Semester I

BOT 401: MICROBIOLOGY - MYCOLOGY

Unit – 1. Bacteria

- General account, Archae and Eubacteria.
- Classification of micro-organisms, microbial morphology (shapes).
- Basic methods in microbiology, economic importance

Unit – 2. Virus

- Virus, characteristics, virions.
- Bacteriophages, lytic and lysogenic, economic importance.
- Phytoplasma, characteristics, plant diseases

Unit – 3. Mycology

- General characteristics, ultrastructure, hyphal Growth, aggregations in Fungi, Nutrition and Reproduction, economic importance
- Recent trends in Classification - Ainsworth; Alexopoulos and Mims.
- General Account of various groups, Heterothallism, Heterokaryosis and Parasexuality, Mycorrhizae.

Unit – 4. Plant Pathology

- Disease, Classification, Symptoms and Disease triangle. Disease Cycle, Host Parasite relationship
- Disease Control, Role of Weather and Soil fertility on disease development.
- Important diseases - Powdery mildew, Downy mildew, Rusts and Wilts.

SUGGESTED READINGS

Semester I

BOT 401: MICROBIOLOGY - MYCOLOGY

1. Agrios, G. N. 1988. *Plant Pathology.* Academic Press.
2. Alexopoulus, C.J., Mims, C.W. and Blackwel, M. 1996. *Introductory Mycology.* John Wiley and Sons Inc.
3. Foster, A.S. and Gifford, E.M. 1967. *Comparative Morphology of Vascular Plants.* Vakils Feffer and Simons Pvt. Ltd. Bombay.
4. Gareth Jones, D. 1989. *Plant Pathology - Principles and Practice.* Aditya Books, New Delhi.

5. Kumar, H.D. 1988. *Introductory Phycology.* Affiliated East - West Press Ltd., New Delhi.
6. Mehrotra, R.S. and Aneja, R.S. 1988. *An Introduction to Mycology.* New Age Intermediate press.
7. Mehrotra, R.S. 1988. *Plant Pathology.* New Age Intermediate press.
8. Rangaswamy, G. and Mahadevan, A. 1999. *Diseases of Crop Plants in India.* (4th Ed.).Prentice Hall of India Pvt. Ltd., New Delhi.
9. Webster, J.1985. *Introduction to Fungi.* Cambridge University Press.

BOT- 402: PHYCOLOGY AND BRYOPHYTES

Unit – 1. Algae - Classification

- Criteria for Classification of algae: pigments, reserve food, flagella.
- Classification - Smith, and Recent Classification of 11 Division by Van Hock et al.
- Characteristics of Cyanophyta, Chlorophyta, Phaeophyta and Rhodophyta.

Unit – 2. Algae – Organization

- Cell ultra-structure of Cyanophyta, Chlorophyta, Phaeophyta and Rhodophyta.
- Thallus organization, Reproduction (Vegetative, Asexual & Sexual), algae in diversified habitats (terrestrial, freshwater and marine).
- Applied Phycology: Biofertilizers, food, feed and uses in Industries. Algal blooms, Water Pollution, Toxicity, Biofouling and Control

Unit – 3. Bryophyta – Basics

- General Account, Alternation of generation
- General Classification including of Rothmaler and Proskauer, characteristics of different groups
- Origin, Reproduction, Vegetative, Sexual, Distribution in India

Unit – 4. Bryophyta – Applications

- Economic and Ecological Importance
- Fossil Bryophytes, general account of fossil Bryophytes – Takakia
- Research in Bryophytes

BOT- 402: PHYCOLOGY AND BRYOPHYTES

1. Morris, I. 1986. *An Introduction to the Algae.* Cambridge University Press, U.K.
2. Parihar, N.S. 1991. *Bryophyta.* Central Book Depot, Allahabad.
3. Puri, P. 1980. *Bryophytes*. Atmaram & Sons., Delhi.
4. Round, F. E. 1986. *The Biology of Algae.* Cambridge University Press, Cambridge.
5. Smith, G. M. 1972. *Cryptogamic Botany.* Vol. 1 & 2. Tata McGraw Hill Publishing Co. Ltd. New Delhi.

BOT 403: PTERIDOPHYTA-GYMNOSPERMS

Unit - 1. Pteridophyta - Basics

- General characters. Origin and evolution
- Alternation of generation, Evolution of Stele, Telome theory.
- Classification – Smith and General Account of various groups

Unit - 2. Pteridophyta – Evolution

- General account of Fossil Pteridophyta - *Asteroxylon*, *Miadesmia*, *Sigillaria* and *Calamophyton*.
- Spore producing parts and Soral Evolution. Origin and development of Heterospory. Origin of Seed habit
- Distribution of Pteridophytes in India, Economic importance

Unit – 3. Gymnosperms

- General characters, Classification by Coulter and Chamberlain, Sporne.
- Origin and evolutionary trend – primary vasculature, secondary wood, leaf, gametophyte, male – female and embryo
- Distribution of Gymnosperms in time and space (India). Economic Importance of Gymnosperms

Unit – 4. Paleobotany

- Techniques for Paleobotanical study, Paleoclimates, process of fossilization.
- General account of Pteridospermales, Bennettitales, Pentoxylales and Cordaitales.
- Gondwana flora, fossilized Pteridophytes – Gymnosperms

BOT 403: PTERIDOPHYTA-GYMNOSPERMS

1. Parihar, N.S... 1996. *Biology and Morphology of Pteridophytes.* Central Book Depot, Allahabad.
2. Sporne, K.K. 1991. *The Morphology of Pteridophytes.* B.I. Publishing Pvt. Ltd. Bombay.
3. Stewart, W.N. and Rathwell, G.W. 1993. *Paleobotany and the Evolution of Plants.* Cambridge University Press.
4. Bhatnagar, S.P. and Moitra, A. 1996. *Gymnosperms*. New Age International Pvt. Ltd., New Delhi.
5. Singh, H. 1978. *Embryology of Gymnosperms. Encyclopaedia of Plant Anatomy X.* Gebruder Bortraeger, Berlin.

BOT 404: PLANT TAXONOMY

Unit – 1. Botanical Nomenclature

- Taxonomy and systematic botany, aim, concepts of plant classification.
- Botanical nomenclature, International Code of Botanical Nomenclature, salient features, species concept
- Tools of taxonomy, plant explorations, collection, herbarium, methodology, flora, Botanical garden, BSI, e – herbarium

Unit – 2. Classification Systems

- Systems of classification(Natural, artificial, phytogenetic) and their merits/ demerits
- Taxonomic evidences (anatomy, embryology, phytochemistry, numerical, molecular)
- Phytogeography, regions of the world, flora of India, Gujarat flora

Unit – 3. Morphology

- Vegetative plant parts (root/ stem/ leaves) and their modifications
- Reproductive plant parts (Inflorescence/ flower/ fruit/ seed) and their modifications
- Plant forms, origin and general evolutionary trends in flowering plants.

Unit – 4. Plant Families

- Plant identification and use of keys, taxonomic literature
- Plant families – dicot (15) characteristics with representative examples and economic importance
- Plant families – monocot (05) features with examples and economic importance.

BOT 404: PLANT TAXONOMY

1. Raghavan, V.1999. *Developmental Biology of Flowering plants.* Springer - Verlag, New York.
2. Singh, G. 1999. *Plant Systematics - Theory and Practice.* Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
3. Stebbins, G.L. 1974. *Flowering Plant - Evolution above Species Level.* Edward Arnold Ltd. London.
4. Takhtajan, A.L. 1997. *Diversity and Classification of Flowering Plants.* Columbia University Press, New York.
5. Naik, V.N. 1984. *Taxonomy of Angiosperms.* Tata McGraw - Hill Publishing Co. Ltd. New Delhi.

BOT 405PR: Practical – I: Based on topics covered in BOT 401 and 402

BOT 406PR: Practical – II: Based on topics covered in BOT 403 and 404

Semester II

BOT 407: CYTOLOGY AND EVOLUTION

Unit – 1. Membrane Systems

- Plasma Membrane: Structure, Models and Functions, Plasmodesmata: Structure and Functions.
- Plant Vacuole: Tonoplast Membrane; functions
- Nucleus : Structure; Nuclear Pores; Nucleosome Organization;

Unit – 2. Cytoskeleton and Organelles

- Structure and function of Microbodies, Golgi apparatus, Lysosomes and Endoplasmic Reticulum.
- The Cytoskeleton; Organization and Role of Microtubules and Microfilaments; Control Mechanisms; Role of Cyclins and Cyclin - dependent Kinases.
- Other Cellular Organelles: Structure and function of Microbodies, Golgi apparatus, Lysosomes and Endoplasmic Reticulum.

Unit – 3. Cell Techniques

- Cell Cycle and Apoptosis: Programmed cell Death; Mechanisms and types, PCD in plant life cycle
- Techniques in Cell Biology, Microscopy (light, phase, contrast), SEM – TEM and Confocal Microscopy and cytophotometry
- Cytochemical techniques, cell fractionation, FISH and flow cytometry

Unit – 4. Evolution

- Fundamentals, forces, sources of variation, evidences
- Evidences and theories of organic evolution, Natural selection, Darwin – Lamarck theory
- Evolutionary divergence, isolating mechanisms, adaptation

BOT 407: CYTOLOGY AND EVOLUTION

1. Burgess, J. 1985. *An Introduction to Plant Cell Development.* Cambridge University Press, Cambridge.
2. Lyndon, R.F. 1990. *Plant Development. The Cellular Basis.* Unnin Hyman, London.
3. Gunning, B.E.S. and Steer, M. W. 1996. *Plant Cell Biology; Structure and Function*. Jones and Barlett Publishers, Boston, Massachusetts.
4. Hall, J.L. and Moore, A.L. 1983. *Isolation of Membranes and Organelles from Plant Cells*. Academic Press, London, UK.
5. Harris, N. and Oparka, K. J. 1994. *Plant Cell Biology: A Practical Approach*. IRL Press, at Oxford University Press, Oxford, U. K.

BOT 408: PLANT PHYSIOLOGY

Unit – 1. Water and Mineral Nutrition

- Water, characteristics importance for plant, water absorption and transport, transpiration
- Mineral nutrition, essential elements, importance and deficiency symptoms
- Nitrogen metabolism, N in environment, assimilation, BNF

Unit – 2. Major Pathways

- Photosynthesis, photosynthetic apparatus, PS I & PS II, mechanism of electron – proton transport, carbon fixation (C_3/ C_4/ CAM), factors affecting photosynthesis, photorespiration – C oxidation cycle,
- Translocation of photosynthetic phloem, source – sink, partitioning and allocation.
- Respiration, Mitochondria, structure, glycolysis, TCA cycle, electron transport, ATP synthesis, different substrates

Unit – 3. Growth and Development

- Growth, development, concept, qualitative – quantative changes
- Growth regulators, biosynthesis, bioassay, mechanism of action, physiological effects, applications (auxin, cytokinin, gibberellins, ABA, ethylene)
- Physiological effects and role of jasmonic acid, polyamines, brassinosteroids, salicylic acid

Unit – 4. Plant Responses

- Phytochrome, Pr and Pfr structure, localization, plant responses, plant movement, cellular actions
- Flowering, shoot apex modification, floral meristem, photomorphogenesis, photoperiodism, biochemical signaling, vernalization
- Stress physiology, water status, deficit, drought, structural and biochemical features to overcome stress, chilling, salinity etc.

BOT 408: PLANT PHYSIOLOGY

1. Salisbury, F.B. and Ross, C.W. 1992. *Plant Physiology* (4th edition). wadsworth Publishing Co. california, USA.
2. Singhal, G.S., Renger, G., Sopory, S.K., Irrgang, K.D. and Govindjee 1999. *Concept in Photobiology: Photosynthesis and Photomorphogenesis.* Narosa Publishing House, New Delhi.
3. Taiz, L. and Zeiger, E. 1998. *Plant Physiology* (2nd edition). Sinauer Associates, Inc., Publishers, Massachusetts, USA.
4. Thomas, B. and Vince-Prue, D. 1997. *Photoperiodism in Plants* (2nd edition). Academic Press, San Diego, USA.

5. Bewley, J.D. and Black, M. 1994. *Seeds: Physiology of Developmentand Germination.* Plenum Press, New York.
6. Bajracharya, D. 1999. *Experiments in Plant Physiology: A Laboratory Manual.* Narosa Publishing House, New Delhi.
7. Moore, T.C. 1974. *Research Experiences* in *Plant Physiology: A Laboratory Manual*. Springer -Verlag, Berlin.
8. Nileson, E.T. and Orcutt D.M. (1996) The Physiology of Plants under Stress. John Wiley & Sons. Inc New York.
9. Advances in Plant Physiology, vol.10, by D.K.Arora and Seema Gupta,1996.Anmol Publications Pvt Ltd.
10. Plant Physiology : Fundamentals and Applications, second edition, by Arvind Kumar and S.S.Purohit, 2001, Agrobios.

BOT 409: PLANT ECOLOGY

Unit – 1. Basics of Ecology

- **Ecological Factors:** Soil, light, water etc, Principles of limiting factors; biotic factors, Productivity: Population ecology – concept, types, fluctuation, factors regulating size, mortality – natality
- Population ecology, concept, type, fluctuations, factors regulating size, autecology, mortality, natality.
- **Ecosystem Organization:** Structure and Function, Types, Energy Flow in Ecosystem, Biogeochemical cycles (C, N, P and S).

Unit – 2. Community and Biodiversity

- **Vegetation Organization:** Composition and Structure of Plant Community, Qualitative and Quantitative Characteristics, Phytosociological Methods, Ecological Niche.
- **Vegetation Development:** Process of Ecological Succession, Models and Climax Stage, Hydrosere, Xerosere and causes of succession, productivity - concept.
- **Biological Diversity:** Concepts and levels; role of biodiversity in ecosystem functions and stability; speciation and extinction; IUCN categories of threat; biodiversity hot spots; ecology of plant invasion;

Unit – 3. Environmental Issues

- **Climate Change:** Greenhouse gases (CO_2, CH_4, N_20, CFCs; sources, trends and role); ozone layer and ozone hole, consequences of climate change (CO_2 fertilization, global warming, sea level rise, UV radiation).
- **Environmental Pollution:** Air, Land and Water. Pollution, **k**inds; sources; quality parameters;
- Ecological Adaptations, various adaptations, types, sustainable development, EIA

Unit – 4. Remote Sensing

- Principles, components and types of Remote sensing
- Applications of remote sensing
- IRS, RADAR, GIS, GPS

BOT 409: PLANT ECOLOGY

1. Basic Ecology – Eugene P. Odum
2. Fundamentals of Ecology- P. Odum
3. Concept in Indian Ecology and Environmental Science – S. V. S. Rana
4. Ecology Theories and Application – Peter Stiling
5. Ecology & Environment – P. D. Sharma
6. Indian Manual of Plant Ecology – R .Misra & G. S. Puri
7. Responses of Plants to environmental stresses, Levitt, J. (1980) Academic Press.
8. Ecology, N.S. Subrahmanyam & A.V.S.S. Sambamurthy, Narosa Publishing House

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BOT - 410: PLANT BREEDING AND HORTICULTURE

Unit - 1. Breeding

- Plant breeding – objectives, origin, domestication, hybrid vigour
- Principles and methods of Plant Breeding, Self pollinated crops, Cross pollinated crops, Clonal crops
- Plant Introductions - NBPGR

Unit - 2. Biosafety and Bioethics

- IPR, Patents, concept, benefits, GATT TRIPS
- Biosafety and bioethics,: objectives, risk assessment, containment, genetically modified plants
- Seed certification, Release of varieties, Plant Breeder's Right, Labeling, Legislation

Unit – 3. Horticulture

- Propagation by seeds and vegetative structures, harvesting, storage and viability, germination, dormancy (seed and bud), Pretreatments
- Techniques, anatomical and Physiological aspects of rooting of cuttings, Grafting, Budding, Layering
- Important horticultural crops of India with emphasis on Gujarat fruit/ flowers, cultivation, harvest and post – harvest handling.

Unit – 4. Gardening and Landscape

- Cultivation under cover, greenhouse: advantages, construction, types, maintenance. Organic farming, mulching, composting, IPM, advantages
- Landscaping – principles, types, planning, Xeriscaping
- Garden – features / elements, styles, Indoor gardening, Gardens of India

BOT - 410: PLANT BREEDING AND HORTICULTURE

1. Callow, J.A., Ford-Lloyd, B.V. and Newbury, H.J. 1997. Biotechnology and Plant Genetic Resources: Conservation and Use. CAB International, Oxon, UK.
2. Manual of cultivated plants by L.H.Bailey 1958.The Macmillan Company,New York.
3. Commercial Floriculture, by S. Prasad and U.Kumar,1998.Agrobotanica.
4. Commercial flower Production, by Utpal Banerjee,2001,Mangal Deep Publications,Jaipur.
5. Some beautiful Indian Trees, second edition,by E. Blatter and Walter S. Millard,1997,Oxford University Press.
6. Some beatiful Indian Climbers and Shrubs, second edition, by N.L.Bor and M.B.Raizada,Oxford University Press.
7. Floriculture in India, by G.S.Randhawa and A.Mukhopdhyay, 1998 ,Allied Publishers Limited.
8. Chopra, V.L. 2001. *Plant Breeding*: *Theory and Practice*. Oxford IBH Pvt.Ltd. New Delhi.
9. Chopra, V.L. 2001. *Plant Breeding*: *Field Crops*. Oxford IBH Pvt.Ltd. New Delhi.

BOT 411PR: Practical – III: Based on topics covered in BOT 407 and 408

BOT 412PR: Practical – IV: Based on topics covered in BOT 409 and 410

Semester III

BOT – 501: PLANT ANATOMY AND EMBRYOLOGY

Unit - 1. General Anatomy

- Shoot and Root Apical Meristem, Cellular manifestation and factors affecting development, Shoot apex of Pteridophyta, Gymnosperm and Angiosperm, lateral roots, root hairs
- Epidermis, stomata, trichomes, types, role
- Secretory Ducts and Laticifers, types, development, function.

Unit - 2. Plant Wood

- Vascular elements, functional differentiation, p proteins
- Nodal Anatomy, Nodal types, leaf gaps, branch
- Wood development and environmental factors, heartwood, softwood and Role of cambium.

Unit – 3. Gametophyte Development

- Structure and development of microsporangium. Microsporogenesis, development of male gametophyte.
- Structure and development of megasporangium. Megasporogenesis, development of female gametophyte.
- Different types of embryo sacs, ultra structure of embryo sac, Nutrition.

Unit – 4. Fertilization

- Pollination, Pollen pistil interaction, Pollen viability, storage, germination, Fertilization, sexual incompatibility
- Embryo development, Types of embryogeny, Polyembryony, Nutrition, endosperm, seed development
- Palynology — morphographic, aeropalynology, Mellitopalynology, Paleopalynology, forensic palynology.

BOT – 501: PLANT ANATOMY AND EMBRYOLOGY

1. Bhojwani, S.S. and Bhatnagar, S.P. 2000. *The Embryology of Angiosperms.* [4th revised and enlarged Ed.]. ViKas Publishing House, New Delhi.
2. Fageri, K. and Van der Pijl, L. 1979. *The Principles of Pollination Ecology.* Pergamon Press, Oxford.
3. Fahn, A.1982. *Plant Anatomy.* [3th Ed.]. Pergamon Press, Oxford.
4. Proctor, M. and Yeo, P. 1973. *The Pollination of Flowers.* William Collins Sons., London.

5. Raghavan, V.1997. *Molecular Embryology of Flowering Plants.* Cambridge University Press, Cambridge.
6. Shivanna, K.R. and Sawhney, V.K. [eds.] 1997. *Pollen Biotechnology for Crop Production and Improvement.* Cambridge University Press, Cambridge.
7. Shivanna, K.R. and Rangaswamy, N.S. 1992. *Pollen Biology: A Laboratory Manual.* Springer - Verlag, Berlin.
8. Shivanna, K.R. and Johri,B.M. 1985. *The Angiosperm Pollen: Stucture and function.* Wiley Eastern Ltd., New York.
9. Shivanna, K.R. and Rangaswamy, n.S. 1992. *Pollen Biology*: *A Laboratory Mannual.* Springer - Verlag, Berlin - Heidelbrrg (and references therein).

BOT - 502: CLASSICAL AND MOLECULAR GENETICS

Unit - 1. Mendelian Genetics

- Genetics – principles of inheritance, pea as a model hybrids
- Gene interactions, linkage and crossing over, genetic mapping
- Extra chromosomal inheritance, chloroplast, Mitochondria, genome and genes.

Unit - 2. Mutation

1. Chromosome aberrations, ploidy, variation in structure and arrangement.
2. Mutation, physical – chemical, molecular basis, recombination, Transposons.
3. Damage and repair, site directed mutagenesis, sex linked inheretance

Unit – 3. Molecular Genetics

- **Molecular basis of genetics, experiments, DNA, characteristics, structure, forms of DNA, gene – genome, replication**
- **Genetic expression, transcription, code, translation, modification**
- **Gene regulation, prokaryotic, operon, eukaryotic**

Unit – 4. Genetic Engineering

- **Recombinant DNA technology, restriction enzymes, gene cloning, choice of vectors.**
- **Construction of genomic/ cDNA library, PCR**
- **DNA analysis, Southern – Northern blotting, sequencing, Molecular markers, microarrays, RNA interference, small RNAs, microRNAs, RNAi based modifications**

BOT - 502: CLASSICAL AND MOLECULAR GENETICS

1. Howell, S.H.1998. *Molecular Genetics of Plant Development.* Cambridge University Press, Cambridge.
2. Murphy, T.M. and Thompson, W.F. 1988. *Molecular Plant Development.* Prentice Hall, New Jersey.
3. Weshthoff, P. 1998. *Molecular Plant Development: from Gene to Plant.* Oxford University Press, Oxford, UK.
4. Atherly, A.G., Girton, J.R. and McDonald, J.F. 1999. The Science of Genetics. Saunders College Publishing, Fort Worth, USA.
5. Russel, P.J.1998. Genetics. The Benjamin/Cummings Publishing Co. Inc., USA.
6. Snustad, D.P. and Simmons, M.J.2000. Principals of Genetics. John Wiley & Sons, Inc., USA.
7. Stent, G.S. 1986. Molecular Genetics. CBS Publication.
8. Brown, T.A. 1999. Genomes. John Wiley & Sons (Asia) Pvt. Ltd., Singapore.
9. Chrispeels, M.J. and Sadava, D.E. 1994. Plants, Genes and Agriculture. Jones & Bartlett Publishers, Boston, USA.
10. Collin, H.A. and Edwards, S. 1998. Plant Cell Culture. Bios Scientific Publishers, Oxford, UK.
11. Primrose, S.B. 1995. Principals of Genome Analysis. Blackwell Science Ltd., Oxford, UK.

BOT - 503: BIOINFORMATICS AND BIOSTATISTICS

Unit – 1. Basics of Computers

- Introduction to Bioinformatics and basics of computers
- Operating systems
- Databases

Unit - 2. Bioinformatic Tools

- Bioinformatic workstation
- Sequence alignment
- Genomics and proteomics, Applications

Unit – 3. Biostatistics – Scope

- Principle and scope of statistical methods in biological research
- Sampling, Data- types, Data Collection, Presentation of data
- Measures of central tendency- Mean, median, mode

Unit – 4. Biostatistics – Methods

- Standard deviation/ error, Coefficient of variation, confidence limits, Tests of statistical significance (chi square, student t test)
- Probability - definitions of various events in probability, laws.
- Linear correlation, Linear regression, ANOVA, Use of computer in statistical analysis

BOT - 503: BIOINFORMATICS AND BIOSTATISTICS

1. Bioinformatics-A beginners Guide-Claverie J & Notredame C
2. Developing Bioinformatics Computer Skills-Gibas C & Jambeck P
3. The single Genetic Algorithm-Vose M D
4. Bioinformatics-Sequence,structure and Databases –Higgins D & Taylor W.
5. A Text Book of Biotechnology, R.C. Dubey, S. Chand Publication.

BOT - 504: PHYTORESOURCES AND CHEMISTRY

Unit - 1. Phytoresources

- Origins of agriculture, World centers of primary diversity of domesticated Plants;
- Origin, evolution, botany, cultivation and uses of Food, forage-fodder fuel, Fiber, furnishings, flavours, Medicinal plants, and oil-yielding plants of Gujarat and India.
- Non-wood forest products (NWFPs): Raw materials for paper – making, Gums and Resins, Dyes.

Unit – 2. Ethnobotany and Conservation

- Basic methods and approaches to study traditional knowledge, various sub disciplines
- Scope, voucher specimen, verification, screening and potential applications
- Conservation, principles, strategies, *in situ* – *ex situ*, protected areas, gene – seed banks, initiatives (international/ national), IUCN.

Unit – 3. Phytochemistry and Pharmacognosy

- Secondary metabolites, types – characteristics, extraction strategies, analysis, biosynthetic pathways and inter relationships
- Pharmacognosy, morphology (macro – micro), methods, adulterants, quality control.
- Role of Phytochemicals, commercial exploitations (cultivation, *in vitro* approaches), important medicinal plants with uses and yielding active principles from underground parts/ whole plant/ flowers/ fruits/ seeds.

Unit - 4. Metabolism

- Enzymes, types, distribution, Km value and enzyme kinetics, factors affecting activity
- Carbohydrates, structural types, biosynthesis, functions
- Proteins, amino – acids, types, structural characters, functions; Lipids, types, biosynthesis, storage lipids, function

BOT - 504: PHYTORESOURCES AND CHEMISTRY

1. Cooper, T.G. 1977. *Tools in Biochemistry*. John Wiley, New York. USA.
2. Copeland, R.A. 1996. *Enzymes*:*A Prectical Introduction to Structure, Mechanism, and Data Analysis.* VCH Publishers, New York.
3. Dennison, C. 1999. *A Guide to Protein Isolation*. Kluwer Academic Publishers. Dordrecht, the Netherland.
4. Dryer, R.L. and Lata, G.F. 1989. *Experimental Biochemistry.* Oxford University Press, New York.
5. Hames, B.D. (ed.) 1998. *Gel Electrophoresis of Proteins: A Practical Approach*, (3rd Ed.). PAS, Oxford University Press, Oxford, U.K.
6. Harborne, T.C. 1981. *Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis.* Chapman and Hall, London.
7. Plummer, D.T.1988. *An Introduction to Practical Biochemistry.* Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
8. Economic Botany – by S. L. Kochhar
9. Economic Botany – by A. V. S. S. Samba Murty
10. Economic Botany – by Bendre & Kumar
11. Ethno botany – Rajiv K. Sinha & Shweta Sinha
12. Contribution to Indian Ethno botany – I
13. Contribution to Indian Ethno botany – I – Jain. S. K
14. Ethno botany, Interdisciplinary Science Reviews
15. Economic Botany by A.V.S.S. Samba Murty and N.S. Subramanyam,Wiley Eastern Ltd.
16. A Manual of Ethnobotany, 2nd Edition, by S.K. Jain. Scientific Publishers, Jodhpur.
17. Ethnobiology, by Rajiv K. Sinha and Shweta Sinha, Surbhi Publication, Jaipur.
18. Wilson, K. and Walker, J.1994.*Practical Biochemistry: Principles and Techniques,* (4thEd.).Cambridge University Press,Cambridge, U.K.

BOT 505PR: Practical – V: Based on topics covered in BOT 501 and 502

BOT 506PR: Practical – VI: Based on topics covered in BOT 503 and 504

Semester IV

BOT- 507: PLANT BIOTECHNOLOGY

Unit – 1. Plant Tissue Culture

- General technique, Laboratory and equipments, aseptic techniques, nutrient medium, plant growth regulators
- Morphogenesis, Plant regeneration, somatic embryogenesis, advantages, synthetic seeds
- Callus, induction, transfer – subcultures, growth kinetics, cell suspension, application

Unit – 2. In vitro Production

- Micropropagation, cloning, various stages, applications, pathogen indexing, meristem culture, virus free plants, therapy (chemo/ Thermo), advantages
- Haploids, androgenesis, various pathways, factors affecting, advantages – applications, gynogenesis
- Phytochemicals, large scale cultures, bioreactors, improvement – elicitors, two phase systems, hairy root cultures, biotransformation, applications

Unit – 3. Plant Improvement

- Somatic hybridization, protoplast isolation, culture, fusion, selection of hybrids, advantages.
- Somaclonal variation, origin, factors inducing variations, cell selection, advantages
- Transgenic plant, gene construct, Ti plasmid, transformation, direct gene transfer methods, advantages

Unit – 4. Complementary Techniques

- Germplasm conservation, slow growth, cryopreservation (freezing – thawing), cryoprotectants, applications
- Distant hybridization, in vitro pollination/ fertilization, embryo culture, embryo – rescue, applications
- Commercial outlook, technology, important plants, International and Indian status, issues

BOT- 507: PLANT BIOTECHNOLOGY

1. Bhojwani, S.S. 1990. Plant Tissue Culture: Theory and Practical (a revised edition). Elsevier Science Publishers, New York, USA.
2. Bhojwani, S.S. 1996. Plant Tissue Culture: Application and Limitations. Elsevier Science Publishers, New York, USA.
3. Vasil, I.K. and Thorpe, T.A. 1994. Plant Cell and Tissue Culture. Kluwer Academic Publishers, the Netherlands.
4. Shantharam, S. and Montgomery, J.F. 1999. Biotechnology, Biosafety and Biodiversity. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
5. Glick, B.R. and Thomson, J. E. 1993. *Methods in Plant Molecular Biology and Biotechnology*. CRC Press, Boca Raton, Florida.
6. Glover, D. M. and Hames, B. D. (Eds.), 1995. *DNA Cloning 1: A Practical Approach; Core Techniques*, (2nd edition). PAS, IRL Press at Oxford University Press, Oxford.
7. Hackett, P.B., Fuchs, J.A. and Messing, J. W. 1988. *An introduction to Recombinant DNA Techniques: Basic Experiments in Gene Manipulation*. The Benjamin / Cummings Publishing Co., Inc Menio Park, California.
8. Shaw, C. H. (Ed.), 1988. *Plant Molecular biology: A Practical Approach*. IRL Press, Oxford.

BOT- 508: BIOPHYSICS AND MODERN APPROACHES

Unit – 1. Biophysics

- Free radicals, Bonds: types and their role
- Laws of Thermodynamics, role in plant processes and functions.
- Tracer techniques Autoradiography: Principle and Working, effect of radiation on biological system

Unit – 2. Separation methods

- Electrophoresis: Principle, types, IEF, technique and application.
- Chromatography: Principle, types, TLC, GLC, HPLC, technique and application.
- Centrifugfation, principle, differential density, ultracentrifugation, application

Unit – 3. Analytic techniques

- Spectroscopy: Gel filtration (ion/ affinity/ exclusion), Principle, types, UV – visible technique and application
- X – ray diffraction, atomic absorption, application
- Advanced spectroscopy, IR, NMR, biosensors

Unit – 4. Modern Approaches

- Sustainable Agriculture, Organic Cultivation, Carbon Trading
- Food Biotechnology, transgenic, strategies
- Nutraceuticals and medicinal Plants

Suggested Readings:-

1 Basic Biophysics by Deniel, Agrobotanical Publishers
2 Principles and Techniques of Practical Biochemistry by Keith Wilson and Jhon Walker Cambridge University Press.
3 Environmental Science by S.C. Santra, New Central Publication, Kolkata.
4 Electrophoresis Theory, Techniques, and Biochemical and Clinical Applications, by Anthony T. Andrews, Clarendon Press, Oxford.
5 Useful Techniques for Plant Scientists, Arvind M. Dhopte and Manuel Livera, Publication Forum for Plant Physiologist, Akola, India.
6 A Text Book of Biotechnology, R.C. Dubey, S. Chand Publication.

BOT 509E: Elective – I

Total Credits: 4

Unit 1. Knowledge enhancement

i. Seminars – in house 0.25/ sem = 0.75 (in 3 semesters)
- Attend/ participate elsewhere with certificate = 0.25

ii. Assignment with write – up and documentation under guidance = 1.0

Unit 2. Skill development

i. Workshop - Training – on photography/ Drawing/ model making/ techniques/ Industrial training/ nursery exercises etc. certificate of completion

For 3 days = 0.5

For 6 days = 1.0

Unit 3. Capacity building

i. Excursion – ethnobotanical/ floristic study , with report

For 3 days = 0.5

For 6 days = 1.0

ii Visit to Institute – for industrial/ institutional with certificate of completion = 1.0

For 2 institutions = 0.5

For 4 institutions = 1.0

Unit 4. Proficiency

i. Scientific Writing 1 period/ 15 days = 0.5

ii. Soft Skill 1 period/ 15 days = 0.5

iii. Communicative English 1 period/ 15 days = 0.5

BOT 510PP: Project Proposal

Compilation under guidance with write – up including introduction, problem, aim, literature survey, methodology, probable outcome, bibliography and enclosures.

BOT 512PR: Practical – VII: Based on topics covered in BOT 506 and 507
