



हिमाचल प्रदेश केंद्रीय विश्वविद्यालय Central University of Himachal Pradesh

(Established under Central Universities Act 2009)

अस्थाई शैक्षणिक खण्ड, शाहपुर, जिला काँगड़ा, हिमाचल प्रदेश - 176206

Temporary Academic Block, Shahpur, Distt. Kangra (HP) - 176206

Website: www.cuhimachal.ac.in

Courses Contents for the Courses offered to M.Sc. Botany, 3rd Semester in the Monsoon Semester (July to December, 2020)

Course Code: (BOT 121)

Course Name: Plant Physiology

Credit: 04

Unit 1

Photosynthesis: General concepts and historical background, photosynthetic pigments and light harvesting complexes, mechanism of electron transport chain, carbon assimilation: the calvin cycle, photorespiration and its significance, the C4 cycle, the CAM pathways.

Unit 2

Respiration: Overview of plant respiration, Glycolysis, the TCA cycle, electron transport and ATP synthesis, pentose phosphate pathways.

Unit 3

Nitrogen Metabolism: Nitrate assimilation: nitrate, light, and carbohydrates regulate nitrate reductase, nitrite reductase converts nitrite to ammonium, plants can assimilate nitrate in both roots and shoots. Ammonium assimilation: conversion of ammonium to amino acids requires two enzymes, biological nitrogen fixation, Nod factors, nodule formation in plants.

Unit 4

Water Balance in Plants: Water in the soil, water moves through the soil by bulk flow, water absorption by roots—Apoplast and Symplast pathways, Active and Passive absorption of water, factors affecting rate of water absorption in plants, theories of ascent of sap: root pressure theory, vital theories and physical theories, cohesion tension theory, physical challenges of xylem transport of water in tall trees.

Unit 5

Stress Physiology: Drought stress/Water stress- effects on the plants, mechanism to avoid water stress, drought signalling. Heat stress- effects of heat stress, mechanism to avoid heat stress, defence mechanism of plants against heat stress. Cold stress-types, symptoms in plants, injuries and defense mechanism, mechanism to tolerate chilling stress, mechanism to avoid freezing stress, cold stress signalling. Salt stress-causes, effects on plants, response of plants, defence strategies/mechanisms of plants.

Suggested Readings:

1. Taiz I and Zeiger E (1998) Plant Physiology (2nd edition) Sinauer Associates Inc. Publishers, Massachusetts, USA.
2. Nelson DL and Cox MM (2008) Lehinger Principles of Biochemistry: 5th Edition Publisher- Sara Tenney.



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COURSE CODE: BOT 419

COURSE NAME: Anatomy and Development of Plants

Credit: 02

Unit I

Introduction to Plant Anatomy: Composition, structure and organization of plant cell wall; Anatomy of root, stem and leaf of monocot and dicot plants; Secondary growth in stem and root.

Unit II

Shoot development: Organization of the shoot apical meristem (SAM) and tissue differentiation, Leaf growth and differentiation of epidermis and mesophyll, Stomata; types and distribution.

Unit III

Root development: Organization of root apical meristem (RAM), cell fates and lineages, tissue differentiation. Lateral roots, root hairs, root microbe interactions. Root shoot transition.

Unit IV

Cambium and Vascular tissue development: Development and structure of the primary xylem, primary phloem, secondary xylem, secondary phloem, sieve tube elements; Development of vascular cambium, cork cambium and structure of its derivatives.

Unit V

Floral development and Embryology: Floral ontogeny and vascularization; floral development taking the examples of homeotic mutants in *Arabidopsis* and *Antirrhinum*. Development of male and female gametophyte; Embryo development.

Suggested Reading

1. Evert, R.F., 2006. *Esau's plant anatomy: meristems, cells, and tissues of the plant body: their structure, function, and development*. John Wiley & Sons.
2. Beck, C.B., 2010. *An introduction to plant structure and development: plant anatomy for the twenty-first century*. Cambridge University Press.
3. Raghavan, V., 2012. *Developmental biology of flowering plants*. Springer Science & Business Media.
4. Bhojwani, S. S & Bhatnagar, S. P. 2000. *The Embryology of Angiosperms*, Vikas.



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Course: Plant Ecology and Evolution

Course Code: BOT 518 (04 credits)

Unit-I

FUNDAMENTAL OF ECOLOGY

Evolutionary ecology, environmental concepts – laws and limiting factors, ecological models, Competition and coexistence; keystone species, ecotypes, nature of ecosystem, production, food webs, biogeochemical cycles, resilience of ecosystem, ecosystem management.

Unit-II

Darwinism and Microevolution: Pre-Darwinian developments, Darwin's theory of evolution, Artificial Selection: Intentional vs. Unintentional, Natural Selection, Darwinian Fitness, Adaptation, Overproduction, Types of Selection: Purifying vs. Positive, Co-evolution, Nature of Natural Selection

Unit-III

Population genetics and evolution:

Gene in populations, The Hardy-Weinberg Equilibrium, Factors that changes allele frequencies in populations: a) Mutations b) Migration c) Natural selection d) Random genetic drift e) Genetic load.

Unit-IV

Origin and evolution of species:

Biological species concept, Anagenesis and cladogenesis, Allopatric, parapatric and sympatric speciation, Gradualism and punctuated equilibrium, Neo-Darwinism, The shifting- Balance Theory of Evolution

Unit-V

Molecular evolution:

Experimental approaches used to compare species at molecular level, Phylogenetic trees, Molecular drive- a cohesive mode of species evolution, Neutral theory of Molecular Evolution

Suggested Readings:

1. Gardener, E. J., Simmon, M. J and Snustad, D. P. Principles of Genetics. John Wiley & Sons, Inc. NY
2. Weaver, R. F and Hedrick, P. W Genetics Wm. C. Brown Publishers
3. Brown, T. A. Genetics- A Molecular Approach. Chapman & Hall
4. Mitra, s. Genetics- A Blueprint of Life. Tat mc Graw Hill
7. Futuyama, D. J. evolutionary Biology, Suinuaer Associations. INC Publishers, Dunderand.
8. King, M. species evolution- the role of chromosomal change. The Cambridge Univeristy Press, Cambridge.
9. Merrel, D. J. Evolution and Genetics Holt. Richart and Winston Inc.
10. Strikbergeer, M, W, Evolution. Jones and Barlett Publishers. Boston London.



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Courses Contents for the Courses offered to M.Sc. Botany, 3rd Semester in the Monsoon Semester (July to December, 2020)

Course: Bioresources and Biotechnology

Course Code: BOT 520 (02 credits)

UNIT - I

Concept of Biodiversity and Bioresources, levels of biodiversity - genetic, species and ecosystem diversity; measuring organismal diversity: species richness index, species evenness index, Shannon-Wiener Index and Simpson Index, Introduction to remote sensing and geographical information system (GIS), Application of remote sensing for bioresources management

Traditional uses of Plant Bioresources: Applications in Food, Beverages (non-alcoholic), Fibres, Timbers, Dye-yielding, Medicine and Cosmetics

UNIT - II

Causes of biodiversity loss: habitat destruction, unsustainable exploitation, biological invasion, environmental pollution and poverty, species extinction, genetic erosion; Species threat status: IUCN threat categories and criteria; Red Data Book; Biodiversity hotspots

UNIT -III

Bioresources conservation: Bioresource Development Board, Indian Bioresource Information Network; National Biodiversity Authority, State Biodiversity Boards, NBPGR, National Genetic Resource Advisory Council, Global measures for conserving bioresources: international conservation organizations (FAO, UNESCO, IUCN, WWF, UNEP, Biodiversity International)

UNIT -IV

Biotechnological tools for sustainable use and conservation of bioresources

Biotechnology and its role in biodiversity conservation, *In vitro* conservation: micropropagation, cryopreservation, DNA and genomic resource banks, Gene banks; *In situ* conservation: Protected areas - Biosphere Reserves, National Parks, Wildlife Sanctuaries; Reserve Forests; Community conserved areas - Sacred groves and community forests; *Ex situ* conservation: Botanical Gardens, Field gene banks and Seed banks

UNIT -V

Molecular characterization of bioresources: Molecular marker: RAPD, SSR, ISSR, AFLP, EST and their advantages, software for molecular characterization and diversity analysis; role of taxonomy in assessment, conservation and sustainable use of biodiversity

Recommended Books:

1. Ray Samit and A.K. Ray (ed.) 2006. Biodiversity and Biotechnology. New Central Book Agency Ltd. Kolkata.
2. Bhojwani, S. S. (1990). Plant Tissue Culture: Applications and Limitations, Elsevier, Amsterdam.



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3. K. V. Krishnamurthy (2003). Textbook of Biodiversity, Illustrated reprint, Science Publishers. Correa, Carlos M. (2000). Intellectual Property Rights, the WTO and Developing Countries: the TRIPS Agreement and Policy Options. Zed Books, New York.
4. Kurt Weising, Hilde Nybom, Markus Pfenninger, Kirsten Wolff, Gunter Kahl. DNA Fingerprinting in Plants, Principles, Methods & Application, 2nd edition, Taylor & Francis.
5. Engelmann F. (2004). Plant Cryopreservation: Progress and Prospects. *In vitro Cellular and Developmental Biology* 40:427-433.
6. Groom, M.J., Meffe, G.K. and Carroll, C.R. (2006). Principles of Conservation Biology. Sircuier Associates, Inc.
7. Collen, B., Pettorelli, N., Baillie, J. E., & Durant, S. M. (Eds.). (2013). Biodiversity Monitoring and Conservation: Bridging the Gap Between Global Commitment and Local Action. John Wiley & Sons.
8. AmeenahGurib-Fakim. (2014). Novel Plant Bioresources: Applications in Food, Medicine and Cosmetics. Wiley-Blackwell.
9. Magurran, A. E. (2013). Measuring Biological Diversity. John Wiley & Sons.
10. Cardinale, B. J., Duffy, J. E., Gonzalez, A., Hooper, D. U., Perrings, C., Venail, P., & Kinzig, A. P. (2012). Biodiversity Loss and its Impact on Humanity. *Nature*, 486(7401), 59-67
11. Khare, C. P. (2008). Indian Medicinal Plants: an Illustrated Dictionary. Springer Science & Business Media.
12. Trivedi, P.C.(2006). Medicinal Plants: Traditional Knowledge. IK International Pvt Ltd.



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Course: Microbiology and Plant Pathology

Course Code: BOT 515 (04 credits)

UNIT-I

Introduction to Microbiology: Different System of Classifications, Scientific Nomenclature, Methods of Microbial identification, bacterial staining, simple and differential staining

UNIT-II

Culturing microorganisms: types of culture media, enumeration of microbial populations, pure culture and cultural characteristics, Maintenance and preservation of microbial cultures and its importance

UNIT-III

Nutritional classes of Microorganisms, Growth, Physical and chemical agents for control of microbial growth, and their mode of action, Microbial sterilization, disinfectants and antiseptics, chemotherapeutic agents, antibiotic susceptibility test

UNIT-IV

Basic Concept of pathogenicity, Plant pathogens, Koch's postulates, Production, types and survival of inocula of plant pathogens; active and passive dispersal of plant diseases

UNIT-V

Pre-penetration activities of pathogens on host surface, direct penetration through intact plant surfaces, penetration through natural openings, post-penetration development, Defence mechanisms in plants, Phytoalexins; pathogenesis-related (PR) proteins

Books recommended:

1. Pelczar Jr., M.J., Chan, E.C.S. and Krieg, Noel R., Microbiology, McGraw Hill (2003) 5th ed.
2. Stanier, R.Y., Ingraham, J.L. and Wheelis, M.L., General Microbiology, MacMillan (2007) 5th ed.
3. Tortora, G.J., Funke, B.R., and Case, C.L., Microbiology- An Introduction, Pearson Education (2007) 8th ed.
4. Agrios, G. N. (2012). Plant Pathology, 5th Edn. Academic Press, London. Alexopoulos, C. J., Mims, C.W. and Blackwell, M. (1996). Introductory Mycology. John Wiley & sons Inc. New York.
5. Burns, R. (2010). Plant Pathology: Techniques and Protocols. Humana Press Inc., USA.
6. Singh, R. S. (2014). Introduction to principles of plant pathology. Oxford & Ibh Publishing Co Pvt Ltd



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COURSE CODE: (BOT-565)

COURSE NAME: Applied and Industrial Biotechnology

Credit: 02

Unit I

Industrially important microbes, its screening, selection and identification. Screening for productive strains and strain improvement process.

Unit II

Industrial production of secondary metabolites; production of vitamins (Vitamin B12), amino acids (Glutamic Acid), vinegar (Acetic Acid) and organic acid (Citric Acid), production of beer.

Unit III

Use of whole cells for food related purposes (Single cell protein production). Industrial production of antibiotics (Penicillin).

Unit IV

Introduction to bioethanol (biofuel) and its advantages, steps of bioethanol production.

Microbial insecticides, types and their mode of action, production of microbial insecticides.

Unit V

Emerging technologies in agro industries: Composting, methods and steps in composting process, Production of Vermiculture. Biofertilizers, types of biofertilizers, methods of application of biofertilizers. Introduction to Rhizobacteria.

Suggested Readings:

1. Kirakosyan, A. and Kaufman, P.B., 2009. *Recent advances in plant biotechnology* (p. 409). Dordrecht: Springer.
2. Bahadur, B., Rajam, M.V., Sahijram, L. and Krishnamurthy, K.V. eds., 2015. *Plant Biology and Biotechnology: Volume II: Plant Genomics and Biotechnology*. Springer.
3. Plant Biotechnology New Products and Applications. Hammond, J., McGarvey, P., Yusibov, V. (Eds.)
4. [Biotechnology of Natural Products Wilfried Schwab Springer](#) Schwab, Wilfried, Lange, Bernd Markus, Wüst, Matthias (Eds.).



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Course code: BOT 577

Course Name: Economic Botany and Medicinal Plants

Credit: 02

Unit-1: Importance and History of plants

Economic importance of plants and their products; History of food plants; Centers of origin for cultivated plants; New world and Old world (Vavilov centers of origin).

Unit-II: Food Plants: Cereals and Legumes

Origin, distribution, cultivation, botanical description, high yielding varieties and uses of Cereals; Wheat, Rice, Barley, and Maize; Legumes; Chickpea, Pigeon Pea and Pea, Oil yielding plants; Mustard and Groundnut.

Unit-III: Food Plants: Vegetables, Nuts and Spices

Botanical description, cultivation and uses of vegetables; Carrot, Beetroot and Potato, Nuts; Cashew nut and Almond and Spices; Cinnamon, Cloves and Cardamom.

Unit-IV: Sources of beverages, fiber and wood:

Origin, cultivation, botanical description and uses of Coffee and Tea, Uses of wood and wood product; from Cedar, Teak, Sal and Pine; Classification of fiber, and its sources; Cotton and Jute.

Unit-V: Plants of medicinal value:

Origin, distribution, botanical description, active constituents, parts used and uses of Foxglove, Opium Poppy, Madagascar Periwinkle, Ashwagandha, Belladonna, Quinine tree, *Rauwolfia* and *Ephedra*.

Suggested Readings

1. Kochhar, S. L. 2016. Economic Botany a Comprehensive Study. Vth (ed), Cambridge University Press, New York.
2. Macmillan, Wagner, H., Hikino, H & Farnsworth, N. 1989. Economic and Medicinal Plant Research. Vols.1-3. Academic Press, London.
3. Bedi, Y.S., Dutt, H.C. and Kaur, H. (2011). Plants of Indian System of Medicine (Vol. I & II). Lambert Academic Publishing, Germany.
4. Maiti, R.K. and Singh R.K. (2006). An Introduction to Modern Economic Botany. Agrobios (India).
5. Metcalfse, D.S. and Elkins, D.M. (1980). Crop Production: Principles and Practices (IV ed.). Macmillan Publishing Co. Inc. New York.
6. Pradhan S. (1995). Economic Botany. HarAnand Publication, New Delhi.



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COURSE CODE: (BOT-578)

COURSE NAME: Genomics, Proteomics and Metabolomics

Credit: 02

UNIT I: Introduction

Introduction to Omics, different omics tools: Multi-Omics and Meta-Omics. Applications of omics tools in various fields.

UNIT II: Genomics

Genome. Molecular Markers: RFLP, RAPD, AFLP, SSR, SNPs.

Sanger's DNA sequencing, 16s rDNA sequencing.

Brief note on Next generation sequencing (NGS). Whole genome shotgun sequencing (WGS).

Applications of genomics.

UNIT III: Transcriptomics

Transcriptome.

Genome wide expression studies: Microarrays, RNA sequencing (RNA-Seq).

Applications of transcriptomics.

UNIT IV: Proteomics

Proteome. Introduction to Gel based and Gel free proteomics, SDS PAGE, 2D PAGE, Mass Spectrometry, Protein identification by peptide mass fingerprinting.

Applications of proteomics.

UNIT V: Metabolomics

Metabolome.

Tools: Gas and liquid chromatography.

Applications of metabolomics.

Reference Material:

1. Discovering Genomics, Proteomics and Bioinformatics, 2nd edition-A. Malcolm Campbell and Laurie J. Heyer (ISBN 0-8053-4722-4)-Cold Spring Harbor Laboratory press and Benjamin Cummings, 28 Feb 2006.
2. Fundamentals of Advanced Omics Technologies: From Genes to Metabolites, 1st Edition- Carolina Simó Alejandro Cifuentes Virginia García-Cañas, Volume 63, 2008.