

Module-I

Primary Metabolites-1: Carbohydrates- Classification, structure and function of different carbohydrates. Storage polysaccharides, Structural polysaccharides. **Proteins and enzymes:** **Proteins-** Classification, Structure of Proteins and Ramachandran plot. **Enzymes-** Properties, Co-factors, Isoenzymes, Michaelis- Menten equation, Mechanism of enzyme action.

Module-II

Plant Metabolites-2: Classification of lipids- Simple and Compound lipids, Biosynthesis of fatty acids, Poly-unsaturated fatty acids, lipoproteins. Oxidation of fatty acids (Alpha and β oxidation), **Amino acids-** General properties, classification and characteristics, peptide bonds, biosynthesis of amino acids.

Module-III

Secondary Metabolites-1: Alkaloids- General characteristics, Structure, General and pharmaceutical properties and Functions. Active constituents, structure, application and uses of *Withania somnifera* (Withaferin), *Catharanthus roseus* (Vincristine and Vinblastine). **Phenols and flavonoids-** General characteristics, Structure, General and pharmaceutical properties and function. Active constituents, Structure, applications and uses of *Curcuma longa* (Curcuminoids) and *Tagetes erecta* (Thiopene).

Module-IV

Secondary Metabolites-2: Terpenoids- General characters, Structure. General and pharmaceutical properties and function. Active constituents, structure, applications and uses of *Andrographis paniculata* (Andrographolide), *Bacopa monnieri* (Bacoside), **Glycosides-** General characteristics, Structure, General and pharmaceutical properties and Function. Active constituents, Structure, Applications and uses of *Stevia* (Stevioside) and *Dolichus lablab* (Flavone glycosides).

Module-V

Plant Essential Oils: General characters, extraction methods, properties and medicinal uses. Biosynthesis and chemical composition of Eugenol (Clove), Lemonine (Citrus), Geranil (Lemongrass), Spearmint oil (Mint), Davana oil (*Artemesia*), Camphor (Sage plant), Ajwain oil (*Trachyspermum ammi*).

References:

1. C.K. Kokate, A.P. Purohit & S.B. Gokhale, Pharmacognosy. 54th Edi. Nirali Prakashan. 2017.
2. Harborne, J. 1984. Phytochemical methods. Ed, Chapman and Hall, London
3. Heldt H.W. and Heldt F., 2005. Plant Biochemistry, Academic press, Californnia.
4. Nelson D.L. and Cox M.M., 2008. Lehninger: Principles of Biochemistry 5th Ed, W.H Freeman and Company, New York.
5. S. Sadasivam and A, Manickam. Biochemical methods New age international publishers
6. Thimmaih S.K, Standard methods of Biochemical analysis, Kalyani Publishers 1999.
7. Voet D. Voet J.G. and Pratt C.W., 2006. Fundamental of Biochemistry 2nd Ed, John willey and Sons Inc.
8. Wilson, K and Walker, J. 1994. Practical Biochemistry: Principles and techniques. Cambridge university press, Cambridge, UK.

PLANT CELL, GENETICS AND MOLECULAR BIOLOGY 22BOT32

52Hrs

Module-I

Structural Organization of Plant Cell/ The Dynamic Cell: Structural organization of plant cell, specialized plant cell types chemical foundation. Cell wall- Structure and functions, Plasma membrane- structure, models and functions, site for ATPase, ion carrier's channels and pumps, receptors. Plasmodesmata and its role in movement of molecule. Chloroplast- structure and function, genome organization. Mitochondria; structure, genome organization,

Module-II

Mendelian Genetics, Inheritance and Population Genetics: Chromosomal theory of sex determination in model plants (*Silene*). Dosage compensation; Cytoplasmic inheritance and cytoplasmic genes, male sterility in plants and gene mapping. Multiple alleles. Multigene families. Population Genetics: Hardy Weinberg's law; factors affecting allelic frequency in population- mutation, migration, non-random mating, genetic drift, genotype frequency, amino acid variation, molecular drive. Gene: split genes, repetitive DNA, interrupted genes.

Module-III

Central Dogma: Transcription- RNA polymerase types, structure and function; mechanism of transcription- Initiation, Elongation and Termination in prokaryotes and Eukaryotes. Post transcriptional modifications- RNA Processing, Capping, Polyadenylation, Splicing. Structural organisation of tRNA and rRNA. Translation- tRNA identity, amino acylation of tRNA, aminoacyl synthetase. Mechanism of translation- Initiation, Elongation and Termination, Proof reading, translational inhibitors, post translational modification of polypeptide chain.

Module-IV

Gene Regulation: Operon concept- lac operon, Operon- positive and negative control. Tryptophan operon- attenuation, ribosomal proteins as translational repressors, regulation in lytic and lysogenic cycle. Eukaryotes- transcription activator, transcriptional repression, Gene silencing by modification of Histone and DNA. RNA interferons.

Module-V

Methods in Molecular Biology: Human Genome Project, DNA sequencing: Sanger's method and Next generation sequencing. Molecular markers in genome analysis, RAPD and SSR. Marker sequencing sites- EST (Expressed sequence tags). Structural and functional genomics and metagenomics, Gene editing- Scope and Types.

References:

1. Benjamin A. Pierce. 2016. Genetics: A conceptual approach. WH Freeman 6th edition.

2. Fatik Baran Mandal 2015, Introduction to evolutionary Biology, oxford and IBH Publishing.
3. Monroe W. Strickberger. Genetics, 3rd Edi. Pearson. 2017.
4. P K Gupta. Cell and Molecular Biology: Cell and Molecular Biology-Concept and Experiments: Gerald Karp (2010)
5. P.K. Gupta. Cell Biology. 2017. Rastogi Publication.
6. P.K. Gupta. Cellular molecular biology. 2018. 5th Edition. Rastogi Publication.
7. P.S. Varma & B.K. Agarwal. Cell biology, genetics, molecular biology, evolution and ecology. 2004. S. Chand Publication.
8. P.S. Varma & P.K. Agarwal. Genetics. 2009. 9th Edition.. S. Chand Publication.
9. Peter Snustad, Simmons, Gardner 2006, Principles of genetics, Wiley press.
10. S.C. Rastogi. Cell biology, 2005. 3rd Edition.. New Age International Publishers..

Module-I

Fundamentals of Biotechnology: Vectors in gene cloning and their selection. Molecular research procedure; Gene amplification, basic PCR, its modification, application, DNA polymorphism. **Protoplast & somatic hybridization:** Isolation, purification and culture of protoplast. Protoplast fusion. General applications of PTC.

Module-II

Recombinant DNA technology- Definition, Enzymes in rDNA technology: Nucleases- Endonucleases, Exonucleases and Restriction endonucleases (Nomenclature and mode of action), Ribonuclease H; DNA modifiers- DNA Polymerase, Reverse transcriptase, Alkaline phosphatase, Polynucleotide Kinase, Terminal Nucleotidyl transferase and Methyl transferase; DNA ligases. Cloning vectors- Plasmids- Nomenclature and classification, Phage, Cosmids and YAC.

Module-III

Genetic Engineering: Definition, Basic concepts, Methods of gene transfer- *Agrobacterium*, Particle bombardment, PEG and Chloroplast/ Plastid transformation. Vectors used for transformation. Selectable markers and Reporter genes. Genetically Modified organisms and their Benefits. Genetically Modified Foods and their Impact on human Health.

Module-IV

Post transformation study: Expression of recombinant proteins in bacteria and plant. Transgenic plants- Benefits and Possible risks. Isolation, sequencing and synthesis of genes: Isolation of genes, DNA sequencing, synthesis, gene synthesis machines, Plant genetic engineering: gene transfer techniques

Module-V

OMICS: study of genome, proteome, and metagenomics, Proteomics-Protein sequence information, composition and properties, transcriptomics. Global analyses of proteins, RNA, genes, metabolites, lipids, and methylated DNA or modified histone proteins in chromosomes. Emerging OMICS technologies and data analysis techniques to characterise and quantify pools of biological molecules, their roles, relationships and actions in the cells of a living creature.

References

1. Adrian Slater, Nigel W. Scott and Mark R. Fowler. Plant Biotechnology-the genetic manipulation of plants, 2nd Edi. Oxford University Press. 2008.
2. Allard. R.W. 1961. Principles of Plant Breeding. 2nd Ed. John Wiley & Sons Inc., New York.
3. B.P. Pandey. Biotechnology, S. Chand publication New Delhi.
4. Balasubramanian, D. 2005. Concepts of Biotechnology New edition.
5. Benjamin A. Pierce (2016) Genetics: A conceptual approach. WH Freeman 6th edition.
6. C.M. Govil, Ashok Agarwal and Jitendra Sharma. Plant biotechnology and genetic engineering. PHI Learning Pvt. Ltd. 2017.
7. Chahal G S and Gosal S S. Principles and procedures of plant breeding- Biotechnological and conventional approaches: 2002
8. Chawla H S. Introduction to plant biotechnology: (Oxford & IBH, New Delhi 2000).
9. Chawla, H.S. 2008. Plant Biotechnology 3rd ed. Oxford & IBH. 2008.
10. Dixan and Ganzales RA. Plant Cell Culture – A practical approach: (Oxford Univ Press NY 1994).
11. Frey. K.J. 1981. Plant Breeding II. Iowa State University Press, Oxford.
12. Gambarg O L and Phillips. Plant cell, tissue and organ culture- Fundamental method: (Naraosa, New Delhi.1996)
13. Hartmann, Kester, Davies, and Geneve. Plant propagation- Principles and practices: (2011)
14. Jones. D.A. & Wilkins. D.A. 1971. Variation and Adaptation in Plant Species. Heinemann Educational Books Ltd., London.
15. M.K. Razdan. Introduction to plant tissue culture, 2nd Edi. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi. 2012.
16. Pranav Kumar, Praveen Varma & Usha Meena. Biotechnonology a problem approach, 5th Edi. Pathfinder Publication. 2017.
17. Pranav Kumar, Praveen Varma & Usha Meena. Biotechnonology a problem approach, 5th Edi. Pathfinder Publication. 2017.
18. Sadhu M.K. 2000. Plant propagation, New Age publication, New Delhi.
19. Satyanarayana U. 2005 Biotechnology.
20. Singh. B.D. 2012. Plant Breeding: Principles and Methods. Kalyani Publishers, Delhi.

Module-I

Introduction and significance: Introduction and significances of Nutraceuticals and functional foods; importance, history, definition, classification. Scope and future prospects, list of functional foods and their benefits. Markers for development of functional foods. Anti-nutritional factors. Biotechnology in phyto-nutraceuticals- GM foods e.g- Golden rice and GM tomatoes.

Module-II

Phytochemicals as nutraceuticals and functional food: nutritional assessment of carbohydrates, proteins and fats, recommended dietary intake, acceptable dietary intake. Properties, structure and health benefits of antioxidants, vitamins, minerals, carotenoids, amino acid, gums and resins, chitin, chitosan, glucosamine, octacosanol, lycopene, carnitine, melatonin, ornithine, Alpha- keto glutarate. Formulation of functional foods containing nutraceuticals – stability, analytical and labelling issues.

Module-III

Pre and probiotics: Introduction to Prebiotics, Probiotics and synbiotics. Taxonomy and important features of Probiotic Microorganisms. Probiotic source in various food. Prebiotics: Non digestible carbohydrates, dietary fibers, resistant starch and gums. Principle, mode of action and benefits of probiotics and prebiotics. Synbiotics for maintaining good health. Algae as source of nutraceuticals- *Spirulina* and sea weeds.

Module-IV

Food as remedies: Nutraceuticals bridging the gap between food and drug. Antioxidants role as nutraceuticals and functional foods. Nutraceuticals for specific situations such as cancer, heart disease, diabetes, stress, osteoarthritis, hypertension. Nutraceutical remedies for common disorders like arthritis, bronchitis, circulatory problems, hypoglycemia, liver disorders, osteoporosis, psoriasis and ulcers.

Module-V

Product development and clinical trials: Activity screening, formulations, toxicology, bioavailability, bioequivalence; use of animal models and pre-clinical and clinical trials involved. Effect of processing, storage and interactions of various environmental factors on the potential of nutraceuticals. Regulatory issues for functional foods and nutraceuticals. Recent development and advances in the areas of nutraceutical and functional foods.

References

1. Handbook of nutraceuticals Vol I by Yahwant Vishnupant Pathak, CRC press,2009.
2. Handbook of nutraceuticals Vol II by Yahwant Vishnupant Pathak, CRC press,2011.
3. Pathak, Y.V. (Ed.) 2010. Handbook of nutraceuticals. vol. 1: Ingredients, formulations, and applications. CRC Press, Boca Raton, Florida, USA.
4. Functional Foods: Principles and Technology, M. Guo, CRC press, 2009.

**PRACTICALS: PHYTOCHEMICALS AND BIOACTIVE METABOLITES
(22BOTL35)**

- 1) Estimation of Primary Metabolites.
 - a) Carbohydrates.
 - b) Protein.
- 2) Preliminary Screening Primary and Secondary Metabolites.
- 3) Estimation of Secondary Metabolites.
 - a) Alkaloids
 - b) Flavonoids
 - c) Phenol.
 - d) Saponins.
 - e) Terpenoids.
- 4) Extraction and Estimation of Eugenol from Ocimum.
- 5) Extraction of Aetherial oil from Lemon grass.
- 6) Soxhlet Apparatus.
- 7) Clevenger Apparatus.
- 8) Estimation of Flavanoids from onion peel.

**PRACTICAL: PLANT CELL, GENETICS AND MOLECULAR BIOLOGY
(22BOTL36)**

1. Preparation of fixatives and strains.
2. Cytological squash preparation of
 - a. Onion root tips to study mitosis.
 - b. Onion flower buds to study meiosis.
3. Genetic problems: Mendelian inheritance and gene interaction, chromosome mapping in eukaryotes, population genetics.
4. Smear of *Rheo discolor* flower buds to study metaphase plate.
5. Structural and Numerical changes induced by Colchicine (C-mitosis) and EMS.
6. Karyotyping and Ideogram.
7. Chromosomal aberrations- Chromosomal bridges; Laggards and fragments; chromosomal breakages; precocious moments of chromosomes; unequal separation of chromosomes.
8. Genetic problems on – Gene Mapping Mono and Di hybrid cross, population genetics, pedigree analysis.

PRACTICAL: PLANT BIOTECHNOLOGY AND OMICS (22BOTL371)

1. Propagation through seeds, methods to overcome the seed dormancy.
2. Preparation of medium, autoclaving and sterilization techniques.
3. Sterilization of plants material and induction of callus.
4. Induction of organogenesis and whole plants.
5. Isolation of protoplasts.
6. Induction of suspension cultures.
7. Isolation of Plant genomic DNA from plant tissue.
8. Separation of seed proteins using SDS-PAGE.
9. Problems on restriction mapping.

PRACTICAL: PLANT NUTRACEUTICALS AND FUNCTIONAL FOODS (22BOTL372)

1. To study nutritional composition (Proteins, carbohydrates, lipids, vitamin C and presence of secondary metabolites) of the following: Dairy products, Beans, Spinach, Carrot, Amla, Pineapple, Papaya, Lentil and Soya.
2. Estimation of omega-3 fatty acids from Chia seeds.
3. Estimation of Lycopene from tomato.
4. Estimation of Chitin.
5. Cultivation of *Spirulina* and Study of single cell Protein.
6. Determination of carotene from plant.
7. Estimation of total phenols and chlorogenic acid (Phenolic compound) in plant material.