core | | | | Soft core | | | | Open elective | | Total credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Theory | | Practicals | | Theory | | Practicals | | Theory | | |
| | | Hrs | Credits | Hrs | Credits | Hrs | Credits | Hrs | Credits | Hrs | Credits | |
| I | 4 | 4 | 4x3=12 | 4 | 2x3=6 | 3 | 3x1=3 | 4 | 2x1=2 | - | - | 23 |
| II | 5 | 4 | 4x2=8 | 4 | 2x2=4 | 3 | 3x2=6 | 4 | 2x2=4 | 3 | 3 | 25 |
| III | 5 | 4 | 4x2=8 | 4 | 2x2=4 | 3 | 3x2=6 | 4 | 2x2=4 | 3 | 3 | 25 |
| IV | 4 | 4 | 4x2=8<br>4x1=4* | 4 | 2x2=4 | | 3x1=3 | | - | - | - | 19 |

* **Project work**

HC credits - 58 63%
SC credits - 28 30%
Open elective - 06 7%
92

**Program outcome**

The syllabus covers all aspects of the subject. Syllabus is a good blend of classical topics and recent topics which are applied in nature. This helps the students to know how the subject has developed. The early topics mainly relate to the diversity of different groups of plants and helps in understanding their life cycle and uses. This forms the base of the subject and helps in largely understanding the diversity of plants. The remaining topics deal with the functional aspects and also in manipulating these organisms to our benefit.

**Program specific outcome:**

- The course includes detailed study on the major groups of life forms from algae to angiosperms
- Paper on morphology and taxonomy is spread over two semesters to give a comprehensive coverage particularly of angiosperm families
- Even in practicals on taxonomy students are trained in the proper identification of plants using relevant literature. This is done for other plant groups also to the extent possible
- The course has a special emphasis on biodiversity and conservation
- Students have an advantage of a unique botanical garden (Arboretum) of endemic tree species of the Western Ghats in the campus
- Other courses like seed technology, post harvest technology, cytogenetics, plant breeding, biotechnology can help them in getting employed and choosing avenues for higher studies

## SEMESTER I

### BOH401- PLANT MORPHOLOGY AND TAXONOMY – I

**Teaching Hours: 10/Unit**

**Course outcome:**

- Students will know the diversity of algae, bryophytes and the polypetalous angiosperms.
- Various aspects like their habitat requirement, richness of the diversity, present status are included.
- Also, the economic use of these various plant categories are given.
- This forms the foundation for the course.

**Unit I:**
Algae: Study of different kinds of classifications - thallus organisation, Life cycle pattern and general reproductive biology of Cyanophyceae, Chlorophyceae, Phaeophyceae, Xanthophyceae, and Rhodophyceae; Fossil algal records; economic importance.

**Unit II:**
Bryophyta: Study of different kinds of classifications, Life cycle patterns andreproductive biology ofHepaticae, Anthocerotae and Musci. Ecological and economic use of Bryophytes.Evolution of land plants and significance of bryophytes.

**Unit III:**
Brief history of development of plant taxonomy: Brief history of taxonomic studies in India. Contributions of Van Rheede, William Roxburgh, NatithanielWallich, Robert Wight, J.D. Hooker, R.H. Beddome and George Watt.Organisation and functioning of the Botanical Survey of India of pre and post independent India.Taxonomic tools - Herbarium : methodology and its significance; Floras, Revisionary studies and Monographs: Keys - indented and bracketed keys.

**Unit IV:**
Botanical nomenclature: Principles; typification (type method); priority; ranks of taxa and nomenclature of taxa; effective and valid publication; citation; retention, choice and rejection of names and epithets; conservation of names (nominaconservanda).

Systems of classification : Concept of Artificial, Natural and phylogenetic systems of classification - study of Bentham & Hooker's system and Hutchinson's system of classification. (Reference to other systems of classification may be made whenever relevant while treating the families). Brief account of APG system.

**Unit V:**
The study of the following families with their phylogeny as per Bentham & Hooker's system:
Magnoliaceae,Annonaceae, Menispermaceae,Nymphaeaceae, Capparidaceae, Caryophyllaceae, Clusiaceae, Dipterocarpaceae, Oxalidaceae, Balsaminaceae, Meliaceae, Rhamnaceae, Vitaceae, Leeaceae, Sapindaceae,Leguminosae, Rosaceae, Droseraceae, Rhizophoraceae, Combretaceae, Melastomataceae, Lythraceae, Passifloraceae, Cucurbitaceae, Cactaceae.

**Suggested Reading**


Armen Takhtajan. 1969. Flowering plants - Origin and Dispersal. Oliver and Boyd Ltd. Tweeddale Court, Edinburgh, pp. 310.

Bennet, S.S.R. 1979. An Introduction to Plant nomenclature. International Book Distributors. 9/3. Rajpur Road, Dehra Dun 248001. India.

Bhargava M., 2003. Algae 1st Ed, Dominant Publisher, New Delhi.

Davis, P.H., V.H. Heywood. 1963. Principles of Angiosperm Taxonomy. Oliver and Boyd Ltd., Tweeddale Court, Edinburgh.

Heywood V.H., 1976. Botanical Systematics, Academic Press London.

Hock. C.V.D., D.G. Mann & H.M. Jalms. 1993. Algae - an introduction to phycology, Cambridge University Press.

Hutchinson. J. 1973. The Families of Flowering Plants. Oxford University Press, Elky House, London. W.I., pp. 968.

Lawrence, H.M. 1966. Taxonomy of Vascular Plants. TheMacMillonCompany. New York, pp. 823.

Robert Edward Lee 1989. Phycology II End. Cambridge University Press.

Singh S.K., 2006. Text Book of Bryophyta 1st Ed, Campus Book International Publishe,rNew Delhi.

Sivarajan V.V., 1985. Introduction to Principle of Plant Taxonomy, Oxford and IBH Publication, New Delhi.

## BOH402 -PLANT BIOCHEMISTRY

**Teaching Hours: 10/Unit**

**Course outcome:**

- Deals with the functional aspects of plants.
- Get to know the biochemical aspect of the various life processes at cellular levels.
- This course is a prerequisite to other courses like cytogenetics, molecular biology, microbiology, biotechnology, drug development etc.
- The course has a lot of potential for further higher studies

**Unit I**

Membranes : structure, chemical composition, models, transport processes - passive, active, bulk transport.
Plant enzymes - classification, kinetics and mechanism of action.

**Unit II**

Respiration: mitochondrial structures, Carbohydrate bio synthesis, classification, structure and metabolism, glycolysis, HMP pathway, uronic acid pathway, T.C.A. Cycle, E.T.S. & oxidative phosphorylation; factors affecting respiration.

**Unit III**

Proteins and aminoacids: classification, structure - primary, secondary, tertiary and quarternary; biosynthesis and separation (aminoacid sequence, C-terminal, N-terminal, disulfide bonds).
Lipids: classification, structure, function and biosynthesis of fatty acids; Beta oxidation.
Nucleic acids: classification, structure, biosynthesis, functions and metabolism.

**Unit IV**

Vitamins - classification, distribution, structure, production, function.
Secondary plant products: structure, biosynthesis and distribution of terpenes, phenolics and nitrogen containing compounds.

**Unit V**

Nitrogen fixation and metabolism: Nitrogenase, nitrogen fixation, storage and transport.
Signal transduction: Receptors, proteins, phospholipid signalling, role of cyclic nucleotides, calcium - calmodulin cascade, protein kinases and phosphatases. Specific signalling mechanisms in Bacteria and Plants.

**Suggested Reading:**


Buchanan, B.B., Gruissem, W. and Jones, R.L. 2007. Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Maryland, USA.

Dennis, D.T., Turpin, D.H., Lefebvre, D.D. and Layzell, D.B. (eds) 1997. Plant Metabolism. Longman, Essex, England.

Dey P.M. and Harborne J. B., 2000. Plant Biochemistry. Academic press, USA.

Dryer, R.L. and Lata, G.F. 1989. Experimental Biochemistry. Oxford University Press, New York.

Godwin, T.W. and E.I. Mercer 1983. Introduction to Plant chemistry. Pergamon press. USA.

Heldt H.W. and Heldt. F., 2005. Plant Biochemistry, Academic press, California.

Lea, P.J. and R.C. Leegood, 1993. Plant Biochemistry and Molecular Biology, John Wiley and Sons. USA

Madigan M.T., Martinko T. M and Parker J., 2000. Brock Biology of Microorganisms 9th Ed, Prentice Hall international, Inc USA.

Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones. Springer-Verlag, New York, USA.

Nelson D.L. and Cox M.M., 2008. Lehninger: Principles of Biochemistry 5th Ed, W.H Freeman and Company, New York.

Purich D.L, and Allison R.D., 2002 .The Enzymes reference: Academic Press, New York.

Plummer, D.T. 1988. An Introduction to Practical Biochemistry. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.

Stryer L., Tymoczko L.J and Berg J.M., 2006. Biochemistry 6th Ed, W.H. Freeman and Company, New York.

Taiz, L. and Zeiger, E. 2003. Plant Physiology. Sinauer Associates, Inc., Publishers, Massachusetts. USA.

Voet D. Voet J. G. and Pratt C.W., 2006. Fundamentals of Biochemistry 2nd Ed, John Wiley and Sons Inc.

Wilson, K. and Walker, J. 1994. Practical Biochemistry: Principles and Techniques. Cambridge University Press, Cambridge,UK.

Wilson, K. and Goulding, K.H. (Eds), 1996. A Biologists Guide to Principles and Techniques of Practical Biochemistry. Edward Arnold, London, U.K.

## BOH403- MICROBIOLOGY

**Teaching Hours: 10/Unit**

**Course outcome:**

- Gives the basics of microbiology. There is a detailed study of the various major groups of microorganisms.
- Also, students study the processes like fermentation which has practical application in food industry and breweries
- The course also introduces students to the rich diversity of microorganisms like fungi which has a lot of research potential.

**Unit I:**

Introduction: Microbes in relation to other organisms; Microorganisms, their special characters and habitat.

History: Historical development of various fields of microbiology; contributions of early microbiologists like Antony Van Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner, Alexander Flemming, Ivanowski, Lord Lister, Lazzaro Spallanzani, Paul Ehrlich, Emil Christian Hansen and A.E. Mayer. Microscopy - Its principles and applications, Simple - Compound, Dark field, phase contrast, Fluorescent and Electron Microscopes - SEM, TEM, Principles.

**Unit II:**

Morphology and taxonomy: Major groups of microorganisms and their Classification, Nature, structure, reproduction and life-cycle of Bacteria, actinomycetes, Rickettsiae, Mycoplasma.

**Unit III:**

Protozoa, Nature, structure, replication and classification of viruses, classification of fungi, life-cycle of major groups of fungi; heterokaryosis and parasexual cycle.

**Unit IV:**

Bacterial metabolism: sources of energy and nutritional classification of microorganisms - Photolithotrophs, photoorganotrophs, chemolithotrops, Chemoorganotrophs. Aerobic and anaerobic respiration, Fermentation in yeast and bacteria.

**Unit V:**

Bacterial genetics: Mutation, Genetic recombination - Conjugation, transformation, transduction, gene mapping.

**Suggested Reading:**


Alexopoulus, C.J., Mims, C.W. and Blackwel, M. 1996. Introductory Mycology. John Wiley & Sons Inc.

Costa, M.S. Da Ed Microbiology of extreme environment & its potential for biotechnology – 1989.

Collee J.G., Applied Medical Microbiology - 2 edit – 1981.

Freifelder David - 1987. Microbial genetics.

Jacquelyn G. Black, Microbiology (Principles & Explanations) - 4th edition - 1999.

Larry McKane/Judy Kandel -1996. Microbiology (Essential & Appliances) - 2nd Edition.

Narendra, Microbes & Environment – 1994.

Powar & Daginawater. General Microbiology - Vol - I - eight edition - 1992 (Reprint - 2000).

Purohit S.S., Microbiology; fundamentals & applications (1991) 4 ed.

Stanier Roger Y. - 1993. General Microbiology - 5th ed.

Thomas D. Brock, Michael T. Madigan, 2000. Biology of Microorganisms - 6th edition.

Volk, Wesley. A. - 1984 Basic microbiology - 5 ed.
Dubey RC and Maheswari DK (2005). A text book of Microbiology, Revised Multicolour edition, S Chand Publishers, New Delhi

Purohit S.S.,(2005) Microbiology - fundamentals and Applications. Student Edition Publishers, Jodhpur.

Pelezar & Kreig (2006). Microbiology 5th edition. Tata McGraw Hill, New Delhi

Powar & daginawala (2005), General Microbiology Vol.I& II 8th Edition, Himalaya Publishing House, Mumbai

Salle, AJ (2001). Fundamentals & Principles of Bacteriology, 7th edition. Tata McGraw-Hill, Davis

## BOP404- PLANT MORPHOLOGY AND TAXONOMY - LAB - I

**Course outcome:**

- Introduces the methods of identification of algae and bryophytes using the identification manuals
- Students are trained in the method of identification of higher plants
- The field studies help them to appreciate the diversity and put the theoretical knowledge to practice
- Aim is to enable the students to identify the plants independently

Algae and Bryophytes: Study of morphology, anatomy and reproductive structures of the types represented by the groups mentioned in the syllabus. Study of fossils.

Taxonomy: Study of local flora. Study of the families listed in the theory part of the syllabus. Identification of plant specimens level using Gamble's flora. Validating the Botanical names using latest literature; herbarium methodologies; Field work, specimen collection, processing and identification.

Field work/ Study Tour.

## BOP405- PLANT BIOCHEMISTRY– LAB

**Course outcome:**

- Trains the students in basics of biochemical lab procedures
- Students will know to identify basic biochemical compound and certain aspects of enzyme kinetics
- Will be useful if students take up assignments in a chemical based company/industry

Reactions of carbohydrates.

Reactions of proteins &aminoacids.

Precipitation reactions of proteins.

Reactions of non protein nitrogenous substances(NPN).

Reactions of vitamins.

Identification of unknown proteins.

Identification of unknown carbohydrates.

General scheme for identification of unknown carbohydrates, proteins and Non Protein Nitrogenous(NPN) substances.

Estimation of total sugar.

Effect of time and enzyme concentration on the rate of reaction of an enzyme.

Effect of substrate concentration on the activity of an enzyme. Demonstration of the substrate inducibility of the enzyme nitrate reductase.

## BOP406- MICROBIOLOGY - LAB

**Course outcome:**

- Will be trained thoroughly for working in a microbiology lab
- They are trained on methods of sterilisation and handling of culture media
- A thorough training in mushroom cultivation is given. If perceived, can help in earning their livelihood

Introduction - good laboratory practices, sterilization methods, instrumentation.

Staining methods - Gram staining, staining of endospores

Determination of bacterial motility

Preparation of Media, Bacterial and Fungal cultures

Micrometry

Study of AM fungi

Mushroom - Spawn production and cultivation

## BOS407 - PLANT PATHOLOGY

**Teaching Hours: 9/Unit**

**Course outcome:**

- Syllabus has basics of plant pathogen interaction and some established examples of disease life cycles
- Students will be trained in identifying diseases based on symptoms caused by various groups of pathogens
- They will be familiar with the diseases of vegetables, cereals and plantation crops
- They will know the various control measures available for different plant diseases

**UNIT I**

History: History of plant pathology with reference to important diseases of crop plants. Plant diseases and World Crop production, Concept of plant diseases, Types of plant diseases, Identification of plant diseases: Koch's rules.

**UNIT II**

Seed borne diseases and Transmission: Pollination, fertilization, embryogenesis, morphology and physiology in relation to seed infection. Seed-borne pathogens and their importance - viruses, bacteria, fungi and nematodes; seed infection and contamination, seed to plant transmission, establishment of infection and course of disease; factors affecting establishment and course of disease - pathogenic, host, physico-chemical and biotic.

**UNIT III**

Important Plant diseases: General aspects of plant diseases caused by viruses, mycoplasma, bacteria, fungi, protozoa, nematodes, parasitic angiosperms - symptoms, etiology, life cycle, transmission etc., Non-parasitic diseases.

**UNIT IV**

Plant disease cycles, Epidemiology and Forcasting:
Plant disease cycles and Plant disease triangle, human and time factors.

Factors affecting plant disease epidemics, measurement, classification, pattern and development of epidemics, forecasting plant disease epidemics.

**UNIT V**

Host-parasite interactions: Pathogenic factors in disease development - Mechanism of penetration and establishment - prepenetration, penetration and infection phases; invasiveness - biotrophic and nectrotrophic pathogens; - production of enzymes, toxins - specific and non specific toxins and their role, growth regulator and polysaccharides; effect of infection on physiological functions of host, translocation of water and mineral nutrients, organic nutrients, respiration and permeability, transcription and translation.

**Suggested Reading:**


Ainsworth, G.C. 1981. Introduction to the history of Plant Pathology.

Agrios, N. 1997. Plant Pathology, Academic Press, NewYork.

Agnihotri, V.P., Sarbhay, A.K., Singh, D.V., 1997. Management of threatening plant diseases of National Importance.

Bedell P.E. (1998) Seed Science and and technology. New Delhi - Allied PP 346.

Callow, J.A., (Ed.) 1983. Biochemical plant pathology. John Wiley & Sons.

Chester, Starr, K., 1994. Arihant Plant diseases – Jaipur.

Dhingra, D. 1993. Basic Plant Pathology methods - Delhi CBS.

Fungal pathogenesis in plants and crops.
John A. Lucas - 3rd Ed. 1998. Plant Pathology & Plant Pathogens.

Mahadevan. A. Post infectional defence mechanisms - New Delhi (Today & Tomorrow, 1991).

Maude, R.B (1996) Seed borne diseases and their control. Wallingford: Cab International, Lowman PP 280.

Paul Neergaard (1988). Seed Pathology Vols. I & II. Published by the Macmillan Press Ltd. Houndmills. Basingstoke, Hampshire

Rangaswami, Mahadevan, A. 2001. Diseases of crop plants in India. Prentice Hall of India, Pvt. Ltd., New Delhi.

Singh, R.S. 1990. Plant diseases - 6th ed. New Delhi. Oxford & IBM.

Vidhyasekaran, P. 1997. Fungal Pathogenesis in plants and crops. (Molecular Biology and host Defense mechanisms), Marcel Dekker Inc.

Vidhyasekaran, P. - 1990. Basic research for crop diseases Management - Daya Pub., Delhi.

## BOS408 -Plant Microbe Interaction

**Teaching Hours: 9/Unit**

**Course outcome:**

- Interaction of microorganism of various kinds are included. Interactions could be beneficial and harmful
- Students will know the mechanism of interactions of different kinds of microorganisms
- There is a detailed study of the defence mechanisms operating in plants which will help in regulating these organisms
- The various useful bacteria and fungi are of practical use in developing organic manure, disposal of solid waste, remediating heavy metal pollutants etc
- If perceived further, these can generate employment.

**Unit I:**

**Plant-associated microbial pathogens**

Classification of microbes associated with plant systems:
Bacteria, fungi and oomycetes, phytoplasmas and spiroplasmas, protozoa, parasitic algae, viroids and viruses.
Generalised scheme of their anatomy, physiology and reproduction
Mechanism of infection and symptoms
Plant disease epidemiology
Economic losses

**Plant-bacterial interactions**

Quorum sensing
Plant penetration (foliar and soil-borne bacteria), attachment
Role of cell-wall degrading enzymes (CWDEs), toxins, hormones and extracellular polysaccharides (EPSs)
Determinants of host specificity, bacterial *Avirulence*genes (*Avr*)
Type III secretion in plant pathogens
Hrp-pili, regulation of *hrp*genes
Secreted proteins, secretion signals
Role of plasmids
Diseases caused by bacterial interaction

**Unit II:**

**Plant-fungal interactions**

Dispersal of spores, attachment, penetration methods, appressorial development
Cell-wall degrading enzymes (CWDEs) and mycotoxins
Necrotrophy and biotrophy
Host barriers, overcoming host barriers (quiescence, detoxification of phytoanticipins, detoxification of

phytoalexins, suppression of active oxygen species, avoidance of recognition)
Fungal and oomycete genetics [concepts of race structure, *Avirulence*genes (*Avr*)]
Diseases caused by fungal interaction

**Plant-viral interactions**
Structure of plant viruses
RNA viruses
DNA viruses
Transmission of viruses by vectors (insects, nematodes, fungi, seeds and pollens)
Movement of plant viruses in plants
Viral effects on plants (Alteration in host gene expression, host cell metabolism and suppression of defence responses)
Virus-resistance mechanisms in plants, post-transcriptional gene silencing (PTGs)

**Unit III:**

**Beneficial microbes**
*Rhizobium*-legume symbiosis
Nitrogen-fixing bacteria in non-legumes
Epiphytic microbes
Rhizosphere bacteria
Mycorrhizae
Endophytes

**Unit IV:**

**Plant tumors**
Viral tumors, Fungal galls, Bacterial tumors, Nematode galls, Galls caused by Mycoplasma and Rickettsia, Insect galls; causes for tumors - Physical factor, chemical factors and Genetic factors.

**Unit V:**

**Plant defense processes**
Preformed defense mechanisms
Inducible defence mechanisms
Recognition of a pathogen [Gene-for-gene resistance, plant *Resistance* (*R*) genes, pathogen *Avr* gene products]
*R* gene (leucin-rich repeats, cellular localization of recognition, TIR domains, NBS domain, other *R* gene domains, genetic organisation of *R* genes, mechanism of generation of new *R* gene specificities, coevolution of *R* genes)
Pathogen associated molecular patterns (PAMPs), PAMP-triggered immunity (PTI), effector proteins, effector-triggered immunity ETI), microbe-induced molecular patterns (MIMPs)

Elicitation of defence response and activation of signal transduction (oxidative burst, PAMPs trigger protein kinases, ion fluxes, nitric oxide, activation of transcription factors) Hypersensitive response (HR) and systemic acquired resistance SAR) {programmed cell death (PCD), signalling molecules of SAR [salicylic acid (SA), jasmonic acid (JA), ethylene],*Pathogenesis- related* protein genes (*PR*), master regulator protein NPR1 (Non-expresser of *PR* genes)} Induced systemic resistance (ISR)

**References**

Arun Misra 1985 Plant tumors Today and Tomorrow's Printers and Publishers, New Delhi. pp 222

Agrios, G N. Plant Pathology (2006) Academic Press.

Dickinson M. Molecular Plant Pathology (2003) BIOS Scientific Publishers.

Jeng-Sheng H. Plant pathogenesis and resistance: Biochemistry and Physiology of Plant Microbe Interactions (2009) Kluwer Academic Publishers.

Sullia, S B. and Shantharam, S. General Microbiology (1998) Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi

Reed, G. (Ed.). Prescott & Dunn's Industrial Microbiology (1983) (4th Ed.), AVI Publishing Co., Connecticut, U.S.A.

Gray Stacey, Beth Mullin and Peter M. Gresshoff. Biology of Plant – Microbe Interactions1996) Proceedings of the 8thInternational Symposium on Molecular Plant-Microbe Interactions, conducted at Knoxville, Tennessee, during July 14-19, 1996. Pub. International Society for Molecular Plant-Microbe Interactions, St. Paul, Minnesota, USA.

## BOS409 -Anatomy & Histochemistry

**Teaching Hours: 10/Unit**

**Course outcome:**

- Syllabus gives the basics of anatomy of vascular plants
- The working of various instruments useful for anatomical studies is given
- This trains students particularly in camera lucida and sectioning through microtomes
- All the useful staining techniques are also included
- These methods will be useful if students take up higher studies (Research) or they can set up a biological supplies company providing biological materials to institutions

**Unit I:**

Primary vegetative body of the plant: Stem: Arrangement of tissues, epidermis, cortical bundles, medullary bundles, steles of various types: Leaf-Structure of foliage leaves, petiole and node of dicot leaves, vascular system of moncot leaves, stem-leaf junction of monocots, structure of fern and gymnosperm leaves: Structure of modified leaves-Kranz anatomy and C4 photosynthesis. Xerophytic and submerged foliage leaves, cataphylls, hypsophylls: Root-Structure of primary root, mucigel, epidermis, exodermis, dimorphic roots, root nodules.

**Unit II:**

Ultra structure of the cell wall and differentiation. Ultra structure and differentiation of xylem and phloem: tracheary elements and their differentiation, sieve elements and their differentiation. Meristems: Apical meristems, shoot apex of Pteridophytes, gymnosperms and angiosperms, root apex and intercalary meristems. Secondary growth of the plant body: Periderm, variations in wood structure. Anomalous secondary growth in climbers and monocots. Floral anatomy: Flower, flower parts and their arrangement, vascular system, floral meristem, origin and development of floral parts. Pathological Anatomy.

**Unit III:**

Plant Histochemistry:

Minerals, Carbohydrates, Lignins, Polyphenols, Proteins, Nucleic acids and Histones, Lipids, Cutin, Suberin and Waxes, Ascorbic acid. Study of the instruments, their principles and uses (a) Camera lucida, (b) Micrometry (c) Microtomes –sledge Rocking, Rotary (D) Fluorescence microscope (e) Electron Microscope.

**Unit IV:**

Staining technique –Principles of histochemical stain s, Killing, fixing & staining of plant tissues; Important reagents & chemicals needed in the fixatives; FAA, Carnoy's fluid, Navashins solution, fleminge; Dehydrating agents, mounting media, Double staining, Saffranin, Fast green, Embedding: TBA method, embedding for electron microscope, Sectioning, Whole mounts maceration. Histochemical-PAS Test, Sudan black lipids, Feulgen reaction –N acids.

**Reference:**

Abraham F. 1982. Plant Anatomy. 3rdedn. Pergaon Press. Oxford.

Cariquist S, 1967. Comparative Plant Anatomy-Holt Reinert and Winston, NY.

Cutter D G, 1971. Plant Anatomy-Part 1, Cell and Tissues Edward Arnold London.

Cutter D G, 1971. Plant Anatomy-Part 1, Cell and Tissues Edward Arnold London. Part-II.

Eames and McDaniel 1947, II edn., " Plant Anatomy" McGraw Hill, N.Y.

Esau K 1965, Plant Anatomy, Joh Wiley and Sons, N.Y.

James D Mauseth, 1998. Plant anatomy The Benzamin/ Cummins Publishing Co.Inc.

Katherine Esau, 1979, Anatomy of seed plants-first Wiley eastern reprint. New Delhi.

Krishnamurthy K. V. 1988. Methods in Plant Histochemistry. S. Viswanathan (Printers and Publishers) Pvt. Ltd. Madras.

## BOP410 -PLANT PATHOLOGY - LAB

**Course outcome:**

- Students study the symptoms and the etiology of the diseases caused by different groups of organisms
- They will be trained to identify pathogens using relevant manuals
- They will familiarise with the diseases and control measures of local cereal/plantation/vegetable crops

Study of symptoms of important plant diseases caused by bacteria, fungi, nematodes, viruses and mycoplasma on cereals, vegetables, fruit crops, plantation crops & wild plants - Symptoms etiology and morphology.

Histopathology - sectioning & staining the tissues affected by different pathogens.

Seedling symptom test.
Detection of seed-borne bacteria.

Detection of seed-borne nematodes.
Growing on test.
Isolation of Pathogens and inoculation.

Study of Plant disease enzymes.

Production of mycotoxin.
Isolation of microbes antagonistic to fungi and bacteria from the soil.

## BOP411 -Plant Microbe Interaction- Lab

**Course outcome:**

- Good training in identifying endophytic and arbuscular mycorrhiza will be given
- This can be useful in further/higher studies and also can be used for developing biofertilizer, treating solid waste etc.

Study of Rhizolium nodules

Ephiphytic microbes

Phyllopane and Rhisosphre microflora

Endophytes

Plant tumors

Cell wall degrading enzymes

## BOP412 -Anatomy & Histochemistry- Lab

**Course outcome:**

- Gives basic tissue organisation in plants. Practicals help them differentiate these tissues
- Also this will train them in various methods of staining
- They will also be trained in microtomy

Staining of xylem and phloem elements.

Anatomy of roots in: Ficus, Musa, Dieffenbachia, Orchid.

Anamalous secondary growth in the following examples: Stems of Aristolochia,

Nyctanthes, Pyrostegia, Peperomia, Tinospora, Achyranthes.

Ecological anatomy.

Pathological anatomy.

Vasculature in floral organs.

Double staining technique.

Embedding: TBA method, embedding for electron microscope, Sectioning, Microtomes, Whole mounts maceration.

Histochemical-PAS Test, Sudan black lipids, Feulgen reaction –N acids

**SEMESTER II**

**BOH451 -PLANT MORPHOLOGY AND TAXONOMY - II**

**Teaching Hours: 10/Unit**

**Course outcome:**

- Students will know the diversity and life-cycle of pteridophytes and gymnosperms
- Also includes complimentary methods in solving taxonomic problems and locally relevant angiosperm families
- For these categories, their habitat requirement, richness of diversity, threatened categories etc will be given
- Economic use of these plants will be given

**Unit I:**
Pteridophyta - Distribution and classification of pteridophytes. Evolution of steles; fossil pteridophytes; Heterospory and the origin of seed habit; Economic importance.

**Unit II:**
Gymnosperms: Distribution and classification of gymnosperms. Brief account of the families of Pteridospermales, Lygenopteridaceae, Medullosaceae, Caytoniaceae, Glossopteridaceae; General account of Cyacadeoidales and Cordaitales; Structure and reproduction in Cycadales, Ginkgoales, Coniferales, Epherdrales, Welwitchiales and Gnetales. Economic importance.

**Unit III:**
Angiosperm taxonomy: Taxonomic evidence: Anatomy, Palynology, Chemotaxonomy, Cytotaxonomy, Numerical taxonomy.

**Unit IV:**
Study of following families with their phylogeny as per Bentham & Hookers system Rubiaceae, Asteraceae, Sapotaceae,Ebenaceae, Oleaceae, Asclepiadaceae, Loganiaceae, Gentianaceae, Boraginaceae, Scrophulariaceae, Lentibulariaceae, Bignoniaceae, Acanthaceae, Verbenaceae, Amaranthaceae, Podostemaceae, Piperaceae, Myristicaceae, Lauraceae, Loranthaceae, Santalaceae, Moraceae, Urticaceae.

**Unit V:**
Hydrocharitaceae, Orchidaceae, Musaceae, Zingiberaceae, Liliaceae, Amaryllidaceae, Dioscoreaceae, Commelinaceae, Araceae, Cyperaceae, Poaceae.

**Suggested Reading:**


Bhattacharya B. and B.M. Johre. 1998. Flowering plants - Taxonomy and phylogeny. Narosa Publishing House, New Delhi.

Bhatnagar, S.P. and Moitra, a. 1997. Gymnosperms. New Age International Pvt. Ltd., New Delhi.

Biswas. C., and Johri B.M. 1997. The Gymnosperms. Narosa Publishing House, New Delhi.

Coulter & Chamberlains. 1959. Morphology of gymnosperms. Central Book depot. Hyderabad.

Gurucharan Singh, 1999. Plant systematics - Theory and practice. Oxford and IBH Publishing Co., Pvt Ltd., New Delhi.

Heywood, V.H. and Moore, D.M. 1984. Current Concepts in Plant Taxonomy. Academic Press, London.

Heywood V.H., 1976. Botanical Systematics, Academic Press London.

Lawrence, H.M., 1966. Taxonomy of vascular plants. The Mac Million Company, New York.

Stace, C.A. 1989. Plant Taxonomy and Biosystematics (2nd Edition). Edward Arnold Ltd., London.

Singh G., 1999. Plant Systematics, Oxford and IBH, New Delhi.

## BOH452 - PLANT PHYSIOLOGY

**Teaching Hours: 10/Unit**

**Course outcome:**

- Deals with the functional aspects of plants
- A basic course required to understand cell functioning in plants. Also, helps in a better understanding related courses like molecular biology, biotechnology etc.
- Has a good potential for further higher studies

**Unit- I**

Cell differentiation: Internal factors - cytoplasmic, genetic; environmental.

Mechanism of ion uptake, transportation and accumulation; Donnan's equilibrium; translocation of solutes.

**Unit- II**

Water relations: water requirement, transpiration; factors affecting transpiration, transpiration control and antitranspirants.

Mineral Nutrition: Elements found in plants, essential elements, quantitative requirements and tissue analysis, functions, Nutrient deficiency.

**Unit III**

Hormones and growth regulators - biosynthesis and mechanisms of action of auxins, gibberellins, cytokinins, ethylene, abscissic acid; application of growth hormones and retardants in agriculture and horticulture; hormone receptors; mechanism of flowering, fruit ripening, abscission, senescence.

**Unit- IV**

Environmental physiology: Response of plants to environmental radiation; allelochemicals and allelopathy; stress physiology - stressful environments, water stress, chemical stress, temperature stress; stress tolerance.
Chronobiology: Circadian and other rhythms, clock mechanisms, biological clock.

**Unit- V**

Photomorphogenesis: properties of phytochromes, distribution, mode of action, role of phytochromes in seed germination and seedling establishment Photosynthesis: chloroplasts - structure and function, cyclic and noncyclic photophosphorylation, photolysis, electron transport system; CO2 fixation; C3 and C4, mechanisms, Photorespiration factors affecting photosynthesis.

**Suggested Reading:**


Buchanan, B.B., Gruissem, W. and Jones, R.L. 2007. Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Maryland, USA.

Burgess, J. 1989. An introduction to plant cell development. Cambridge University Press, Cambridge.

Devlin, R. and F.H. Whiteman 1986. Plant physiology. CBS publishers and distributors, New Delhi.

Hemantaraman A., 2007. Environmental Physiology, Scientific Publisher, India.

Hale M.G. and D.M. Orcutt 1987. The physiology of Plants under stress. A wiley - interscience publication. New York.

Hopkins, W.G. 2005. Introduction to Plant Physiology. John Wiley & sons, Inc., New York, USA.

Khan N.A. and Singh S., 2008. Abiotic Stress and Plant Responses, I.K. International Publishing House Pvt Ltd, New Delhi.

Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones Springer-Verlag, New York, USA.

Moore, T.C. 1974. Research Experiences in Plant Physiology: A Laboratory Manual: Springer-Verlag, Berlin, New York.

Noggle, G.R. and G.J. Fritz 1986. Introductory plant physiology, CBS Publishers and distributors, New Delhi.

Scott P., 2008. Physiology and Behavior of Plant, John Wiley and Sons Ltd, USA.

Srivastava L.M, 2005. Plant Growth and Development and Environment, Academic Press, California.

Salisbury, F.B. and Ross, C.W. 2001. Plant Physiology. Wadsworth Publishing Co., California, USA.

Taiz, L. and Zeiger, E. 2003. Plant Physiology Sinauer Associates, Inc., Publishers, Massachusetts. USA.

Wilkins, M.B. 1989. Advanced plant physiology. Longman Scientific and Technical, England.

## BOP453 - PLANT MORPHOLOGY AND TAXONOMY - LAB - II

**Course outcome:**

- Students study a detailed anatomical structure of pteridophytes and gymnosperms. This will give them a clear evolutionary trend in vascular structure
- Students are trained in identifying plants using relevant literature
- They will be familiar with literature required for plant identification
- They will be trained in describing a species and also updating the name to plants
- Field studies help them to appreciate the diversity and to put the theoretical knowledge to practice

Pteridophytes and Gymnosperms: Study of morphology, anatomy and reproductive structures of representative types of the groups. Study of fossils.

Angiosperm Taxonomy: Identification of plants pertaining to the families mentioned in the syllabus. Construction of dichotmous keys for family, genus, and species. Preparation of ten herbarium specimens of common plants.

Field work / study tour.

## BOP454- PLANT PHYSIOLOGY - LAB

**Course outcome:**

- Introduces students to some basic experiments in plant physiology
- This will help them in appreciating the topics studied in the theory class better
- Students will study chromatographic techniques, certain extraction procedures, ecological adaptations in plants etc along with other experiments

Separation of aminoacids by thin layer chromatography (TLC).

Separation of Amino acids by paper chromatography.

Studies on the factors affecting rate of respiration in plants.

Effect of phytohormones on plant development.

Extraction of chloroplast pigments from leaves and preparation of the absorption spectrum of chlorophylls and carotenoids.

To determine the chlorophyll a/chlorophyll b ratio in C3 and C4

plants.

Extraction of seed proteins.

Preparation of standard curve of protein (BSA) and estimation of the protein content of plant materials.

Physiological adaptations in plants - xerophytes, mesophytes, hydrophytes.

Determination of water potential using scholander pressure chamber.

Estimation of vitamin C (Ascorbic acid) in plants.

Determination of diffusion pressure deficit.

Determination of stomatal frequency, stomatal index and the area of stomatal aperture.

## BOS455-MOLECULAR PLANT PATHOLOGY

**Teaching Hours: 9/Unit**

**Course outcome:**

- They will know the defence mechanisms available in plants and various chemicals involved in it
- Also, the genetic mechanism of pathogen virulence and resistance will be taught. These will provide a good understanding of mechanism of pathogen infection and resistance
- Further, a study of important diseases on various crops with an emphasis on local crops is given
- They will also study various methods available for disease control

**UNIT I**

Elicitor and signal transduction: Early Recognition process of host and pathogen, types of Elicitors, Production of Elicitor, Elicitor Receptor concept, Signal transduction: Intra- cellular and Systematic signal transduction, systemic Acquired Resistance.

**UNIT II**

Host - defence mechanisms: structural and chemical defence, Hypersensitive reaction, Active oxygen radicals, Lipoxygenases, Pathogen related proteins, Phytoalexins, Phenoliccompounds, Polyphenol oxidases, plantibodies, Detoxification of pathogen toxins.

**UNIT III**

Genetics of host-parasite interaction: genes and variability in pathogens; genetics of virulence and resistance, horizontal and vertical resistance, Gene to Gene concept. Breeding of resistant varieties.

**UNIT IV**

Study of Plant Diseases: Study of Important Diseases on fruits, vegetables, cereals and plantation crops.

**UNIT V**

Control of Plant Diseases: Physical, chemical and biological; Cultural practices; integrated pest management; plant quarantine Crop certification.

**Suggested Reading:**


Ainsworth, G.C. 1981. Introduction to the history of Plant Pathology.

Agrios, N. 1997. Plant Pathology, Academic Press, NewYork.

Agnihotri, V.P., Sarbhay, A.K., Singh, D.V., 1997. Management of threatening plant diseases of National Importance.

Callow, J.A., (Ed.) 1983. Biochemical plant pathology. John Wiley & Sons.

Chester, Starr, K., 1994. Arihant Plant diseases – Jaipur.

Dhingra, D. 1993. Basic Plant Pathology methods - Delhi CBS.

Dordrecht; 1995. Induced resistance to disease in plants.

Fungal pathogenesis in plants and crops.
John A. Lucas - 3rd Ed. 1998. Plant Pathology & Plant Pathogens.

Mahadevan. A. Post infectional defence mechanisms - New Delhi (Today & Tomorrow, 1991).

Rangaswami, Mahadevan, A. 2001. Diseases of crop plants in India. Prentice Hall of India, Pvt. Ltd., New Delhi.

Singh, R.S. 1990. Plant diseases - 6th ed. New Delhi. Oxford & IBM.

Vidhyasekaran, P. 1997. Fungal Pathogenesis in plants and crops. (Molecular Biology and host Defense mechanisms), Marcel Dekker Inc.

Vidhyasekaran, P. - 1990. Basic research for crop diseases Management - Delhi: Daya Publ.

## BOS456 -APPLIED MICROBIOLOGY

**Teaching Hours: 9/Unit**

**Course outcome:**

- Has basic chapters on nutritional requirements and methods of culture of various types of bacteria
- Chapter on microbial growth includes kinetics of growth and measurement of growth in culture
- Plant microbe interaction gives different kinds of association including some useful interactions like arbuscular mycorrhiza. These if studied further can give valuable information
- Chapter on immunology gives a good foundation on immunity related issues and also gives certain important techniques

**Unit I:**
Microbial nutrition: Essential microbial nutrient elements and their role, vitamins and growth factors
Culture: cultivation of aerobic and anaerobic bacteria.

**Unit II:**
Bacterial growth - growth curve - Kinetics of Growth - Mathematical expression of exponential growth phase; Measurement of growth and growth yields - Batch Culture - Synchronous growth - Techniques of pure culture. Factors affecting growth and death - physical and chemical.

**Unit III:**
Microbial toxins: Mycotoxins and bacterial toxins; Food poisoning food infections - exotoxins, enterotoxins, endotoxins, virulence.

**Unit IV:**
Plant microbe interactions: Symbiosis, Mutualism, commensalism, parasitism, Ecto and endomycorrhiza - Arbuscular Mycorrhiza. Normal microflora of man, pathogenic flora, entry of pathogens and colonization.

**Unit V:**
Immunology: Cellular and humoral defense system, phagocytosis, cells of immune system; Immunogen, and Antibody - structure of immunoglobulins.

Types of immunity, antibody production, primary and secondary response; antigen-antibody reaction - agglutination, precipitation, complement, complement fixation; Immunological tests - precipitation test, Immunodiffusion, Immuno electrophoresis, Immunofluorescence, Radio immunoassay; antibody tests - ELISA, Western blotting; Monoclonal and polyclonal antibodies.

**Suggested Reading:**


Ahmed M and Basumatary S.K., 2006. Applied Microbiology M.J.P. Publishers, Chennai, India.

Alexopoulus, C.J., Mims, C.W. and Blackwel, M. 1996. Introductory Mycology. John Wiley & Sons Inc.

Black J.C., 2005. Microbiology: Principle and Exploration 6th Ed, John Willey and Sons Inc, USA.

Collee J.G., Applied Medical Microbiology - 2 edit - 1981 -
Elgert K.D.,1996. Immunology: Understanding Immunosystem, Wiley –Liss, New York.

Kalaichetvans P.T. and Pandi I.A., 2007. Bioprocess Technology M.J.P. Publishers, Chennai, India.

Kuby J., 1993. Immunology 2nd Ed, W.H. Freeman and company, New York.

Murray R.R, Resenthal K.S, Kobayashi G.S and Pfaller M.A., 1994. Medical Microbiology 3rd Ed, Mosby, New York.

Moat A.G, Foster J.W and Spector M.P., 2002. Microbial Physiology Wiley – Liss, Canada.

Pelezar, Michael J. 4th ed. - New Delhi; Tata Mcgraw Hill 1983 Copy (2)

## BOS457 -Ethnobotany and IPR

**Teaching Hours: 9/Unit**

**Course outcome:**

- Gives the basics of ethnobotany including an understanding of the tribals of India
- There is an exhaustive coverage of the methodologies used in ethnobotanical studies
- Tribal groups and their role in various kinds of agricultural practices are included
- Study of some important medicinal plants which are probably the fallout of ethnobotanical/traditional practices

**Unit I:**

Ethnobotany: Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science. The relevance of ethnobotany in the present context; Ethnic groups and Ethnobotany: Major and minor ethnic groups or Tribals of India, and their life styles. Forest Vs. ethnic groups; Plants in Tribal life with reference to Magico-religious rituals and social customs. Sacred groves.

**Unit II:**

Methodology of Ethnobotanical studies: a) Field work- documenting the information- questionnaire, video recording, interviews b) Herbarium c) Ancient Literature d) Archaeological findings e) temples and sacred places f) Protocols.

**Unit III:**

Role of ethnobotany in modern Medicine with special examples; Medico-ethnobotanical sources in India with special reference to Karnataka; Tribals Vs. Agriculture: Shifting, Podu and Jhum cultivation. Role of ethnic groups on surrounding environment. Crop Genetic sources. Endangered taxa and forest management (participatory forest management).

**Unit IV:**

Ethnobotany and legal aspects. Ethnobotany as a tool to protect interests of ethnic groups. Sharing of wealth concept with few examples from India. Ethnobotany as a source (recent) of already known drugs: a) Withania as an antioxidant and relaxant b) Sarpagandha in brain ailments c) Becopa and Centella in epilepsy and memory development in children d) Phyllanthus fraternus in

diabetic and viral jaundice e) Artemisia as a powerful cerebral antimalarial agent and its possible use in tuberculosis.

**Unit V:**

Bioprospecting and Biopiracy, Intellectual property Rights: Forms of protection, Patents, Trademarks, Trade secrets, Designs, Geographical indicator, Plant variety protection

References:

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

S.K. Jain (ed.) Glimpses of Indian. Ethnobotany, Oxford and I B H, New Delhi–1981

Lone et al,.Palaeoethnobotany

S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.

S.K. Jain, 1990. Contributions of Indian ethnobotany. Scientific publishers, Jodhpur.

Colton C.M. 1997. Ethnobotany –Principles and applications. John Wiley and sons –Chichester

Rama Ro, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in Andhra Pradesh, India. Botanical Survey of India. Howrah.

Rajiv K. Sinha –Ethnobotany The Renaissance of Traditional Herbal Medicine –INA–SHREE Publishers, Jaipur-1996

Faulks, P.J. 1958. An introduction to Ethnobotany, Moredale pub. Ltd. London

**BOS458 - Reproductive Biology of Angiosperms and Plant Morphogenesis**

**Teaching Hours: 10/Unit**

**Course outcome:**

- This is a very useful basic course in Botany
- Syllabus includes developmental studies of reproductive structures in plants and development of other regions
- This will form a good basis for subjects like tissue culture and helps in better understanding of organogenesis

**Unit I:**

Reproductive Biology of Angiosperms: Historical over view, Contributions of P. Maheshwari; BM Johri; BGL Swamy to the development of embryology in India; Microsporogenesis-Male gametophyte development; anther wall layers and functions; Tapetum-types, Concept of male germ unit; Pollen morphological features; Unusual features: pollen development in Cyperaceae, pollen embryosac; Scope of palynology.

**Unit II:**

Megasporogenesis - Female gametophyte development; Ovular structure & types; Development of monosporic, bisporic, tetrasporic & special types of embryo sacs; Ultrastructure & nutrition of female gametophyte; Fertilization-A general account; double fertilization; single fertilization; heterofertilization & polyspermy; Pollen recognition & rejection reactions-Types; structures; methods to overcome incompatibility reactions; Endosperm-Types; haustorial variations; ruminate & composite endosperm; Embryo-Structure; development of monocot, dicot & grass embryo; significance of embryonal suspensor; Experimental Embryology-Scope &applications.

**Unit III:**

Plant Morphogenesis: Historical developments; Models of morphogenesis-Comparison of plant v/s animal morphogenetic pathways: Embryo, *Coenorhabditis elegans*; Concepts-Cell fate/ fate maps, gradients, stem cells in plants and their significance in development, polarity, symmetry, totipotency of cell types, pluripotency, plasticity, differentiation, redifferentiation, dedifferentiation and regeneration in Acetabularia

**Unit IV:**

Plant growth and development; types, Shoot apical meristems, root meristems; control of cell division in meristems; Quiescent center & Meresteme de attente; Arabidopsis-vascular patterning and leaf development, abnormal growth; Cellular basis of growth-

Maintenance of cell shape; cytoskeletal elements; Photomorphogenesis-Definition, history, Hartmann's technique; Photoreceptors & photo morphogenesis, Localization and properties; effect of bluelight-mediated photomorphogenesis with suitable examples.

References:

Johri, B. M. 1984. The embryology of Angiosperms. Springer Verlag

Johri, B. M. 1982. The experimental embryology of vascular plants. Springer Verlag NY

Swamy, B.G.L. & Krishnamurthy, K. V. 1982. From flower to fruit: The embryology of angiosperms. Tata McGraw Hill Co.

Eames 1961. Morphology of Angiosperms. McGraw Hill book Co., Inc., NY

Maheshwari, P. 1950. An introduction to the embryology of Angiosperms. McGraw Hill book Co., Inc., NY

Maheshwari, P. 1963. Recent advances in the embryology of angiosperms. Edited by the International Society of Plant Morphologists, New Delhi

Bhojwani, S. S. & Bhatnagar, S. P. 1978. The embryology of Angiosperms. Vikas Publishing House, New Delhi.

Turing, A. M. 1952. The chemical basis of morphogenesis. Phil. Trans. R. Soc. Lond. B. 237: 37-72.

Sinnot, E. W. 1960. Plant Morphogenesis. Mc Graw-Hill Book Co. Inc. New York, USA.

Steeves, T.A. & Sussex, I. M. 1989. Patterns in Plant development. 2ndedition, Cambridge University Press. Chasan, R. 1994. Tracing tracheary element development. The Plant Cell 6:917-919.

Lyndon, R. F. 1990. Plant Development : The Cellular basis. Unwin Hyman, London.

Aloni, R. 1987. Differentiation of vascular tissues. Annu. Rev. Plant Physiol. 38:179-219.

Raman, A. 2007. Insect induced plant galls of India; unresolved questions. Curr. Sci. 92 (6): 748-757.

Smith, H. 1975. Phytochrome and Photomorphogenesis-an introduction to the photocontrol of plant development. Mc Graw-Hill Book Co. (UK), Ltd.

Mohr, H. 1972. Lectures in photomorphogenesis. Springer-Verlag, Berlin, Germany

## BOP459 -MOLECULAR PLANT PATHOLOGY- LAB

**Course outcome:**

- Gives the basis of the diseases caused by various kinds of pathogens. Students will be familiar with the symptoms and etiology of these diseases
- Based on symptoms largely they can identify the disease causing agents
- Methods of isolation and culture of various pathogens are included
- This is a course with lot of practical applications

Study of important plant diseases caused by Bacteria, fungi, nematodes, viruses and mycoplasma on cereals, vegetables, fruit crops, plantation crops & wild plants - Symptoms etiology and morphology.

Isolation of Pathogens and inoculation.

Preparation of media, Isolation of pathogens from different plants and their pure culture on different media.

Inoculation of pathogens in pure culture to healthy plants to reproduce the disease.

Study of effect of temperature pH, pesticides (fungicides) on the growth and reproduction of plant pathogens in culture.

Study of Plant disease enzymes: Viscometric and colorimetric methods.

Study of plant diseases caused by nematodes on brinjal.

Pesticide residue analysis.

Study and production of Disease control material (agents).

## BOP460 -APPLIED MICROBIOLOGY - LAB

**Course outcome:**

- Training in isolation and identification of various kinds of soil microorganisms are included. This has practical use
- Also, they are trained in other basic procedures used for microorganisms

Study of microorganisms in milk, curd

Isolation of microorganisms - from rhizosphere and non-rhizosphere soil, Microflora of mouth and teeth crevices

Isolation and study of Rhizobium

Viability staining for bacteria, Capsule staining

Concentration of conidia by Haemocytometer Bacterial growth measurement by spectrometric method

Study of milk sample - Methylene blue reductase test

Testing of water sample, fungal growth measurement

Wine preparation

## BOP461 -Ethnobotany and IPR- Lab

**Course outcome:**

- Visit to tribal area and data collection will familiarise them with the field conditions
- They will learn about the identification of crude drugs from the experienced practitioners
- Students will have a field knowledge of the diversity of medicinal plants

A visit to a Tribal area to collect data

Listing of Crude drugs in Pansali shops (local crude drugs shops) and their identification (little known drugs only).

A visit to nearby Sacred Groves.

**BOP462 -Reproductive Biology of Angiosperms and Plant Morphogenesis- Lab**

**Course outcome:**

- Contains basic experiments in reproductive biology and morphogenesis
- Gives the various stages of the development of reproductive structures in plants
- The various experiments helps them to better understand other courses like tissue culture, biotechnology etc.

**Reproductive Biology of Angiosperms:**

Microsporangium: Slides: Wall layers; tapetal types; two-celled & three-celled pollen; pollen tetrads

Pollen germination: *Balsam, Delonix, Hibiscus*and *Peltaphorum*

Megasporangium: Slides Female gametophyte development in Penstemon, Xyris pauciflora;2, 4, 8-nucleate stages; mature embryo sac

Endosperm mounting : *Cucumis sativus, Grevelliarobusta* & *Croton sparsiflorus*
Embryo: Slides: Monocot, dicot & grass embryo
Embryo mounting : *Crotalaria*

**Plant Morphogenesis:**

Study of stem cells in plants: SAM, RM

Regeneration abilities of shoot apical meristems of dicots on media with combinations of growth regulators

Study of totipotency in cell types: stomata, epidermal cells, stem and leaf explants on a tissue culture media

Polarity in stem cuttings: *Pothos*spp.

Study of regeneration in succulents *Kalanchoe, Byrophyllum*

Study of leaf galls of plants: *Pongamiapinnata* & *Achyranthes aspera*: Morphological observations and histology.

## BOE463 - Medicinal Plants

**Teaching Hours: 9/Unit**

**Course outcome:**

- Contains basic chapters required to understand scientific study of plants
- They will learn the use of plants in different systems of medicine
- Also, topics on various systems of plant conservation, IPR and IUCN classification threatened categories are included
- There is a detailed account on the cultivation practices of certain medicinal plants
- This will give the basics of medicinal plant cultivation and if perceived students can take this as a career

**Unit I:**

Plant classification – Broad outline of major groups and ranks of taxa, Plant Nomenclature- Common names, Bionomial nomenclature, IUBN- brief outline of methods in nomenclature; Typification.

Herbarium- Methods of collection, processing of herbarium specimens; Major herbaria of the world, Botanical Survey of India- brief outline of its organization and its role and significance.

**Unit II:**

Medicinal plants – system of herbal medicine, threatened medicinal plants- Threats, various approaches to conservation - *in-situ* and *ex- situ;* MPCA, Biosphere reserves, National parks, Sacred grooves, CITES, IUCN categories of plant, Brief account of Biodiversity Act.

**Unit III:**

Ethnobotany: Basic approaches to study the traditional knowledge on plant use. Collection methods, field methods and studying of Herbarium specimens and folklore; verification of data, Aesthetic value.

**Unit IV:**

Plants as medicine: Drugs of botanical origin. Medicinal properties of important local plants, Nutraceuticals Bioprospecting, Biopiracy.

Intellectual property Rights: Forms of protection, Patents, Trademarks, Trade secrets, Designs, Geographical indications, Plant variety protection.

**Unit V:**

Cultivation potential of important medicinal plants Agroclimatic requirements, propagation, Transplanting and aftercare of the following medicinal plants.

*Acorus calamus*
*Andrographis paniculala*
*Asparagus racemosus*
*Azadirachtaindica*
*Centellaasiatica*
*Piper longum*
*Rauwolfia serpentina*
*Zingiberofficinale*
*Vincarosea*
*Emblica officinalis*
*Cinnamomumsuphuratum*

**Suggested Reading:**

Agarwal.S.S.M.Paridhavi (2007) Herbal Drug Technology, University press, Hyderabad.

Bennet, S.S.R. 1979. An Introduction to Plant nomenclature. International Book Distributors. 9/3. Rajpur Road, Dehra Dun 248001. India.

Davis, P.H., V.H. Heywood. 1963. Principles of Angiosperm Taxonomy. Oliver and Boyd Ltd., Tweeddale Court, Edinburgh.

Heywood V.H., 1976. Botanical Systematics, Academic Press London.

Stace, C.A. 1989. Plant Taxonomy and Biosystematics (2nd Edition). Edward Arnold Ltd., London.

Sumy, Ved& Krishnan (2000) Tropical Medicinal Plants, FRLHT, Bangalore.

## SEMESTER III

### BOH501- Plant Ecology & Environment

**Teaching Hours: 10/Unit**

**Course outcome:**

- A basic course to understand ecosystem functioning
- Chapters on autecology, community ecology and population ecology can be of use in higher studies
- Chapters on global warming and pollution of various kinds are very relevant and helps to appreciate these problems
- Mainly creates an awareness of the current environmental issues

**Unit I:**

Ecosystems: Introduction, trophic levels, Food webs, Energy flow, Primary and secondary production, nutrient cycles: C,N, P and S.

Soil : Classification, types of soil, soil profile.

Ecological succession: Types and causes, climax community: Characteristics of climax, theories about climax; Unit of vegetation - Formation, Association, Consocies, Island Biogeography.

**Unit II:**

Autecology: Scope and method of study: Systematic position, flowering, pollination - types, adaptations, plant-pollinator interaction, seed output, germination, viability and dormancy, reproductive capacity, seed dispersal, seedling growth, vegetative growth, phenology.

Genecology: Ecological amplitude, ecads, ecotypes, ecospecies; habitat, ecological niche.

**Unit III:**

Synecology (Community ecology): Major plant communities: characters used in the study of community structure - analytical and synthetic characters. Methods of study of community: floristic, physiognomic and phytosociological, methods - quadrat, transect, sampling plots and point methods; vegetation analysis - gradient analysis, ecotone, edge effect.

Diversity indices - Simpson's index, Shannon-Weiner's index, alpha, beta and gamma diversity, Jaccard's index, Sorenson's similarity index.

**Unit IV:**

Population ecology: Abiotic factors that affect species distribution patterns, characteristics of population - density, natality, mortality, age distribution, biotic potential, growth forms, fluctuations and dispersal; population structure - dispersal, aggregation, intraspecific interactions in populations; population growth - life tables, deterministic models, stochastic models, causes of population change - key factor analysis, density dependence.

**Unit V:**

Global warming: Green house effect - causes and consequences. Ozone depletion- causes and consequences. Air & water pollution - major pollutants, their source, permissible limits - and control. Radioactive pollution: Ionising radiation, disposal of radioactive waste, Nuclear accidents.

**Suggested Reading:**


Hunter JR. M. L., 1999. Maintaining Biodiversity in Forest Ecosystem, Cambridge University Press.

Harold, W., Hocker. Jr. 1979. Introduction to Forest Biology, John Wiley and Son's Publication, Toranto.

Kormondy, E.J. 1996. Concepts of Ecology. prentice-Hall of India pvt. Ltd., New Delhi.

Ludwig, J.A. and Reynold, J.F. 1988. Statistical Ecology. Wiley, New York.

Narasaiah M. L., 2005. Biodiversity and Sustainable Development, Discovery Publishing House, New Delhi.

Robert S. B. Ronald A., Gecsey D.S.G, Sayler G., 1988. Technique in Microbial Ecology, Oxford University, Press New York.

Sinha R. K., 2008. Biodiversity Global Concerns, Commonwealth Publishers, New Delhi.

Tondon P, Abrol Y. P, Kumaria S., 2007. Biodiversity and its significance, I K International, New Delhi.

Tewari D. N., 1995. Western Ghats Ecosystem, International Book Distributor, Dehra Dun.

Odum, E.P. 1971. Fundamentals of Ecology. Saunders, Philadelphia.

Odum, E.P. 1983. Basic Ecology. Saunders, Philadelphia.

Peter D. Stiling, 1992. Introductory Ecology. Prentice Hall, Englewood Cliffs, NJ 07632

Smith, R.L. 1996. Ecology and Field Biology. Harper Collins, New York.

Smith, R.L. 1996, 1990. Ecology and Field Biology. Harper Collins, New York.

## BOH502 -CYTOGENETICS AND MOLECULAR BIOLOGY

**Teaching Hours: 10/Unit**

**Course outcome:**

- The course forms a good basis on mendelian principles and the developments thereafter in genetics
- Gives a molecular basis of chromosome structure and organisation
- Techniques like DNA finger printing has practical applications
- The molecular basis of gene expression and regulation are fundamental requirement for students of biology
- Incorporates most of the recent topics in molecular biology

**Unit I:**

History of cytogenetics, a comparative account on structure, organization and function of prokaryotic and eukaryotic cell system. Structure and function of nucleus, endoplasmic reticulum and golgi bodies. Mendelian principles dominance, segregation, independent assortment, deviation from Mendelian inheritance. Allele, multiple alleles, pseudoalleles. Gene interactions - pleotropy, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters. polygenes and Polygenic inheritance, inheritance of mitochondrial and chloroplast genes. Maternal inheritance.

**Unit II**

Evolution of gene concept - cistron, genome and genotype; DNA - discovery, structure, types, properties. RNA structure, types and factors affecting its stability. Chromosome structure, organization and types. Chromosome banding techniques, flow cytometry, confocal microscopy, chromosome microdissection, chromosome walking, *in situ* hybridization. Genome sequences and gene numbers, clusters and repeats, multigene families and evolution of genome. Phylogenetic tree, Techniques of DNA finger printing, its applications and limitations. C value paradox, Cot and Rot values and its significance.

**Unit III**

Gene expression and their regulation: transcription, translation in pro and eukaryotic cell system, mechanism of RNA splicing, ribozyme, genetic code, lac operon, tryptophan operon, *gal* system in yeast, phage strategies.

**Unit IV:**

DNA replication: Replicon, mechanism of DNA replication and their regulation in pro and eukaryotic cell system, molecular mechanism of F and Ti plasmid mediated conjugation, DNA repair mechanism, regulation of cell cycle, Cancer

**Unit V:**

Mutation: types, causes, detection, chemical, physical and insertional mutagens, mechanism of mutation induction, structural and numerical alteration of chromosomes, transposons, Ames test, *in vitro* complementation test, conditional lethal, important mutants studied in pro and eukaryotic cell system. Epigenetic effects and regulatory RNA's.

**Suggested Reading:**


Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K., and Watson, J.D. 1999. Molecular Biology of the Cell. Garland Publishing Inc., New York.

Buchanan, B.B., Gruissem, W. and Jones, R.L. 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Maryland, USA.

Cooper G.M. and Hausman R.E., 2004. The Cell: A Molecular Approach 3rd Ed, Sinaur Associates, Inc. Sunderland, Massachusetts.

Gardner E.J., Simmons M.J. and Snustad, D.P., 2003. Principles of Genetics 8th Ed, John Wiley and Sons. Inc., New York.

Glick B.R. and Pasternak, 1998. Molecular Biotechnology: Principal and Application of Recombinant DNA 2nd Ed, ASM Press, Washington D.C.

Gunning, B.E.S. and Steer, M.W. 1996. Plant Cell Biology: Structure and Function. Jones and Bartlett Publishers, Boston, Massachusetts.

Hartl, D.L. Jones E.W., 2002. Essential Genetics: A Genomic Perspective 3rd Ed, Jones and Bartlett Publishers, Sudbury, Massachusetts.

Hughes M.A.,1999. Plant Molecular Genetics, Addison Wesely Longman Limited, England.

Karp G., 2008. Cell and Molecular Biology: Concepts and Experiments, John Wiley and Sons Inc., New York.

Lewin B., Lingappa V.R. and Plopper G., 2007. Cells, Jones and Bartlett Publishers, Sudbury, Massachusetts.

Lewin, B. 2000. Genes VII. Oxford University Press, New York.
Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell, J. 2000. Molecular Cell biology (4th Edition). W.H. Freeman and Co., New York, USA.

Malacinski G.M., 2003. Essentials of Molecular Biology 4th Ed, Jones and Bartlett Publishers, Inc Sudbury, Massachusetts.

## BOP503 - PLANT ECOLOGY & ENVIRONMENT LAB

**Course outcome:**

- Contains basic studies on ecological adaptations of different plant groups
- Trains them in understanding basic environmental parameters
- Methods of estimation of various inorganic parameters of soil, water samples etc enables them to know pollution levels etc
- Useful for them to work in institutes dealing with pollution control

Morphology and Anatomy of plants in relation to habitats - xerophytes, mesophytes, hydrophytes, halophytes and psammophytes.

Preparation of ombrothermic diagrams.

Calculation of Evapotranspiration.

Population studies by transects and quadrats.

Soil analysis: Soil grading, Soil moisture, water holding capacity, porosity, pH and bulk density.

Estimation of organic carbon, sulphate, phosphate, nitrogen, calcium, sodium, potassium.

Water analysis: Salinity, alkalinity, Hardness, Chlorine demand, Residual Chlorine.

Determination of dissolved oxygen and CO2 in different water samples.

Field work/ Study tour.

## BOP504 - CYTOGENETICS AND MOLECULAR BIOLOGY LAB

**Course outcome:**

- This has certain basic experiments of cytogenetics
- Working out problems in genetics helps in establishing the concepts of genetics
- Sequence analysis exercise introduces them to this recent method

Study of mitosis and meiosis using onion and *Rheo.*

Pollen viability studies using different techniques.

Identification of B-Chromosomes.

Solving problems in genetics.

Study of multiple translocation in *Rheo.*

Orcein and Feulgen staining of the salivary gland chromosomes in Drosophila.

Isolation of DNA plant source
Isolation of DNA Microbial source

Quantification of DNA - Plant source
Quantification of DNA - Microbial source

Quantification of RNA - Plant source
Quantification of RNA - Microbial source

Sequence analysis - Demonstrations

## BOS505- PLANT TISSUE CULTURE

**Teaching Hours: 10/Unit**

**Course outcome:**

- Basics of plant tissue culture including laboratory set up and culture media are included
- Syllabus deals with the various applications of tissue culture including germplasm storage
- Methods and uses of culturing different kinds of plants are also included
- A unit on protoplast isolation and fusion is very useful for students
- The course is useful for further studies and has practical applications

**Unit I**

Laboratory organization, basic principles of cell and tissue culture.

Culture media: types of media, preparation, sterilization, role of macronutrients, micronutrients, organic nutrients, growth regulators and gelling agents, undefined supplements, different carbon sources used in tissue culture media.
Micropropagation: explant selection, totipotency, induction of callus, meristem culture, embryo culture, factors affecting *in vitro* stages of micropropagation, applications and limitations of micropropagation.

**Unit II**

Cytodifferentiation and organogenesis, factors involved in vascular tissue differentiation and organogenesis. Somatic embryogenesis, synthetic seeds.

Germplasm storage and cryopreservation: long term storage – plant materials, pre – freezing treatments, cryoprotectants, freezing, thawing, reculture, checking the efficiency of cryopreservation. Advantages of cryopreservation.

**Unit III**

Cell suspension culture: isolation of cells, types of suspension cultures, synchronization, assessment of growth and viability in suspension culture, techniques involved in and factors affecting

single cell culture. Types of bioreactors, production of secondary metabolites, problems associated with secondary metabolite production.

**Unit IV**

Haploid production: Androgenic haploids – anther culture, microspore culture, factors responsible for the success of androgenesis, ploidy level, significance of haploids, problems involved in haploid culture. Gynogenic haploids – explants, pre – treatment, factors responsible for gynogenesis and importance of gynogenesis.

Triploid production: callusing, physical factors, organogenesis, factors responsible for shoot bud differentiation and applications of endosperm culture.

**Unit V**

Protoplast isolation and fusion: Methods of protoplast isolation, culture techniques, protoplast developments. Methods of protoplast fusion, selection, characterization of hybrids, cybrids, applications and limitations of somatic hybridization.

Somaclonal variation: somaclonal variants, isolation of somaclonal variants, basis for somaclonal variation, applications.

**Suggested Reading:**

Evans D. E., Coleman J.O.D., and Kearns A. 2008. Plant cell culture. Bio Scientific Publ. London

PUROHIT S. D., 2012. Introduction To Plant Cell Tissue And Organ Culture PHI Learning Pvt. Ltd., New Delhi

Roberta, H. Smith, 2012. Plant Tissue Culture: Techniques and Experiments 3 edition. Academic Press; US.

Bhojwani, S.S. and Razdan, M.K. 2004. Plant Tissue Culture: Theory and practice. Elsevier Science Publishers, New York, USA.

Chawla H.S., 2009, Plant Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi

Chrispeels, M.J. and Sadava, D.E. 1994. Plants, Genes and Agriculture, Jones and Bartlett Publishers, Boston, USA.

Collins, H.A. and Edwards, S. 1998. Plant Cell Culture. Bios Scientific Publishers, Oxford, UK

Giri C C and Giri A., 2007. Plant Biotechnology Practical Manual, I K International Publishing House Pvt Ltd.

Khanna V K., 2003. Plant Tissue Culture Practicals, Kalyani, 2nd Ed, U.P.

Kumar K, 2004. An introduction to Plant tissue culture, New Central Book Agency (P) Ltd

Peter K V, Keshavachandran R., 2008. plant Biotechnology: Methods in Tissue Culture and Gene Transfer, Universities Press, Hyderabad.

Purohit S.S. 2000. Bio-fundamentals and applications, Agrobios, Jodhpur

Ramavath K G.,2004. Plant Biotechnology, Chand Publication, New Delhi.

Reinert, J. 1982. Plant Cell and Tissue Culture: A Laboratory Manual. Narosa Publishing House, New Delhi.

## BOS506 - SEED TECHNOLOGY

Teaching hours: 10/unit

**Course outcome:**

- The course has basic concepts related to seed structure and germination
- Students will know the seed quality and seed health testing methods
- Various seed processing methods have practical applications. They will know the various methods used in seed processing
- Seed certification and production and marketing procedures will familiarise them with the essential requirements in seed production
- With this, they can be employed in seed production companies
- Students can also establish seed production units and generate employment

**Unit I:**

Significance of Seed Technology

Seed germination: Structure of monocot and dicot seeds; factors affecting germination; Seed dormancy- types, significance, mechanism, endogenous and exogenous factors regulating dormancy, Orthodox and recalcitrant seed

**Unit II**

Seed quality and health Testing: Implications of seed health testing, ISTA and its role in seed testing. seed sampling, purity analysis, moisture determination, viability, vigour, incubation tests, bioassays and biochemical procedures, factors affecting incubation test results

**Unit III**

Seed processing: seed drying – methods, types of driers, seed cleaning and upgrading- equipment and their functions; functions of scalper, debearder, scarifier, huller, seed cleaner and grader. Screen cleaners, specific gravity separator, indented cylinder, velvet-spiral-disc separators. Seed treatments- methods of seed treatment, seed treating formulations and equipments, seed disinfestations, identification of treated seeds. Seed Packaging and labelling,

**Unit IV**

Seed certification- objectives of seed certification; seed certification agency/organization and staff requirement; quarantine regulations- import and export, Field Inspection- principles, phases and procedures; reporting and evaluation of observations; pre and post-harvest control tests for genetic purity evaluation (grow-out tests), seed inspection, seed legislation- Seed Act, Seed Rules, seed law enforcement, seed quality regulation in India.

**Unit V**

Seed production and Marketing: Management of seed production: general principles of seed production, location of seed production, cropping, selection of cultivars, cultural practices, Longevity and storage of seeds, impact of storage fungi on seeds, transgenic seeds, hybrid seeds. Seed marketing management.

**Suggested Readings**


Agarwal RL. 1997. Seed Technology. Oxford & IBH.

Agrawal PK &Dadlani M.1992. Techniques in Seed Science and Technology. 2nd Ed. South Asian Publ.

Agrawal PK. (Ed.). 1993. Handbook of Seed Testing. Ministry of Agriculture, GOI, New Delhi.

Copland LO & McDonald MB. 1996. Principles of Seed Science and Technology. Springer.

Neergaard P. 1988. Seed Pathology. Mac Millan.

Khare Dhirendra.2000. Seed Technology, Jodhpur Scientific Publishers.

Ramamoorthy K & Sivasubramanian 2006. Seed Technology Ready reckoner, Agrobios publications

Agarwal P.K. 2015 Principles of seed technology; Indian Council of Agricultural Research

Bhattarai & Mehta 2010. Seed Technology (Processing Storage & Marketing)

Black M & Bewley D 2000. Seed Technology & its Biological basis. Sheffield Academic Press Ltd.

Krishnasamy et.al; 2004. Compendium on Seed Science & Technology. Tamil Nadu Agricultural University, Coimbatore.

Tiwari B 2014 Seed Science and Technology. Oxford Press

Khan Ali 2014. A text book of Seed Science & Technology. Agrotech.

Singh Sharon 2014 Post Harvest Technology and Management

Tiwari 2014 Seed Production and Quality Control. Oxford Press

Reddy 2008. Principles of Crop Production. Kalyani Publishers, New Delhi

## BOS507- Economic Botany

**Teaching Hours: 10/Unit**

**Course outcome:**

- Deals with various kinds of plant products that are of economic value
- This introduces them to diverse kinds of cereals, millets and vegetable crops from different geographical regions
- They will know the various other plant products which are of economic use
- Use of many of these are becoming limited now owing to their less availability or synthetic products taking their place
- Knowledge of traditional use of plant products is important and has to be passed on to future generations

Chapter on medicinal plants helps them to understand the importance of medicinal plant conservation

**Unit I:**

Food Plants: Agroclimatic regions, diversity, nutritional and neutraceuticals properties, components of cereals, millets, legumes and nuts; vegetables – root, stem, herbage and fruit vegetables. Fruits - tropical and temperate.

Important spices and condiments of India.

**Unit II:**

Fibre and fibre yielding plants - textile fibres, uses of cotton; soft or bast fibres, jute industry, coir industry. brush fibres, filling fibres.
Vegetables sponges, artificial fibres.

**Unit III:**

Wood and Cork:
Diagnostic features of wood, mechanical properties of wood, seasoning of wood; veneers, plywood, lamina boards, cork and uses of cork.

Important timber yielding plants of India.

**Unit IV:**

Tannins, dyes, gums and resins
Tannins from bark, wood, leaves and fruits - uses of tannins
Dyes - sources uses of dyes.

Classification of Indian gums and resins, important plant sources for gums and resins.

**Unit V:**

Medicinal plants, Drugs from roots, stems, bark, leaves and flowers. Important medicinal plants of India. Threatened medicinal plants.

Fumitories and masticatories - Tobaco, arecanut, betel, catechu, opium, cocaine, hemp.

**Suggested Readings**

Anonymous 1952 The Wealth of India Series CSIR New Delhi

Hill A.F. 1952 Economic Botany Tata McGraw-Hill Cp Ltd New Delhi

Kocchar, H.L. 1998 Economic Botany of the tropics, 2 Edn. Macmilln India Ltd. India

Pandy, B.P. 2000. Economic Botany, S. Chand and Company Pvt. Ltd., New Celhi

Pandy, S.N. and Chandha, A. 1999. Economic Botany, Vikas Publishing House Lvt. Ltd., New Delhi.

**BOS508 Phytochemical methods**

**Teaching hours – 10/unit**

**Course outcome:**

- Introduces them to various kinds of phytochemicals in plants
- Detailed methods of extraction and isolation will help them in higher studies
- A unit on evaluation of phytochemicals for various disorders also is useful in higher studies
- The chapter on herbal drugs helps to understand the significance of our traditional herbal practices
- Together, all these will help them to get jobs in pharmaceutical or such other companies or take up further studies in drug development

**Unit I**

Scope of phytochemistry, plants as source of chemical compounds, primary and secondary metabolites. Important source of carbohydrates, proteins, lipids, phenolics, flavonoids, pigments, alkaloids, volatile oils, terpenes, resins.

**Unit II**

**Extraction, isolation and purification of phytochemicals**

Selection of plant samples, processing and storage of samples for extraction.

Extraction methods- infusion, decoction, digestion, maceration, percolation, solvent extraction, fluid extraction, ultrasound, microwave assisted extraction, advantage and disadvantage involved in each method.

Isolation of selected primary and secondary metabolites – amino acids, proteins and carbohydrate. Phenolics, flavonoids, alkaloids, lipids, oils, terpenes and saponins.

Purification techniques for primary and secondary metabolites – solvent-solvent fractionation and chromatography techniques - HPTLC, silica gel column (normal and reverse), ion exchange, size exclusion

**Unit III**

**Characterisation and analysis of phytochemicals**Preliminary, qualitative and quantitative techniques – paper chromatography,

thin layer chromatography, Column Chromatography – HPLC, GC (qualitative and quantitative)

Colour reactions for amino acids, sugars, phenolics, flavonoids, alkaloids, terpenes, saponins, oils, lipids. Spectroscopic estimations/gravimetric determination of total sugars, amino acids, proteins, phenolics, flavonoids, alkaloids, terpenes, saponins, oils, lipids.

Characterisation using spectroscopic techniques - UV/VIS, FTIR, DSC (differential scanning calorimeter), NMR, MS, MALDI. XRD – single crystal and powder.

**Unit IV**

**Phytochemical evaluation**

Evaluation of phytochemicals for bioactive potential *in vivo in vitro*. Evaluation of phytochemcials for antimicrobial, antioxidant, antidiabetic, anti inflammatory, anti pyretic, diuresis, anti thyroid, anticancer, hepatoprotective activities and nutritional values. Toxicity study, route of administration, analysis. Ethical guidelines and clearance.

**Unit V**

**Standardisation and validation of phytochemicals**

Quality determination of herbal drugs. Role of processing methods and storage conditions on quality of drugs. Standardisation parameters– impurity limit, ash content, extractable matter, moisture content, other phytocemicals, microbial contaminants, pesticides.

Validation of drug – guidelines, limit of detection and quantification of impurities, organoleptic properties, physical, chemical, biological characteristics, stability testing, storage conditions and packing system/unit.

**Suggested Readings**

Bourne, U.K. Kokate, Purohit C.K. and Gokhale S.B. (1983), Pharmacognosy. Nivali Prakashan Publication

Braithwaite, A and Smith F J (1996) Chromatographic Methods (5th edition) Blackie Academic & Professional London

Harborne J.B. (1973) Phytochemical methods a guide to modern techniques of plants analysis. Chapman and Hall, London Ltd.

Sadasivam. S and A. Manickam, Bio Chemical methods 2nd edition. New age International pvt New Delhi.

## BOP509 -PLANT TISSUE CULTURE LAB

**Course outcome:**

- Students will get a comprehensive idea of a tissue culture laboratory and its working
- They will know the different techniques of plant propagation through tissue culture
- They will familiarise with other techniques like preparation of synthetic seeds, production of secondary metabolites through cell/callus culture
- Has a job potential in biotechnology or advanced plant production companies

Laboratory organization, fumigation, sterilization techniques.

Preparation of culture media.

Effect of media on callus development / morphogenesis / embryogenesis.

Effect of growth regulators on callus development / morphogenesis / embryogenesis.

Callus induction, organogenesis – shooting, rooting, hardening from different explant sources.

Embryo culture.

Anther culture.

Preparation of synthetic seeds.

Cell suspension culture.

Hemocytometer cell counting.

Percent viability of cells in suspension.

Analysis of cell growth in suspension culture (fresh weight and dry weight method).

Detection of secondary metabolites in callus using PC / TLC
Estimation of phenolics.

Qualitative detection of steroids in cells.

Estimation of chlorophyll in cultured cells.

## BOP510 -SEED TECHNOLOGY LAB

**Course outcome:**

- They will know the basic and simple experiments on seed viability test, seed sampling, detection of seed borne fungi etc
- The course has a bright job potential in seed production companies

Methods of seed sampling,

Purity Analysis, Inspection of dry seed sample

Examination of seed washing.

Viability by TTC

Detection of seed borne fungi- Blotter, Agar plate, deep freezing method. Component plating.

Embryo extraction,

Growing on test, seedling symptom test,

Seed germination and vigour,

Study of efficacy of fungicides.

## BOP511 - Economic Botany - Lab

**Course outcome:**

- They work on the estimation and identification of various phytochemicals
- This will stand them in good stead in getting jobs in biochemical based companies

Field survey for collection of economically important plants.

Study of important medicinal plants and their uses.

Acquaintance of plant materials of economic importance of various categories.

## BOP512 Phytochemical methods LAB

**Course outcome:**

- Field studies will introduce them to many of the economically important plants
- They will also come to know a large number of various plant products of economic use

Estimation of Saponins

Estimation of Phenols

Estimation of Flavonoids

Estimation of Starch

Estimation of Lycopene

Estimation of Crude fibre

Extraction of essential oils

Estimation of total sugars by Anthrone method

Phytochemical screening of secondary metabolites

Estimation of alkaloids

Antioxidant activity of plant extracts

Antimicrobial activity of plant extracts

Estimation of Caffeine

Extraction of secondary metabolites through soxhlet apparatus

## BOE513 - Plant Propagation

**Teaching Hours:10/Unit**

**Course outcome:**

- There are topics of basics on plant propagation. This helps to even non biology students to understand the subject better
- Apart from the basic theory of plant propagation, they will know the infrastructure available for modern plant propagation industry
- There is a chapter covering propagation through seeds. If this is perceived further, they can take up seed production as a career
- A detailed account of the established methods like cuttings, layering, grafting and budding are given. This can help them in establishing a nursery
- Tissue culture methods of propagation are also taught. They can take this up as a career choosing the required crops

**Unit I:**

History, scope and importance of plant propagation. Propagation structures - green house equipment and media. Modern plant propagation industry.

**Unit II:**

Biology and Environmental factors: Genetic control in propagation - sexual versus asexual, hormonal control of plant growth and development.

Microclimatic and edaphic factors.

Biotic factors - Pathogen and pest management. Post propagation care.

**Unit III:**

Seed propagation: Formation of fruit, seed and embryo, polyembrony and apomixes, hormones and seed development. Seed testing, seed storage, seed germination - types. Nursery techniques for transplant production.

**Unit IV:**

Vegetative propagation: Cuttings - advantages, types, source of cutting materials, rooting media.

Grafting - History, terminology, types - detached scion grafting, approach grafting, repair grafting.
Budding and layering - patch, ring and chip budding.
Layering - simple, tip, mound, air and trench layering.

**Unit V:**

Micropropagation: Culture techniques - Macro and micronutrients, growth regulators and media. General laboratory facilities and procedures. Hardening technique. Propagation methods for Banana, Orchid, Anthurium, Gladiolus.

**Suggested Reading**


Abbott, A.J. and Atkin, R.K.(9eds.)1987 Improving vegetatively propagated crops. Academic press, New York.

Bose, T.K.,Sadhu,M.K.,&Das,P.,1986.Propagation of Tropical and Subtropical Horticultural crops, Nowya Prakash, Calcutta.

Hartmann and Kester,1983. Plant propagation

Hartmann, H.T., Kester E.D., Davis, F.T., and Geneve, R.L. 1997. Plant propagation. Principles and practices. Prentice Hall of India Private Limited, New Delhi.

Krishnamurthy.H.M.1981. Plant Growth substances including application in Agriculture.

L.M. Pierik 1987. Invitro culture of Higher plants Murtinus Nijhoff pub., Dordrecht.

M.K. Razdan1994. An Introduction to Plant tissue culture, Oxford and IBH Pub. Co., PVT. Ltd., Bombay and Calcutta.

Mac Donald, B.1987. Practical woody plant propagation for nursery growers. Portland, OR: Timber press.

Sadhu,M.K.1989. Plantpropagation Wiley eastern Ltd.N.Delhi.

## SEMESTER IV

### BOH551- PLANT BREEDING

**Teaching Hours: 10/Unit**

**Course outcome:**

- Students will know early developments in plant breeding including domestication of plants and centre of origin
- Methods in collection and maintenance of germplasm can help in preserving the traditional crop varieties which are very valuable
- Knowledge on types of hybridisation can be used in the area of seed production
- Basic knowledge on breeding in self pollinated crops, pure line theory, variation and its significance are very useful to students
- Also, chapters on breeding for disease and pest resistance, mechanism of variability in pathogens gives a good foundation in the subject
- The course if perceived has practical applications

**Unit I**

History, objectives, present status and future prospectus of plant breeding plant breeding as both an art and science. Modes of reproduction: sexual, asexual and vegetative. Determination of mode of reproduction and pollination in a species. Morphological contrivances promoting allogamy and autogamy, self incompatibility and male sterility.

**Unit II:**

Centres of origin, domestication, plant introduction-history and procedure; germplasm collection- types, purpose, maintenance, evaluation, achievements, merits and demerits. Significance of continuous variation and qualitative traits; significance of discontinuous variation and qualitative traits. Exploitation of physiological efficiency of plants - as a new parameter for human selection.

**Unit III:**

Nature of gene action and components of genetic variation; genotype and environment interaction and adaptation. Methods of selection, population improvement, hybrids and synthetic varieties. Breeding for nutritional quality. Mutation breeding.

**Unit IV:**

Breeding in self pollinated crops: Hybridization- history and objectives, types, procedure, consequences and achievements. Pure lines - origin of variation, pure line theory, effect of self pollination on the genotype and achievements in breeding self pollinated crops; heterosis- homozygous and heterozygous balance. Wide crosses and their uses in plant breeding.

**Unit V:**

Breeding for disease resistance- History, mechanism of variability in pathogens, methods of breeding for disease resistance; Breeding for pest resistance; Polyploidy- types, induction, applications and limitations. Breeding for wide adaptation.

**Suggested Reading:**

Allard R.W., 1960. Principles of Plant Breeding, John Wiley Publication.

Atherly, A.G., Girton, J.R. and McDonald, J.F. 1999. The Science of Genetics. Saunders College Publishing, For Worth, USA.

Cochran, G.W. and Cox, M.G. (1987) Experimental Design. John Wiley & Sons Inc.

Chaudhari H.K., 1974. Elementary Principles of Plant Breeding, Oxford and IBH, New Delhi.

Hegberg and Arne., 1961. Mutation and Polyploidy in Plant Breeding, Heinemann Publication, London.

Khush, G.S. 1973. Cytogenetics of Aneuploids. Academic Press, New York, London.

Mauro Ed G. P., 1988. Sexual Reproduction in Higher Plants, Springer Verlag, New York.

Sharma J.R. 1994. Principles and practice of Plant Breeding. Tata McGraw Hill Publishing Co. Ltd. New Delhi. pp 599.

Winer, B.J. 1971. Statistical Principles in Experimental Design Second edition. McGraw-Hill Kogakusha Ltd. New Delhi. pp. 907.

## BOH552 - PLANT BIOTECHNOLOGY

**Teaching Hours: 10/Unit**

**Course outcome:**

- Students will know most of the basic techniques useful in plant biotechnology
- As a basic requirement, they will study the transposable elements both in prokaryotes and eukaryotes
- They will have a good understanding of the concepts of molecular markers and the application and advantages of these markers in biotechnology
- Various direct methods and agro bacterium mediated Gene transfer along with other methods are included
- Application of these methods in crop improvement in terms of disease resistance, high yield or other characters of choice are also included. This will help them in their higher studies

**Unit I:**

Techniques in plant biotechnology: Gel electrophoresis – agarose, poly acrylamide, blotting techniques – nucleic acid and protein blotting, dot blot technique, autoradiography, transformation technique

**Unit II:**

Genetic engineering: transposable elements in bacteria – IS elements, composite transposons, complex transposons, transposable elements in eukaryotes –class I, class II elements, transposon gene tagging, applications.

Gene isolation: isolation of gene of interest, gene cloning, chromosome walking, chromosome jumping

**Unit III:**

Molecular markers and marker assisted selection – morphological markers, biochemical markers, molecular markers – types (RFLP, PCR, RAPD, AFLP, SSR, SPAR,STMs, SCARs, CAPS), cloning, construction of genetic and physical maps, FISH, gene testing using transformation and complementation tests.

**Unit IV:**

Direct gene transfer - microinjection, electroporation, chemical transformation, liposome mediated, ultrasound mediated, calcium

phosphate co precipitation, particle bombardment method. Advantages and disadvantages of direct gene transfer.

Agrobacterium mediated gene transfer – Ti plasmid, cointegrate and binary vector, culturing, advantages and disadvantages. Viral vector mediated gene transfer – Cauliflower mosaic virus mediated and Gemini virus mediated, advantages and disadvantages.

**Unit V:**

Transgenics in crop improvement: resistance to biotic stress-insect resistance, virus resistance, disease resistance. Resistance to abiotic stress – herbicide resistance, metal tolerance. Transgenics for improved quality – storage and male sterility. GMOs, problems, safety, and public acceptance of cultivating transgenic plants.

Biodegradation, bioremediation, biofertilizer, production of single cell proteins.

**Suggested Reading:**

Stewart N., 2016. Plant Biotechnology And Genetics: Principles, Techniques, and Applications Edited by C Jr. University of Tennessee Knoxville, Tennessee. John Wiley & Sons, Inc., Hoboken, New Jersey

Bhojwani S.S. and Razdan M.K., 2004 Plant tissue culture, Panima Publishing Corporation, Delhi.

Chawla H.S., 2009 Plant Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi

Gustafson, J.P. 2000. Genomes, Kluwer Academic plenum press, New york.

Ignacimuthu, S.J. 1997. Plant Biotechnology, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.

Old, R.W. and Primrose, S.B. 1989. Principles of Gene Manipulation, Blackwell Scientific Publications, Oxford UK.

Primrose, S.B. 1995, Principles of Genome Analysis. Blackwell Science Ltd., Oxford, UK.

Purohit S.S. 2000.Bio-fundamentals and applications, Agrobios, Jodhpur.

Purohit S.S.-1999. Agricultural Biotechnology, Agro Botanical Publ. Bikaner.

Reinert, J. 1982. Plant Cell and Tissue Culture: A Laboratory Manual. Narosa Publishing House. New Delhi.

Scheppler J.A., Cassin, E.P. and Gambier R.M. 2000. Biotechnology explorations, ASM press, Washington. DC.
Smith E. 1996. Biotechnology, Cambridge press, U.K.

Smith, R.M. 2000. Plant tissue culture, Techniques and experiments, Academic press, New York.

Treshan 1990. Biotechnology, Wiley Eastern, New Delhi.

## BOP554 - PLANT BREEDING LAB

**Course outcome:**

- A detailed study of the floral biology of different kinds of flowers helps in understanding the adaptations for pollination available in flowers
- Most of the basic experiments in plant breeding like selfing, bagging, nursery techniques etc are useful to students
- A detailed training in grafting, budding and layering is given. This can help them in setting up plant propagation units
- There is a very detailed study of statistical methods useful in plant breeding. This will help them even in other courses and in their higher studies as well

Study of floral biology and pollination mechanism.

Demonstration of mode of pollination by bagging preparation of nursery in coconut, paddy and mulberry.

Techniques in Hybridization.

Demonstration of bud selfing and bud pollination in self-incompatiblity plant system (sporophytic and gametophytic st)

Procedures of emasculation in plants.

Grafting, budding and layering.

Induction of polyploidy using colchicines.

Study of floral biology and pollination mechanism.

Techniques in Hybridization.

Procedures of emasculation in plants.

Grafting, budding and layering.

Induction of polyploidy using colchicines.

Biometrics: Definition of `Statistics'; its usages.

Construction of frequency tables. Frequency graphs and their uses. Measures of Central tendency - mean, median and mode. Measures of dispersion - Range, standard deviation. Coefficient of variation.

Population versus sample - Need and objectives of sampling. Methods of simple random sampling, stratified sampling, cluster sampling and sub sampling and their application in field research. Non-parametric tests - Sign test, Wilcoxon test, Mann-Whitney test, Kruskal and Wallis test.

Distribution of sample mean; standard error and its uses.

Scatter diagram, simple correlation and regression; multiple correlation.

Basic concepts of probability. Theoretical distributions - Binomial, Poisson and Normal.

Statistical inference - need and meaning in biological research. Normal, t, Chi-square and F-tests.

Analysis of variance - meaning and uses in research. Basic principles of experimental designs. Completely randomised design and randomised block design. Comparison of pairs of treatments using t test.

**BOP555 -PLANT BIOTECHNOLOGY LAB**

**Course outcome:**

- They are trained in techniques like gel electrophoresis, PCR, SDS-PAGE etc. These can be useful in higher studies
- These can also help them if they take up work in industries or research institutes

Estimation Proteins-UV Vis.

Preparation of competent cells and bacterial transformation.

Agarose gel electrophoresis technique

PCR.

SDS –PAGE technique.

Biodegradation

Biofertilizer

SCP

Industrially important enzymes

**BOS556 -POST HARVEST TECHNOLOGY**

**Teaching hours: 10/unit**

**Course outcome:**

- A detailed account on seed processing is included. Using this, they can set up seed processing units
- Methods and knowledge on seed storage, seed certification and quarantine regulation will be useful if they get jobs in seed production companies
- The course also has topics in post harvest processing of food grains, fruits, vegetables, flowers etc. This will enable them to be employed in agriculture based industries
- Various food quality monitoring tests will make them suitable to be employed in food industry with further training

**Unit I**

Seed biology and Physiology: Pollination, fertilization, embryogenesis, morphology and physiology in relation to seed infection.

**Unit II**

Seed processing: importance, equipments used in preparation of seed for processing- threshing, shelling, debearding and scalping. Seed drying- drying methods, types of driers, seed cleaning and upgrading, types of cleaners /graders, grading of seeds, seed treatment- importance, common pesticides used, types of seed treaters, analysis of treated seed and assay of protectants.,

**Unit III:**

Principles of Post Harvest technology: Causes of post-harvest losses; biochemical changes of crops after harvesting; aspects of packaging, seed storage- methods, traditional and modern insulation, air conditioning, humidification, fumigation, seed storage losses. post-harvest treatment; seed certification, quarantine regulations, field and seed inspection.

**Unit IV**

Food Processing- General principles and method of preservation; modern techniques in food processing, Biological and physico-chemical principles of food materials in relation to processing; Unit operation in Post-Harvest processing, Processing of food grains, animal feed, seeds, fruits and vegetables, flowers, spices. parboiling of wheat and paddy.

**Unit V**

Food quality monitoring: quality assurance for the agro-industries, Rheological techniques and instrumentation for measuring the mechanical properties of foods, food textural qualities, Food specifications, grades, and standards; Sensory test methods flavor, color, texture. Food borne infections and intoxications, Methods to control, detect, and enumerate microorganism in food; Food legislation and safety: Food laws and regulation.

**Suggested Readings**


Agrawal PK &Dadlani M. (Eds.). 1992. Techniques in Seed Science and Technology. South Asian Publ.

Baskin CC & Baskin JM. 1998. Seeds: Ecology, Biogeography and Evolution of Dormancy and Germination. Academic Press.

Basra AS. 2006. Handbook of Seed Science and Technology. Food Product Press.

Bench ALR & Sanchez RA. 2004. Handbook of Seed Physiology. Food Product Press.

Bewley JD & Black M. 1982. Physiology and Biochemistry of Seeds in Relation to Germination. Vols. I, II. Springer Verlag.

Bewley JD & Black M. 1985. Seed: Physiology of Seed Development and Germination. Plenum Press.

Copeland LO & Mc Donald MB. 1995. Principles of Seed Science and Technology. 3rd Ed. Chapman & Hall.

Khan AA. 1977. Physiology and Biochemistry of Seed Dormancy and Germination. North Holland Co. Kigel J &Galili G. (Eds.). Seed Development and Germination.

Marcel Dekker. Murray DR. 1984. Seed Physiology. Vols. I, II. Academic Press. Sadasivam S & Manickam A. 1996. Biochemical Methods. 2nd Ed. New Age

## BOS557 - Biodiversity& conservation

**Teaching Hours: 10/Unit**

**Course outcome:**

- The course is gaining more importance and relevance in the recent years
- It gives an exhaustive idea about biodiversity at different levels and groups of plants
- A detailed account on endemism and the various uses of biodiversity further emphasises the importance of biodiversity
- The course deals with the various threats to diversity and conservation measures including environmental laws
- Also, various afforestation programmes, impact assessment methodologies and environmental movements etc further adds to the methods available for conservation
- Also, there is a detailed study on the use of remote sensing in monitoring various aspects of diversity
- With the tremendous human impact on biodiversity the course becomes very relevant

**Unit I:**

Phytogeography: Phytogeographical regions of the world, Phytogeographical regions of India. Centre of origin of plants, migration routes, Vavilov's theory - Diversity and vegetation types of Western Ghats, vegetation types of Karnataka.

**Unit II:**

Biodiversity: Diversity at the species, genetic, habitat levels; Diversity among different taxonomic groups. Mega diversity regions, Biodiversity hotspots.

**Unit III:**

Endemism: Definition, types of endemics, causes of endemism. An account of endemic plants of Western Ghats - Pteridophytes, Gymnosperms and Angiosperms.

Role of biodiversity in ecosystem functions and stability. Values of Biodiversity - economic and aesthetic values; an account of medicinal and timber yielding plants, NTFP.

**Unit IV:**

Threats to biodiversity - speciation and extinction; IUCN classification of threatened plants, introduction of exotic species, Conservation methods :-Ex-situ and In-situ

conservation, protected ecosystems - biosphere reserves, national parks, game sanctuaries, botanical gardens, Medicinal plant conservation areas (MPCA).

Environmental movements: Global and regional, Earth summit, Man and biosphere programme.

**Unit V:**

Environmental laws - Indian Forest conservation Act, Biodiversity bill (2002), Community Biodiversity register, CITES (Convention on international trade in endangered species), UNESCO Heritage sites, Intellectual Property Rights (IPR).

Ecological management: Sustainable development, biological indicators. Environmental impact assessment (EIA). Carrying capacity, ecological restoration; afforestation, green belt, social forestry, agroforestry. Remote sensing and forestry, Concept of Geographical Information System (GIS).

**Suggested Reading**

Ahmedullah, M. and M.P. Nayar, 1986. Endemic plants of the Indian region. Vol 1. Botanical Survey of India.

Champion, H.G. and S.K. Seth, 1968. A revised survey of the forest types of India.

Harold, W., Hocker. Jr. 1979. Introduction to Forest Biology, John Wiley and Son's Publication, Toronto.

Hunter JR. M. L., 1999. Maintaining Biodiversity in Forest Ecosystem, Cambridge University Press.

Jain, S.K & Mehra K.L. 1983. Conservation of tropical plant resources BSI. Calcutta.

Jain S.K. & R.R. Rao. 1983. An assessment of threatened plants of India. BSI Calcutta.

Longman, K.A. & Jenik, J. 1987. Tropical forests and its environment. English language book society.

Narasaiah M. L., 2005. Biodiversity and Sustainable Development, Discovery Publishing House, New Delhi.

Nayar& Sastry 1987. Red data book of Indian Plants. Vol 1-3 BSI Pub. Calcutta.

Odum& Gray W Barret Fundamentals of Ecology V Ed. Cangage Learning India Pvt. Ltd., New Delhi.

Pascal J.P. 1988. Wet evergreen forests of the Western Ghats of India. Institute Francais de Pondicherry.

Peter D. Stiling 1992. Introductory Ecology Prentice Hall.

Puri G.S., V.M. Meher-Homji, R.K. Gupta and S. Puri 1980. Forest ecology (2nd edn.) Vol. 1. Phytogeography and forest conservation. Oxford and IBH.

Puri G.S., V.M. Meher-Homji, R.K. Gupta and S. Puri 1989. Forest ecology (2nd edn.) Vol.2 - Plant form, diversity, communities and succession. Oxford and IBH.

Tondon P, Abrol Y. P, Kumaria S., 2007. Biodiversity and its significance, I K International, New Delhi.

Tewari D. N., 1995. Western Ghats Ecosystem, International Book Distributor, Dehra Dun.