



# Central University of Himachal Pradesh

(Established under Central Universities Act 2009)

PO BOX: 21, DHARAMSHALA, DISTRICT KANGRA – 176215, HIMACHAL PRADESH

## List of the courses to be offered in department of plant Sciences during academic session 2019-200

SN	COURSE CODE	COURSE NAME	Credits
<b>M.Sc. Botany semester - I</b>			
1	BOT 504A	Biology and diversity of Bryophytes and Pteridophytes	2
2	BOT 506A	An Introduction to Gymnosperms	2
3	BOT 503 A	Algae	2
4	BOT 410	Mycology and Plant Pathology	4
5	BOT 514	Cytogenetics and Molecular Biology	2
6	BOT 412	Practical Course on Bryophytes, Pteridophytes and Gymnosperms	2
7	BOT 413	Practical Course on Phycology, Mycology, Plant Pathology and Biology	2
<b>Foundation Courses</b>			
8	BOT 424	Herbal and medicinal plants	2
9	BOT 427	Organic farming and practices	2
		<b>Total</b>	<b>20</b>
<b>M.Sc. Botany semester - III</b>			
1	BOT 419	Anatomy and Development of Plants	2
2	BOT 420	Practical Course on Anatomy of Plants	2
3	BOT 565	Applied and Industrial Microbiology	2
4	BOT 576	Genetics	2
5	BOT 578	Genomics, proteomics and metabolomics	2
6	BOT 577	Economic Botany and Medicinal Plants	2
7	BOT 121	Plant Physiology	4
8	BOT 516	Genetics and molecular biology	4
		<b>Total</b>	<b>20</b>



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**Course code: BOT 503 A**

**Course Name: ALGAE**

**Credits: 02**

**Semester-I**

**Course contents**

**Unit I**

General characteristics of algae, Algae in diversified habitats (terrestrial, fresh water, marine), Thallus organization in algae, pigments, reserved food, flagella, Reproduction (Vegetative, asexual, sexual) and patterns of life cycle.

**Unit II**

Division Chlorophyta; Distribution, morphology and life history of following genera: *Chlamydomonas*, *Volvox*, *Ulothrix*, and *Oedogonium*.

**Unit III**

Division Xanthophyta, Bacillariophyta and Phaeophyta; Distribution, morphology and life history of following genera: *Vaucheria*, Diatoms, *Ectocarpus* and *Sargassum*.

**Unit IV**

Division Rhodophyta and Cyanophyta; Distribution, morphology and life history of following genera: *Batrachospermum*, *Polysiphonia*, *Nostoc* and *Anabaena*.

**Unit V**

Blue green algae: A potential Biofertilizer for rice, Algae as a source of Biofuel, Economic importance of algae, Phycoremediation.

**Suggested Reading:**

1. Fritsch, F. E. The structure and reproduction of algae. Vol. I & II, London, Cambridge Univ. Press (1971-72).
2. Round, F. E. (1986). The biology of algae. Cambridge University Press, Cambridge.

3. Kumar, H. D. (1985). Algal cell Biology. Affiliated East-West Pres Limited, New Delhi.
4. Moris. I. (1967). An Introduction to the Algae. Hutchinsen University Library, London.
5. The Algae World Editors: DinabandhuSahoo and Joseph Seckbach DOI 10.1007/978-94-017-7321-8 Springer ISBN 978-94-017-7320-1 ISBN 978-94-017-7321-8.



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PO BOX: 21, DHARAMSHALA, DISTRICT KANGRA – 176215, HIMACHAL  
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**Course code: BOT 514**

**Course Name: CYTOGENETICS AND MOLECULAR BIOLOGY**

**Credit: 02**

**Semester-I**

### **Unit-I**

**Chromatin structure:** Histones, nucleosome and higher level of organization; Functional states of chromatin; Euchromatin, heterochromatin, Lampbrush chromosome, Polytene chromosome and Alterations in chromatin organization

### **Unit-II**

**Cytogenetic aspects of cell division:** Chromosome labeling; Cell cycle analysis, Overview of mitosis and meiosis, sister chromatid cohesion remodeling, regulation of exit from metaphase.

### **Unit-III**

**Nucleus:** structure, nuclear pores; structure, import and export through nuclear pore, nucleolus. DNA structure and replication: structure and forms of DNA; replication in prokaryotes and eukaryotes, damage and repair.

### **Unit-IV**

**Transcription:** Structure of ribosome, promoters and transcription factors, mRNA transport, rRNA biosynthesis, mechanism of translation, initiation, elongation and termination, structure and role of tRNA.

### **Unit-V**

**Recombinant DNA Technology & Gene Manipulation:** General concepts, Various vectors, Enzymes, Cloning strategy in E. coli (plasmid, phage, cosmid, phagemid) and Yeast vectors (YAC), Plants (Ti / Ri plasmids of Agrobacterium).

### **Suggesting readings:**

1. Brown T.A. Genetics: A Molecular Approach. USA: Chapman & Hall, 1999. Print.
2. Glick B.R., and Pasternak, J.J. Molecular Biotechnology. USA: American Society for Microbiology, 1998. Print.
3. Karp G. Cell and Molecular Biology. USA: Wiley & Sons, 1999. Print.

4. Lewin B. Genes VII. UK: Oxford University Press, 2000. Print.
5. Lodish H., Berk, A., Zipursky, L., Matsudaira, P., Baltimore, D., and Darnell, J. Molecular Cell Biology. USA: W.H. Freeman & Co., 2005. Print.
6. Primrose S.B., Twyman, R.M., and Old, R.W. Principles of Gene Manipulation. UK: Blackwell Publisher, 2001. Print.



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PO BOX: 21, DHARAMSHALA, DISTRICT KANGRA – 176215, HIMACHAL  
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**Course Code: BOT 504 A**  
**Course Name: BIOLOGY AND DIVERSITY OF BRYOPHYTES AND**  
**PTERIDOPHYTES**  
**Credit: 02**  
**Semester-1**

**Course Contents:**

**Unit 1**

General characteristics of Bryophytes and their comparison with other cryptogamous plants.

Economic importance of Bryophytes.

**Unit 2**

A general account of following (with reference to genera mentioned):

Marchantiales: *Marchantia*; Anthocerotales: *Anthoceros*;

**Unit 3**

A general account of following (with reference to genera mentioned):

Funariales: *Funaria*; Psilopsida: *Psilotum*.

**Unit 4**

General characteristics of Pteridophytes and their comparison with other archegoniates.

Economic importance of Pteridophytes

**Unit 5**

A general account of following (with reference to genera mentioned):

Sphenopsida: *Equisetum*; Pteropsida: *Adiantum*.

**Suggested readings:**

1. Rashid A (1998) An Introduction to Bryophyta (Diversity, Development and Differentiation). Vikas Publishing House Pvt. Ltd. New Delhi.

2. Watson EV (2005) The Structure and life of Bryophytes. Hutchinson University Library, London.
3. Sharma OP (2017) Text book of Pteridophytes. Mc. Millan India Ltd. New Delhi.
4. Sporne KR (1982) The Morphology of Pteridophytes. Hutchinson University Library, London (Reprinted in 1991 by BI Publishing Pvt. Ltd., Bombay).



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PO BOX: 21, DHARAMSHALA, DISTRICT KANGRA – 176215, HIMACHAL  
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**Course Code: BOT 506 A**  
**Course Name: AN INTRODUCTION TO GYMNOSPERMS**  
**Credit: 02**  
**Semester-1**

**Course Contents:**

**Unit I**

General characteristics and classification of Gymnosperms (Broad outline) and their affinities with pteridophytes and angiosperms.

**UNIT II**

Vegetative morphology and reproduction of the following (with reference to the genera mentioned):

Family: Cycadaceae: *Cycas*

**Unit III**

Vegetative morphology and reproduction of following (with reference to the genera mentioned)

Family: Pinaceae : *Pinus*

**UNIT IV**

Vegetative morphology and reproduction of following (with reference to the genera mentioned)

Ginkgoaceae : *Ginkgo*

**Unit V**

Seed development in Gymnosperms.

Economic importance of gymnosperms.

**Suggested readings:**

1. Biswas, C And Johri, B. M 1997. The Gymnosperms. Narosa Publishing House, New Delhi, 494pp.
2. Bhatnagar, S. P; and Moitra, A. 1996, Gymnosperms, New Age International Pvt. Ltd., New Delhi, 470pp.



3. Foster, A.S. and E.M. Gifford. Comparative Morphology of Vascular Plants. 2nd Ed. W.H. Freeman and Co. , San Francisco. 1974.
4. Meyen, S.V.. Basic features of Gymnosperms, Systematics and Phyogeny as evidenced by the Fossil Record. Bot. Rev. 50 : 1-112. 1984



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**Course Code: BOT 410**  
**Course Name: MYCOLOGY AND PLANT PATHOLOGY**  
**Credit: 04**  
**Semester-1**

**Course Contents:**

**UNIT I**

Koch postulates; Brief introduction to plant disease epidemiology: disease triangle-host factors, pathogen factors, environmental and other factors; disease cycle: stages in disease development in plants; general symptoms of fungal plant diseases, measures to control fungal diseases of plants, tools to study epidemiology. Types of fungal pathogens: biotrophs, necrotrophs, hemibiotrophs and their colonization patterns.

**UNIT II**

Plant diseases caused by fungal pathogens: Late blight of potato (*Phytophthora infestans*), Blast disease of rice (*Magnaporthe grisea*), Black stem rust of wheat (*Puccinia graminis* f. sp. *tritici*), Tikka disease of groundnut (*Phaeoisariopsis personata*). Introduction to Mycorrhizae: beneficial plant-fungal association.

**UNIT III:**

Study of host-parasite interactions, pathogen-recognition and infection, host specific toxins, host non-specific toxins, plant cell wall degrading enzymes, cellulosome complex.

Preformed and inducible plant defenses: oxidative burst, cell wall reinforcement, phenolics, phytoalexins, PR proteins, elicitors, defensins, chitinases, growth regulators.

**UNIT IV:**

Genetic basis of disease resistance and pathogenicity: gene for gene hypothesis (Flor's hypothesis), Plant disease resistance (*R*) genes and structural motifs, effectors molecules, Systemic acquired Resistance (SAR), Induced Systemic resistance (ISR), Hypersensitive Reaction (HR), Non-host resistance.

**UNIT V**

Molecular approaches to clone disease resistance genes; Different transgenic approaches to control fungal diseases in plants.

**Reference Material:**

1. Plant Pathology, T.N. Agrios, Academic Press, 2001
2. Introduction to Plant Pathology, Richard N Strange, 2003, Springer publication
3. Host Pathogen Interactions, Lucas, 2001, Blackwell publication
4. Biochemistry and Molecular Biology of Plants. 2<sup>nd</sup> Edition by Buchanan. Wiley Blackwell publishers.
5. Annual Review of Phytopathology
6. Current Opinion in Plant Biology

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**Credit: 02**

**Semester-III**

**Course Contents:**

**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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PO BOX: 21, DHARAMSHALA, DISTRICT KANGRA – 176215, HIMACHAL  
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**Course code: BOT 577**

**Course Name: ECONOMIC BOTANY AND MEDICINAL PLANTS**

**Credit: 02**

**Semester: III**

**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, Oilyielding plants; Mustard and Groundnut.

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

Botanical description, cultivation and uses of vegetables; Carrot, Beetroot and Potato, Nuts; Cashewnut 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 576**  
**Course Name: GENETICS**  
**Credits: 02**  
**Semester-III**

**Course Contents:**

**Unit-1**

**Mendelian and Non-Mendelian:** Mendel's law; Monohybrid crosses and Law of segregation, Chromosomal theory of inheritance, Incomplete dominance and codominance, Dihybrid crosses and Law of independent assortment, Gene Interaction; dominant and recessive epistasis, Duplicate dominant and recessive epistasis, dominant and recessive interaction.

**Unit-2**

**Allelism and Linkage:** Multiple Allelism: Definition, Characters of Multiple Alleles, Examples of multiple allelism, Theories of multiple allelism, Pseudo-alleles, Pleiotropism and its examples, Linkage: Historical view, kinds of Linkage, Linkage groups, Significance of Linkage, Crossing over: Definition, types, mechanism of meiotic crossing over.

**Unit-3**

**Mutations:** Basic concept, Mutagens: physical (ionizing and non-ionizing radiations) and chemical (Base analogs, Deaminating agents, Alkylating agents), Types of Mutations, spontaneous, induced, suppressor mutation, missense and non-sense mutation.

**Unit-4**

**Population Genetics:** Gene pool, Gene frequency, Hardy-Weinberg Law, Rate of change in gene frequency through mutation, natural selection, migration and genetic drift.

**Unit-5**

**Microbial Genetics:** Bacterial plasmids, Bacterial conjugation:  $F^+ \times F^-$  Mating, Hfr-conjugation and F-conjugation, transformation, transduction: generalized and specialized transductions, mapping the genome. Fungal genetics – mating types and genetic exchange, heterokaryosis, parasexual cycle.

**Suggested Readings:**

1. Brooker R.J. Genetics. USA: Addison-Wesley, Longman Publisher, 1999. Print.
2. Brown T.A. Genetics: A Molecular Approach. USA: Chapman & Hall, 1999. Print.



3. Griffiths A.J.F., Gelbart, W.M., Miller, J.H., and Lewontin. Modern Genetic Analysis. USA: W.H. Freeman & Company, 2002. Print.
4. Karp G. Cell and Molecular Biology. USA: Wiley & Sons, 1999. Print.
5. Lewin B. Genes VII. UK: Oxford University Press, 2000. Print.
6. Russel, P.J. Genetics. California: Addison Wesley Longman, 2006. Print.
7. Snustad, D.P. and Simmons, M.J. Principles of Genetics. USA: Wiley and Sons, 2003. Print.



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**Course Code: BOT 121**  
**Course Name: PLANT PHYSIOLOGY**  
**Credit: 04**  
**Semester-III**

**Course Contents:**

**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 C<sub>4</sub> 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 defence 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: 5<sup>th</sup> Edition Publisher- Sara Tenney.



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**Course Code: BOT 516**  
**Course Name: GENETICS AND MOLECULAR BIOLOGY**  
**Credit: 04**  
**Semester-III**

**Course Contents:**

**UNIT I: Genome complexity**

Central Dogma of molecular Biology and Reversal of central dogma. Genome Organization: C-value paradox, arrangement of genes as operons in prokaryotes vs multigene family, gene clusters in eukaryotes. transposable elements (*Ac-Ds* elements) in maize.

Monogenic vs polygenic traits, features, similarities, comparisons, examples.

**UNIT II: Prokaryotic Transcription**

Transcription unit – start site (TSS), promoter regions, terminator; RNA polymerase, sigma factor; mechanism of transcription-initiation, elongation and termination, Rho-dependant and independent termination; inducible (lactose) and repressible (tryptophan) operons; DNA footprinting to study Promoter-RNA polymerase interactions; inhibitors of prokaryotic transcription.

**UNIT II: Eukaryotic Transcription**

Transcription factors – general features, motifs - zinc fingers, leucine zippers, helix-turn helix, homeodomains, Promoter and regulatory elements – enhancers, silencers, response elements. RNA Polymerase I, II, III. Transcription initiation, elongation and termination. Inhibitors of eukaryotic transcription.

**UNIT III: Post transcriptional modifications**

Introns, exons, mechanism of gene splicing, 5' cap formation, 3' polyadenylation. Brief introduction to RNA editing, RNA interference (RNAi), catalytic role of RNA (Ribozyme).

**UNIT IV: Translation.**

Post-translational modifications of proteins, transport of proteins and molecular chaperones; Protein turnover and degradation; inhibitors of translation.

**UNIT V: Gene discovery**

Methods of screening of genomic and cDNA libraries, Enhancer trap, promoter trap, insertional mutagenesis, genetagging, activation tagging.

**Reference Material:**

1. Alberts B, Bray D, Lewis J, Raff M, Roberts K, and Watson J.D. Molecular Biology of the Cell. Garland Science.
2. Pollard T.D., Earnshaw W.C, Schwartz J.L. Cell Biology. Elsevier Publishing Co.

3. H.Lodish and A.Berk, Molecular Cell Biology, W.H.Freeman Publishers.
4. D.E.Sadava Cell Biology, CBS Publishers.
5. Latest review articles from Peer reviewed journals.
6. Genomes by T. A. Brown.



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**Course Code: BOT 578**  
**Course Name: GENOMICS, PROTEOMICS AND METABOLOMICS**  
**Credit: 02**  
**Semester-III**

**Course Contents:**

**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 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.



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PO BOX: 21, DHARAMSHALA, DISTRICT KANGRA – 176215, HIMACHAL  
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**Course Code: BOT 565**

**Course Name: APPLIED AND INDUSTRIAL BIOTECHNOLOGY**

**Credit: 02**

**Semester-III**

**Course Contents:**

## **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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[www.chuimachal.ac.in](http://www.chuimachal.ac.in)

**Credit: 02**

**Semester-III**

**Course Contents:**

## 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.

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**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.
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**Course code: BOT 577**

**Course Name: ECONOMIC BOTANY AND MEDICINAL PLANTS**

**Credit: 02**

## Semester: III

### 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, Oilyielding plants; Mustard and Groundnut.

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

Botanical description, cultivation and uses of vegetables; Carrot, Beetroot and Potato, Nuts; Cashewnut 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 576**

**Course Name: GENETICS**

**Credits: 02**

**Semester-III**

**Course Contents:**

## **Unit-1**

**Mendelian and Non-Mendelian:** Mendel's law; Monohybrid crosses and Law of segregation, Chromosomal theory of inheritance, Incomplete dominance and codominance, Dihybrid crosses and Law of independent assortment, Gene Interaction; dominant and recessive epistasis, Duplicate dominant and recessive epistasis, dominant and recessive interaction.

## **Unit-2**

**Allelism and Linkage:** Multiple Allelism: Definition, Characters of Multiple Alleles, Examples of multiple allelism, Theories of multiple allelism, Pseudo-alleles, Pleiotropism and its examples, Linkage: Historical view, kinds of Linkage, Linkage groups, Significance of Linkage, Crossing over: Definition, types, mechanism of meiotic crossing over.

## **Unit-3**

**Mutations:** Basic concept, Mutagens: physical (ionizing and non-ionizing radiations) and chemical (Base analogs, Deaminating agents, Alkylating agents), Types of Mutations, spontaneous, induced, suppressor mutation, missense and non-sense mutation.

## **Unit-4**

**Population Genetics:** Gene pool, Gene frequency, Hardy-Weinberg Law, Rate of change in gene frequency through mutation, natural selection, migration and genetic drift.

## **Unit-5**

**Microbial Genetics:** Bacterial plasmids, Bacterial conjugation:  $F^+ \times F^-$  Mating, Hfr-conjugation and F-conjugation, transformation, transduction: generalized and specialized transductions, mapping the genome. Fungal genetics – mating types and genetic exchange, heterokaryosis, parasexual cycle.

### **Suggested Readings:**

1. Brooker R.J. Genetics. USA: Addison-Wesley, Longman Publisher, 1999. Print.
2. Brown T.A. Genetics: A Molecular Approach. USA: Chapman & Hall, 1999. Print.
3. Griffiths A.J.F., Gelbart, W.M., Miller, J.H., and Lewontin. Modern Genetic Analysis. USA: W.H. Freeman & Company, 2002. Print.
4. Karp G. Cell and Molecular Biology. USA: Wiley & Sons, 1999. Print.
5. Lewin B. Genes VII. UK: Oxford University Press, 2000. Print.
6. Russel, P.J. Genetics. California: Addison Wesley Longman, 2006. Print.

7. Snustad, D.P. and Simmons, M.J. Principles of Genetics. USA: Wiley and Sons, 2003. Print.



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**Course Code: BOT 121**

**Course Name: PLANT PHYSIOLOGY**

**Credit: 04**

**Semester-III**

## **Course Contents:**

### **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 defence 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: 5<sup>th</sup> Edition Publisher- Sara Tenney.



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**Course Code: BOT 516**

**Course Name: GENETICS AND MOLECULAR BIOLOGY**

**Credit: 04**

**Semester-III**

## **Course Contents:**

### **UNIT I: Genome complexity**

Central Dogma of molecular Biology and Reversal of central dogma. Genome Organization: C-value paradox, arrangement of genes as operons in prokaryotes vs multigene family, gene clusters in eukaryotes. transposable elements (*Ac-Ds* elements) in maize.

Monogenic vs polygenic traits, features, similarities, comparisons, examples.

### **UNIT II: Prokaryotic Transcription**

Transcription unit – start site (TSS), promoter regions, terminator; RNA polymerase, sigma factor; mechanism of transcription-initiation, elongation and termination, Rho-dependant and independent termination; inducible (lactose) and repressible (tryptophan) operons; DNA footprinting to study Promoter-RNA polymerase interactions; inhibitors of prokaryotic transcription.

### **UNIT II: Eukaryotic Transcription**

Transcription factors – general features, motifs - zinc fingers, leucine zippers, helix-turn helix, homeodomains, Promoter and regulatory elements – enhancers, silencers, response elements. RNA Polymerase I, II, III. Transcription initiation, elongation and termination. Inhibitors of eukaryotic transcription.

### **UNIT III: Post transcriptional modifications**

Introns, exons, mechanism of gene splicing, 5' cap formation, 3' polyadenylation. Brief introduction to RNA editing, RNA interference (RNAi), catalytic role of RNA (Ribozyme).

### **UNIT IV: Translation.**

Post-translational modifications of proteins, transport of proteins and molecular chaperones; Protein turnover and degradation; inhibitors of translation.

### **UNIT V: Gene discovery**

Methods of screening of genomic and cDNA libraries, Enhancer trap, promoter trap, insertional mutagenesis, gene tagging, activation tagging.

### **Reference Material:**

1. Alberts B, Bray D, Lewis J, Raff M, Roberts K, and Watson J.D. Molecular Biology of the Cell. Garland Science.
2. Pollard T.D., Earnshaw W.C, Schwartz J.L. Cell Biology. Elsevier Publishing Co.
3. H.Lodish and A.Berk, Molecular Cell Biology, W.H.Freeman Publishers.
4. D.E.Sadava Cell Biology, CBS Publishers.
5. Latest review articles from Peer reviewed journals.
6. Genomes by T. A. Brown.



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**Course Code: BOT 578**

**Course Name: GENOMICS, PROTEOMICS AND METABOLOMICS**

**Credit: 02**

**Semester-III**

## **Course Contents:**

### **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 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.



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**Course Code: BOT 565**

**Course Name: APPLIED AND INDUSTRIAL BIOTECHNOLOGY**

**Credit: 02**

**Semester-III**

**Course Contents:**

**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.).