ಮಂಗಳೂರು ವಿಶ್ವವಿದ್ಯಾನಿಲಯ

MANGALORE UNIVERSITY

(Accredited by NAAC with 'A' Grade)

ಕ್ರಮಾಂಕ/ No. : MU/ACC/CR 58/2020-21/A2

ಕುಲಸಚಿವರ ಕಛೇರಿ
ಮಂಗಳಗಂಗೋತ್ರಿ – 574 199
Office of the Registrar
Mangalagangothri – 574 199
ದಿನಾಂಕ/Date:15.01.2021

NOTIFICATION

Sub: Revised syllabus of M.Sc. Botany programme.
Ref: Academic Council approval vide agenda
No.: ಎ.ಸಿ.ಸಿ:ಶೈ.ಸಾ.ಸ.2:15(2020–21) dtd 23.12.2020.

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The revised syllabus of M.Sc. Botany programme which is approved by the Academic Council at its meeting held on 23.12.2020 is hereby notified for implementation with effect from the academic year 2020-21.

Copy of the Syllabus shall be downloaded from the University Website (www.mangaloreuniversity.ac.in)

REGISTRAR

To,

1. The Chairman, Dept. of Botany, Mangalore University, Mangalagangothri
2. The Chairman, BOS in Botany, Dept. of Botany, Mangalore University.
3. The Registrar (Evaluation), Mangalore University.
4. The Superintendent (ACC), O/o the Registrar, Mangalore University.
5. The Asst. Registrar (ACC), O/o the Registrar, Mangalore University.
6. Guard File.

MANGALORE UNIVERSITY
M.Sc., BOTANY (CBCS)

Course pattern and scheme of Examination

I Semester							
Paper Code	Title of the Paper	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	15	35	50	2
BOP405	Plant Biochemistry - Lab	4	3	15	35	50	2
BOP406	Microbiology - Lab	4	3	15	35	50	2
Soft Core							
	One paper to be selected by the student	3	3	30	70	100	3
BOS407	Plant Pathology						
BOS408	Plant Microbe interaction						
BOS409	Anatomy & Histochemistry						
	***to be selected by the student**	3	3	15	35	50	2
BOP410	Plant Pathology - Lab						
BOP411	Plant Microbe interaction - Lab						
BOP412	Anatomy & Histochemistry - Lab						
	Total					600	23

II Semester							
Paper Code	Title of the Paper	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	15	35	50	2
BOP454	Plant Physiology - Lab	4	3	15	35	50	2
Soft Core							
	Two papers to be selected by the student	3x2	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**	3x2	3x2	15x2	35x2	50x2= 100	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					700	25

III Semester							
Paper Code	Title of the Paper	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	15	35	50	2
BOP504	Cytogenetics and Molecular Biology - Lab	4	3	15	35	50	2
Soft Core							
	Two papers to be selected by the student	3x2	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**	3x2	3x2	15x2	35x2	50x2= 100	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					700	25

IV semester							
Paper Code	Title of the Paper	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	15	35	50	2
BOP555	Plant Biotechnology - Lab	4	3	15	35	50	2
Soft Core							
	One paper to be selected by the student	3	3	30	70	100	3
BOS556	Post Harvest Technology						
BOS557	Biodiversity & conservation						
	Total					500	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

DEPARTMENT OF BOTANY

Scheme for M.Sc., CBCS Course

Semester	No. of papers	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 4x1=4*	4	2x2=4		3x1=3		-	-	-	19

* **Project work**

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

	92	
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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 – Algae biofertilisers, algae as food, feed and uses in industry. Algae blooms and their importance.

Unit II:
Bryophyta: Study of different kinds of classifications, Life cycle patterns and reproductive biology of Hepaticae, 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, Natithaniel Wallich, 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: History of nomenclature. Salient features and major provisions of International code of Botanical nomenclature: Principles; Rules and recommendations. Ranks of taxa, Naming of different taxa,- Effective and valid publication. Rule of priority, Typification – Topotype, Isotype, Paratype, Syntype, Lectotype; Neotype; Author citation, Valid name, Synonym, Basionym, Homonym, Tautonym, Autonym; naming of cultivated plants. Nomina conservanda.

Systems of classification : Concept of Artificial, Natural and phylogenetic systems of classification - study of Bentham & Hooker's system. Basis of Phylogenetic system – study of APG IV 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. The MacMillon Company. 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 Publisher, New 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. Enzyme inhibition: competitive, non competitive and uncompetitive inhibition. Michaelis – Menten Equation. Units of enzyme activity.

Unit II

Respiration: mitochondrial structures, Carbohydrate bio synthesis, classification, structure and metabolism, Glycolysis and its regulation, HMP pathway, uronic acid pathway, T.C.A. Cycle, Electron Transport System(E.T.S.) and its regulation & oxidative phosphrylation; factors affecting respiration.

Unit III

Amino acids: structure and classification based on polarity and structure. Zwitter ionic properties. pKa value. Essential and non essential amino acids. Proteins classification, structure - primary, secondary, tertiary and quarternary; Ramachandran plot. biosynthesis and separation (aminoacid sequence, C-terminal, N-terminal, disulfide bonds).

Lipids: structure, classification, properties and biological role of Lipids. Fatty acids- classification, properties and biological role. Essential fatty acids. Beta oxidation.

Nucleic acids: Nucleosides and nucleotides of Nucleic acids. classification, structure, biosynthesis, functions and metabolism. Melting of DNA.

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: Scope of microbiology - Ancient Microbiology. 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:
Microbial Taxonomy : Definition and systematics, Nomenclatural rules and identification. Haeckel's three kingdom classification, Whittaker's five kingdom approach - Woese domain system. Major characteristics used in taxonomy – morphological, physiological, metabolic, reproduction and genetic and molecular taxonomy. life-cycle of Bacteria, actinomycetes, Rickettsiae, Mycoplasma.Bergey's Classification of bacteria. Concepts of Microbiome, synthetic biology.

Unit III:
Biology of Microorganisms: Differences between prokaryotic and eukaryotic cell. Biology of bacteria - cell structure, size, shape, arrangement membrane, cell wall, cytoplasmic inclusions, mesosomes, flagella and motility, slime, capsule, pili, chemotaxis, endospore. Biology of fungi- classification, structure, reproduction and Parasexual cycle. Biology of yeast – reproduction. Virus (bacteriophages) structure, life cycle (lytic and lysogenic) – Mycoplasma – prions. Protozoa, Nature, structure, replication and classification.

Unit IV:
Microbial nutrition: Microbial nutrient requirements – macro-nutrients, micro-elements – growth factors - sources of nutrients – nutritional classification of bacteria - Phototroph, Chemotroph, Autotroph (lithotroph), Heterotroph (organotroph), Photoautotroph, Photoheterotroph, Chemoautotroph, Chemoheterotroph - Nutritional patterns of pathogens – Saprophytes - Auxotroph. 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.

Ananthanarayanan R., Jayaram Paniker C.K. (2017). Textbook of Microbiology, 10th edition. Orient Lomgman.

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

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Extraction of phytochemicals using Soxhlet apparatus

Extraction of essential oil using Clevenger apparatus

Reactions of carbohydrates.

Reactions of proteins (Precipitation reactions of proteins) & non protein nitrogenous substances.

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

Preliminary screening of phytochemicals: Alkaloids, terpenes, steroids & phenols

Quantitative estimation of reducing sugar, amino acids & flavonoids.

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

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

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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 born 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)

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

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Gray Stacey, Beth Mullin and Peter M. Gresshoff. Biology of Plant – Microbe Interactions1996) Proceedings of the 8th International 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 stains, 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.

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

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Microscopy, calibration and measurement of spores. Camera Lucida drawing, cleaning of glassware's, preparation of reagents and stains.

Preparation of mounting slides and stains for temporary and permanent mounts. Collection and preservation and maintenance of plant pathogens.

Sterilization methods, preparation of culture media, determination of Ph, inoculation, isolation of fungi from aquatic and infected tissues, purification of fungal cultures.

Morphological features of different groups of fungi based on theory course.

Preparation of herbarium, field trips, class records and permanent slides

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

Phyllopaneand 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

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.

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

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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.

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 of related courses like molecular biology, biotechnology etc.
- Has a good potential for further higher studies

Unit- I

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

Morphogenesis and organogenesis in plants: Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in *Arabidopsis* and *Antirrhinum sp.*

Unit- II

Solute transport and photoassimilate translocation – uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; mechanisms of loading and unloading of photoassimilates.

Water relations: water requirement, Transpiration; mechanism and factors affecting antitranspirants.

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

Unit III

Hormones and growth regulators – biosynthesis, storage, breakdown, transport, physiological effects and mechanisms of action of auxins, gibberellins, cytokinins, ethylene, abscissic acid; mechanism of flowering, fruit ripening, abscission, senescence hormone receptors; Application of growth hormones and retardants in agriculture and horticulture;

Unit- IV

Photosynthesis :- structure of chloroplast and its function, concept of pigment system, Light harvesting complexes; Red drop and Emmersons enhancement effect. Electron transport system, cyclic and noncyclic photophosporylation, ATP synthesis, photolysis, alternate oxidase; photorespiratory pathway. photoprotective mechanisms; CO2 fixation-C3, C4 pathways and CAM cycle.

Unit- V

Sensory photobiology : Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins;

stomatal movement; photoperiodism and biological clocks, circadian and other rhythms, clock mechanisms.

Environmental physiology: Response of plants to environmental radiation; allelochemicals and allelopathy; stress physiology - stressful environments, water stress, chemical stress, temperature stress; stress tolerance.

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, Jhon 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 names of plants
- Field studies help them to appreciate the diversity and to put the theoretical knowledge to practice

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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

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Determination of diffusion pressure deficit.

Determination of water potential using scholander pressure chamber.

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

Separation of aminoacids by thin layer chromatography (TLC).

Separation of Amino acids by paper chromatography.

Separation of plant pigments by column chromatography.

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.

Anatomical characters of C3, C4 and CAM plants.

Physiological adaptations in plants - xerophytes, mesophytes, hydrophytes.

Estimation of vitamin C (Ascorbic acid) in plants.

Extraction of caffeine.

Isolation of intact organelles: Chloroplast and mitochondria

Assay of nitrate/nitrite reductase activity in leaves/algae.

Estimation of proline under stress and normal condition

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 Systamatic signal transduction, systemic Acquired Resistance.

UNIT II

Host - defence mechanisms: structural and chemical defence, Hypersensitive reaction, Active oxygen radicals, Lipoxygenases, Pathogen related proteins, Phytoalexins, Phenolic compounds, 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. Biopesticide and its mode of action with special reference to induced systemic resistance. Control of plant diseases through transgenic approaches.

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, commensualism,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 immunoglbulins.

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 antibodis.

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, vedeo 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:
Bioprospectin and Biopiracy, Intellectual property Rights: Forms of protection, Patents, Trademarks, Trade secrets, Designs, Geographical indicater, Plant variety protection

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 of plants
- 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 variati ons; 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 morp Hogenesis - 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, pleuripotency, 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.

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

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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

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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

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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.

References:

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

S.K. Jain (ed.) Glimpses of Indian. Ethnobotny, 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 ethnobotny. 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

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 help 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, Grevellia robusta* & *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: *Pongamia pinnata* & *Achyranthes aspera*: Morphological observations and histology.

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

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

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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. Springler-Vohrleg, Berlin, Germany

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 approaches for plant conservation, IPR and IUCN classification of 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, Neutraceuticals Bioprospecting, Biopiracy.
Intellectual property Rights: Forms of protection, Patents, Trademarks, Trade secrets, Designs, Geographicalindications, 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
Azadirachta indica
Centella asiatica
Piper longum
Rauwolfia serpentina
Zingiber officinale
Vinca rosea
Emblica officinalis
Cinnamomum suphuratum

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. Priniciples 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: Causes of succession, Primary and secondary succession; Types – Hydrosere, Xerosere, Psamosere. 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 recruitment, phenology.

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

Unit III:
Synecology (Community ecology): Definition and brief history, Major plant communities: Tropical forest, Temperate forest, Deserts, Grasslnd, Taiga, Tundra. 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 - gradiant 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 speices 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 NewYork.

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 microasopy, 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, Ame's 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 ecolological 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

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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 getting a good grounding on the concepts of genetics

- Sequence analysis exercise introduces them to this recent method

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Study of mitosis and meoisis 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:

Tannis, dyes, gums and resins

Tannis from bark, wood, leaves and fruits - uses of tannis

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 MacGrawHill 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 disadvange 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. Standardistation 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

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Laboratory organization, fumigation, sterilization techniques.

Preparation of culture media.

Effect of media on callus development / morphogenesis / embryogeneis.

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

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

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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:

- 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

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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:

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

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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 nonbiology 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, NewYork.

Bose, T.K., Sadhu, M.K.,& Das,P.,1986. Propagation of Tropical and Subtropical Horticultural crops, Nowya Prakash, Calcutta.
Hartmann and Kester,1983. Plantpropagation

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, NewDelhi.

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

L.M.Pierik 1987. In vitro 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. Plant propagation 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 Prinicples 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, PCR (qPCR,RT-PCR),transformation technique .

Unit II:

Genetic engineering:

Gene cloning- Vectors(cloning, shuttle and expression vectors),DNA modifying enzymes (restriction enyzmes, ligases, phosphatases and recombinase), isolation of gene of interest, molecular cloning, identification of cloned genes, DNA sequencing-Chain termination method, Chromosome walking.

Unit III:

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

Unit IV:

Vectorless gene transfer - microinjection, electroporation, chemical transformation, liposome mediated, ultrasound mediated, calcium phosphate co precipitation, particle bombardment method. Advantages and disadvantages of direct gene transfer.

Vector mediated 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:

Transgenic plants: Antisense technology, molecular farming. Application of Transgenic plants- in crop improvement - Resistance to biotic stress (insect resistance, virus resistance, disease resistance), Resistance to abiotic stress (herbicide resistance, metal tolerance).Transgenic plants with improved nutritional quality (golden rice), Plantibodies, Edible vaccines. Transgenics for improved quality – delayed ripening and male sterility.GMOs, problems, safety, and public acceptance of cultivating transgenic plants.

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, Newyork.

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

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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, Kruskel and Wallies test.

Distribution of sample mean; standard error and its uses.

Scatter diagram, simple correlation and regression; multiple correlation.

Basic concepts of probability. Theortical distributions - Binomial, Poision 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 desings. Completely randomised design and randomised block design. Comparision 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

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Biodegradation of xenobiotics using plant/ microbes.

Study of DNA integrity of *Allium cepa* root cells under the influence of xenobiotics.

Preparation of Rhizobialbiofertiliser.

Preparation of single cell protein (SCP) & its quantification by Lowry's method.

Isolation of polysaccharide (starch) from plant source.

Morphological characterization of starch using FSEM.

Isolation of pectin and its confirmation using FTIR.

Isolation of RNA and its quantification by Orcinol method

Isolation of DNA and its quantification by DPA method

Estimation of proteins/DNA/RNA – UV vis.

Study of 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 yiedling 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.

International agreements – Ramsar conservation, World heritage convention, Earth summit, Man and Biosphere programme (MAB), Joint Forest Management (JEM), Brief account on Global Environment Facility (GEF), DIVERSITAS, Tree of life, Alliance for Zero extinction (AZE).

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, Toranto.

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.

Kamaljith S. Bawa 2004 Conservation Biology – A primer for South Asia – University Press (India) Pvt. Ltd.

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.

Singh P., Karthigeyan, P. Laxminarasimhan and S.S. Dash 2015. Endemic vascular plants of India – Botanical Survey of India.

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.