SYLLABUS FOR THE

MASTER OF SCIENCE

in

PLANT BIOTECHNOLOGY

TWO - YEAR FULL-TIME PROGRAMME

(NEP 2020)



Department of Biotechnology

FACULTY OF SCIENCE DEEN DAYAL UPADHYAYA, GORAKHPUR UNIVERSITY, GORAKHPUR – 273009

AFFILIATION

The proposed programme shall be governed by the Department of Biotechnology, Faculty of Science, D.D.U. Gorakhpur University, Gorakhpur–273009.

PROGRAMME STRUCTURE

The M. Sc. Programme is divided into two Parts as under. Each part will consist of two Semesters as given below.

		Semester – Odd	Semester – Even
Part I	First Year	Semester – 1	Semester – 2
Part II	Second Year	Semester – 3	Semester – 4

For semester-1 and 2 would consist of four theory papers of 4 credits each, one laboratory course of 4 credits and Project/Review/Industrial Training of 4 credits. In Semester 1, there would be one open/minor elective course of 4 credit. Total credit in Semester 1 will be 20+4. Each student will carry research project/review/industrial training under the supervision of a faculty of the department. There may be a co-supervisor also from any industry/institute etc. The project/review/industrial training will be related to main subject. The students will submit the joint Research Project of Semester 1 and 2 at the end of 2nd Semester for evaluation. In semester 3, there would be two core courses of 4 credit each and two optional/elective courses having at least 3 options each. Semester 3 would also contain Laboratory course based on the theory papers of 4 credit. There would be a Project/review of 4 credit. In Semester 4, in addition to two core courses, there would be 2 optional courses having 3 options in each. At the end of 4th Semester, students will submit their research project/Review carried out in 3rd and 4th Semester for evaluation

MASTER OF SCIENCE (PLANT BIOTECHNOLOGY) TWO-YEAR FULL-TIME PROGRAMME

		Curriculun	n Structure
Course No.	Course Title	Type (Core/Elective)	Credit
	Semester 1		
PBT-501	Microbiology	Core	4+0
PBT-502	Molecular Biology	Core	4+0
PBT-503	Biochemistry	Core	4+0
PBT-504	Cell biology	Core	4+0
PBT-505	Introductory Plant Biotechnology	Open elective	4+0
PBT-506	Laboratory Course-I (based on core courses)	•	0+4
PBT-507*	Project/review/industrial training		0+4
	Total	I	24+4
	Semester 2		
PBT 508	Recombinant DNA Technology	Core	4+0
PBT 509	Enzyme Technology	Core	4+0
PBT 510	Immunology	Core	4+0
PBT 511	Bio-analytical techniques	Core	4+0
PBT 512	Laboratory Course-II (based on core courses)		0+4
PBT 513	Project/review/industrial training		0+4
	Total	1	24
	Semester 3		
PBT 514	Plant Microbial Diversity	Core	4+0
PBT 515	Fundamental Genetics	Core	4+0
PBT 516	Plant Biotechnology	Optional	4+0
PBT 517	Plant Physiology and Metabolism	(only one)	
PBT 518	Plant Stress Biology		
PBT 519	Molecular Plant breeding	Optional	4+0
PBT 520	Molecular Plant Pathology	(only one)	
PBT 521	Molecular Diagnostics		
PBT 522	Laboratory course-III (based on core and optional courses)	Core	0+4
PBT 523	Project/review	Core	0+4
	Total		24
	Semester 4		
PBT 524	Genomics for crop improvement	Core	4+0
PBT 525	Bioinformatics	Core	4+0
PBT 526	Proteomics and Metabolomics	Optional	4+0
PBT 527	Plant Developmental Biology	(only one)	
PBT 528	Scientific Writing and communication		
PBT 529	Biosafety, IPR and Bioethics	Optional	4+0
PBT 530	Molecular Genetics	(only one)	
PBT 531	Photochemistry and Pharmacognosy		
PBT 532	Project/review	Core	0+4
		Total	20

*Evaluation of the project will be in the second semester

PBT 501 MICROBIOLOGY

4+0

Detailed Syllabus

Unit-1:

Microbial diversity and systematics, Modern approaches to bacterial taxonomy, Nomenclature and outline of bacterial classification as per Bergey's Manual, General characteristics of viruses of bacteria, plants, and animals, prions. Accessing microbial diversity using molecular methods, 16S rDNA sequencing, metagenomics: principle, methodology, types, and applications.

Unit-2

Methods in Microbiology: Theory and practice of sterilization, Pure culture techniques, Construction of culture media, Enrichment culture techniques, Isolation and culture of aerobic and anaerobic bacteria, Culture collection, preservation, and maintenance of microbial cultures.

Unit-3:

Metabolic diversity among microorganisms: Microbial Nutrition: nutritional types and modes of nutrition in bacteria, Extremophiles. Microbial growth: The definition of growth, mathematical expression of growth, growth curve, measurement of growth, and growth yields.

Unit-4:

Types of antimicrobial agents; Classes of antibiotics (β -lactams, tetracyclins, aminoglycosides, macrolids, Polypeptides antibiotics & their mode of action; Antiviral, antifungal, antiprotozoan antibiotics; Development of resistance to antibiotics; Bacterial Genetic System: Transformation, Conjugation, Transduction and Recombination

Suggested Reading:

- Brock Biology of Microorganisms, 9th Edition. By *Michael T. Madigan, John M. Martinko, Jack Parker*. Prentice Hall, Inc.
- Microbiology, 4th Edition. By *Lansing M. Prescott, John P. Harley, Donald A. Klein.* WCB McGraw Hill.
- General Microbiology, 5th Edition by *Roger Y. Stanier, John L. Ingraham, Mark L. Wheelis, Page R. Painter*, Macmillan Press Limited.
- Microbiology: Principles and Explorations, 5th Edition. By *Jacquelyn G. Black*, John Wiley& Son, Inc.

PBT 502 MOLECULAR BIOLOGY

4+0

Unit 1:

Prokaryotic and eukaryotic genome organization, structural elements of chromosome and construction of artificial chromosome. DNA replication: Enzymes, accessory proteins and mechanisms of prokaryotic and eukaryotic DNA replication.

Unit 2:

Fine structure of gene, molecular basis of spontaneous and induced mutations and their role in evolution; DNA damage and repair, DNA amplification and rearrangement. Anti-sense and Ribozyme Technology: Inhibition of splicing, polyadenylation and translation, disruption of RNA structure and capping, Biochemistry of ribozyme, hammerhead, hairpin and other ribozymes, applications of anti-sense and ribozyme technologies.

Unit 3:

Transcription: Organization of transcriptional units, mechanisms of transcription and its regulation in prokaryotes and eukaryotes, Operon concept, attenuation and antitermination controls, RNA processing (capping, polyadenylation, splicing), DNA methylation, heterochromatization, General and specific

transcription factors, regulatory elements and mechanism of transcription regulation, transcriptional and post-transcriptional gene silencing, environmental regulation of gene expression.

Unit-4:

Translation: Genetic code, Prokaryotic and Eukaryotic translation, mechanisms for initiation, elongation and termination, regulation of translation, co-and post- translational modifications of proteins. Homologous Recombination and Site-specific recombination.

Suggested Reading:

- Molecular Biology of the Gene (4th Edition) J.D. Watson, N.H. Hopkins, J.W. Roberts, J.A. Steitz and A.M Weiner, The Benjamin/ Cummings Publ. Co. Inc, California
- Molecular Biology of the cell (3rd Edition) by *Bruce Alberts, Dennis Bray, Julian Lewis, martin Raff, Keith Roberts and James D. Watson,* Garland Publishing, Inc, New York & London
- Gene Cloning and DNA Analysis (4th Edition) by *T.A Brown*, Blackwell Science
- Essential of Molecular Biology (3rd edition) by *G.M. Malacinski& D. Freifelder*, Jones & Bartlett Publisher

PBT 503 BIOCHEMISTRY

Unit 1

Amino acids and proteins: Classification, structure and properties of amino acids; primary, secondary, tertiary, quaternary and domain structure of proteins, forces stabilizing protein structure, Ramachandran plot, DNA-protein and protein-protein interactions, protein folding, protein misfolding and related diseases; protein sequencing.

Unit 2

Nucleic acids: Primary and secondary structure of nucleic acids, Watson-Crick model of DNA, structural polymorphism of DNA and RNA, the three-dimensional structure of RNA, biosynthesis of purines and pyrimidines.

Unit 3

Carbohydrates: Classification and structure of carbohydrates, polysaccharides, glycoproteins and peptidoglycans, glycolysis, TCA cycle, oxidative phosphorylation, glycogen synthesis and breakdown, gluconeogenesis, interconversion of pentoses and hexoses.

Unit 4

Lipids: Classification, structure and functions, biosynthesis of fatty acids, oxidation of lipids, triglycerides, phospholipids, sterols.

Suggested Reading:

- Biochemistry by Stryer, Freeman publisher
- Biochemistry, Vol I, II, III by GeofferyZubey, WCB press
- Fundamentals of Biochemistry by Voet, Voet& Pratt, John Wiley publisher
- Principles of biochemistry by Albert Lehninger, David L Nelson & Michael M Cox, Mac Milan worth publisher.

PBT 504 CELL BIOLOGY

4+0

4+0

Unit 1:

Cellular organelles: Cell types (prokaryotes/ eukaryotes), Plasma membrane, cell wall, cytoskeletontheir structural organization; Mitochondria; Chloroplast; Nucleus and other organelles and their organization and function, genetic constitution of mitochondria and chloroplast, artificial membrane Liposomes.

Unit 2:

Structure and organization of cell skeleton; Microfilaments and Microtubule-structure and assembly, actins, myosin muscle contraction, cilia, flagella-structure and function **Unit 3**:

Unit 3:

Biological membranes: Physicochemical properties of cell membranes and their structural constitution. Transport of nutrients across the membranes: simple, passive, facilitated diffusion, Protein targeting and sorting- Post transitional import of proteins to mitochondria lysosomes, nucleus, secretory vesicles, chloroplast and peroxisomes.

Unit 4:

Cell cycle: Mitosis, meiosis, the role of cyclins and cyclin-dependent kinases, regulation of Cdk-cyclin activity, Cdk inhibitors, induction of cancer with respect to cell cycle, molecular events and regulation in model systems, cell surface receptors, second messenger system, MAP kinase pathways, mechanism of signal transduction pathway. Molecular biology and biochemistry of cancer, oncogenes, tumour suppressor genes, chemical carcinogenesis

Suggested Reading:

- Essential Cell Biology by Bruce Alberts et.al., Garland Publisher.
- Cell and Molecular Biology by F. D P deRobertes, LW & W Publisher.
- Molecular Biology of the Cell by Alberts, Bray, Lewis, Raff, Roberts and Watson, Garland Publishers.
- Molecular Cell Biology by H. Lodish, D. Baltimore, A. Bark, S. L. Zipursky, P.Matsudaira and J. Darnell, Scientific American Books.

PBT 505LABORATORY COURSE-I BASED ON CORE COURSES0+4

Laboratory course will be based on core courses

PBT 506 Introductory Plant Biotechnology

Unit 1: Basis of Plant Tissue Culture

Introduction-Concepts and principles. History of Plant tissue culture. Sterilization techniques-Nutritional requirements for plant tissue culture - Factors affecting plant tissue culture

Unit 2: Pathways of Plant Regeneration

Morphogenesis – direct and indirect, organogenesis and somatic embryogenesis. Callus initiation - establishment and maintenance. Establishment of suspension culture .Synthetic seeds and applications.

Unit 3: Plant Tissue Culture Techniques for Propagation

Meristem culture and virus elimination - virus indexing methods. Shoot tip culture and in vitro clonal multiplication-Applications. Micropropagation techniques in roses, banana and advantages **Unit 4: Organ Culture**

Embryo culture and embryo rescue-applications. In vitro fertilization techniques. Ovule, ovary and

endosperm culture. Anther and microspore culture - production of haploids. Protoplast isolation, culture and protoplast fusion - applications -. Somaclonal variation - applications. In vitro germplasm conservation – Secondary metabolites production through cell culture -bioreactors.

Suggested Reading:

• Bhojwani, S.S and Dantu, P. 2013. Plant Tissue Culture – An Introductory Text. Springer

0+4

Publications

- Karl-Hermann Neumann, Ashwani Kumar and Jafargholi Imani. 2009. Plant Cell and Tissue Culture- A Tool in Biotechnology- Basics and Application. Springer-Verlag, Berlin Heidelberg
- Acram Taji, Prakash P. Kumar, Prakash Lakshmanan, 2002. In vitro plant breeding. The Haworth Press Inc., New York.
- Cassells, A. C and Peter B. Gahan. 2006. Dictionary of plant tissue culture. Food Products Press, an Imprint of the Haworth Press, Inc., New York-London-Oxford
- Gamborg, O.L and G.C.Philips (eds.). 2013. Plant Cell, Tissue and Organ culture-Lab Manual. Springer Science & Business media.
- Razdan, M.K. 2003. Introduction to Plant Tissue Culture. (II Edn.). Science Publishers Inc, Enfield (NH) U.S.A.
 Roberta H. Smith, 2000. Plant tissue culture: Techniques and Experiments. Gulf Professional Publishing.

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PBT 507 Project/Review/Industrial training

Each student must conduct project/review /industrial training in the first semester under the guidance of the allotted advisor/supervisor. The evaluation of the same will be done at the end of the second semester as per the guideline issued by the university authority.

Semester-II

PBT 508 RECOMBINANT DNA TECHNOLOGY

4+0

Unit 1:

Molecular tools and their applications: Restriction endonucleases, polymerases, nucleases, kinases, topoisomerases, gyrases, methylases, and ligases. Adapters, Linkers and Homopolymer tailing, Cloning vectors: Plasmids, Bacteriophages, Cosmids, Phagemids, Artificial chromosomes (BAC, PAC, MAC).

Unit 2:

Construction and screening of genomic and cDNA libraries, EMSA (Electrophoretic mobility shift assay), DNA footprinting, Primer extension, SI mapping, RNase protection assay, Reporter assays, Principles and techniques of nucleic acid hybridization,

Unit 3

Polymerase chain reaction: principle, types, and applications of PCR in different fields. DNA microarray-fabrications, variations, and applications, Serial Analysis of Gene Expression (SAGE)-principle and applications.

Unit 4

Expression strategies for heterologous genes: expression in bacteria, yeast, insects, mammalian cells and plants, *in-vitro* transcription and translation, T-DNA, and transposon tagging.

Suggested Reading:

- iGenetics by *Peter J Russell*, Benjamin/ Cummings, New York
- From Genes to Clones: Introduction to gene technology, by *Ernst-L Winnacker*, VCH Publication, Germany
- Principles of Gene Manipulation: An Introduction to genetic Engineering (6th Edition) by R.W. *Old and S.B. Primrose*, Blackwell Publication
- Genes IX by *Benjamin Lewin*, Oxford University Press, U.K.

PBT 509 ENZYME TECHNOLOGY

4+0

Unit 1

Nomenclature and classification of enzymes, general properties of enzymes, active sites, cofactors and specificity.Isolation, purification and large scale production of enzymes with principles and applications of the involved techniques, viz gel filtration, ion exchange and affinity chromatography, centrifugation and electrophoretic techniques.

Unit 2

Enzyme kinetics: Enzymatic reaction mechanisms, Michaelis-Menten equation, Effect of substrate, pH, temperature and inhibitors on enzyme activity.Mechanism of enzyme action and regulation: Active and regulatory sites, chemical modification, feedback inhibition, positive and negative cooperativity, allosteric enzymes.

Unit 3

Isozymes, multienzyme complexes, artificial enzymes, catalytic antibodies. Enzyme engineeringstrategies, directed evolution, degradation of unnatural substrates.

Unit 4

Industrial enzymes: In detergent, food, leather, dairy, medicines and chemical industries. Enzyme immobilization: Introduction, methods, applications and limitations.

Suggested Reading:

- Enzymes: Biochemistry, Clinical Chemistry by T. Palmor, Harwood press
- Fundamentals of Enzymology: The cell and molecular biology of catalytic proteins, by NC Price and Steven, Oxford press.
- Biochemistry, Vol I, II, III by GeofferyZubey, WCB press
- Fundamentals of Biochemistry by Voet, Voet& Pratt, John Wiley publisher

PBT 510 IMMUNOLOGY

4+0

Unit 1:

Introduction: Phylogeny of Immune System, Innate and acquired immunity, Clonal nature of immune response, Primary and secondary immune response, Organization and structure of lymphoid organs, Cells of the immune system:Haematopoesis and differentiation, lymphocyte trafficking, B lymphocytes, T-lymphocytes, Macrophages, dendritic cells, natural killer and lymphokine activated killer cells, Eosinophils, Neutrophils and mast cells.Antigens and superantigens.Structure and function of immunoglobulins.

Unit 2:

Major histocompatibility complex; Antigen processing and presentation, BCR and TCR, generation of immunological diversity, Complement system.Cell- mediated cytotoxicity : Mechanism of T cell and NK cell mediated lysis, antibody dependent cell mediated cytotoxicity, macrophage mediated cytotoxicity, effector mechanism.

Unit 3:

Regulation of immune response:Generation of humoral and cell medicated immune responses, Activation of B-and T-lymphoeytes, cytokines and their role in immune regulation, Immunological tolerance, Genetic control of immune responses. Immunoprophylatic intervention: Basic concepts of vaccination and different types of vaccines.

Unit 4:

Hypersensitivity, Autoimmunity, Tumor immunology, AIDS and other immune-deficiencies. Antigen and antibody interactions, Immunodiffusion, Immunoelectrophoresis, RIA, ELISA, Hybridoma technology and monoclonal antibodies.

Books Recommended:

- Cellular and Molecular Immunology by *Abbas et al.*, Saunder Publication.
- Essential Immunology by *Roitt*, Blackwell Publisher.
- Immunology by *Kuby*, Freeman Publisher.
- Immunology-a short course by *Benjamini*, Wiley-Liss Publisher.

PBT 511 Bio-analytical techniques

Unit I :

Microscopic techniques: Principles and application of light, phase contrast, fluorescence, confocal, scanning and transmission electron microscopy, cytophotometry and flow cytometry, fixation and staining, Fluorescence in-situ hybridization (FISH), GISH (Genomic in-situ hybridization).

Unit II

Chromatography & Spectroscopy: column chromatography (ion exchange, gel permeation, affinity), GLC and HPLC. Principles of colorimetry and UV-Vis spectrophotometry, Mass spectrometry, MALDI, X-Ray Crystallography

Unit III:

Electrophoresis and Radiation Biophysics: chromatography Agarose and polyacrylamide gel electrophoresis (native and denaturing), Immuno-electrophoresis, Isoelectric Focusing, Capillary electrophoresis. Principles of fluorescence, Tracer Technology, Dose-response relationship, Radioisotopes in Diagnostics and Biotechnology

Unit IV:

Gene Editing: History of its discovery, elucidation of the mechanism including an introduction to all the molecular players, development of applications for in vivo genome engineering for genetic studies, and promise of the technology as a next-generation therapeutic method.

Suggested Readings

- Freifelder D., Physical Biochemistry, Application to Biochemistry and Molecular Biology, 2nd Edition, W.H. Freeman & amp; Company, San Fransisco, 1982.
- Keith Wilson and John Walker, Principles and Techniques of Practical Biochemistry, 5th Edition, Cambridge University Press, 2000.
- D. Holme & amp; H. Peck, Analytical Biochemistry, 3rd Edition, Longman, 1998

PBT 512	Laboratory Course-III (based on core courses)	0+4
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Laboratory course will be based on core courses

PBT 513Project/Review/Industrial training0+4

Each student must conduct project/review /industrial training in the Second semester under the guidance of the allotted advisor/supervisor. The evaluation of the same will be done at the end of the second semester as per the guideline issued by the university authority.

Semester-III

PBT 514 Plant Microbial Diversity

Unit-1

Different interfaces of interactions - Plant-microbe, microbe-microbe, soil microbe, soil-plant-microbe interactions leading to symbiotic (rhizobial, algal, actinomycetous, and mycorrhizal), associative, endophytic, and pathogenic interactions. Microbial communities in the soil. Community dynamics and population interactions employing DGGE, TGGE, and TRFLP.

Unit-2

Molecular approaches in the study of plant-microbe interactions, the genetic basis of pathogenicity and parasitism, signal transduction, compatibility and incompatibility, gene-for-gene concept. Plant interaction with endophytic bacteria and fungi, Use of Avirulent mutants in control of bacterial, fungal, and viral disease of plants. Interactions of plants with soil pathogens and their antagonists in the natural ecosystem.

Unit-3

Plant and microbial gene expression and signal exchange, global and specific regulators for different interactions. Molecular diversity of microbes, plants, and their interactions including transgenic microbes and plants

Unit-4

Transgenic approaches for crop protection pathogen-derived resistance, plantibodies, overexpressing defense genes, use of cloned resistance genes, expression of vaccines in plants, and engineering broad-spectrum resistance. Systemic acquired resistance in plants: Hypersensitive response and associated defense reactions in plants, induced structural and biochemical defense mechanisms.

Suggested Reading:

- Brock Biology of Microorganisms, 9th Edition. By Michael T. Madigan, John M.Martinko, Jack Parker. Prentice Hall, Inc.
- Microbiology, 4th Edition. By Lansing M. Prescott, John P. Harley, Donald A. Klein. WCB McGraw Hill.
- General Microbiology, 5th Edition by Roger Y. Stanier, John L. Ingraham, Mark L.Wheelis, Page R. Painter, Macmillan Press Limited.
- Microbiology: Principles and Explorations, 5th Edition. By Jacquelyn G. Black, John Wiley& Son, Inc.
- Martin Alexander 1983. Introduction to Soil Microbiology, Wiley eastern Ltd., New Delhi.
- Newton, W.E and Orme, Johnson, W.H.1980. Nitrogen fixation vol II: Symbiotic Associations and Cyanaobacteria. University park Press Baltimore, USA.
- Wheeler, B. E. 1976. An Introduction to Plant Disease. ELBS and John Wiley and Sons, Ltd.

4+0

BT 515 Fundamental Genetics

Unit 1:

Introduction to genetics - Great milestones in genetics, Levels of genetic analysis, Genetics in agriculture, medicine and society, Basic cell.

Unit 2:

Basic principles of Heredity, Mendelian principle of inheritance - Experiments of Mendel, Principle of segregation of genes, Principle of independent assortment, test cross and back cross with unlinked genes, Extensions and modifications of Mendelian principles - Complete, incomplete & codominance, Penetrance and Expressivity, Gene interaction with epistasis. Application of probability and chi-square in genetics, Multiple alleles, Complex genetics of coat color in dogs, lethal alleles.

Unit 3:

Linkage, recombination and crossing over - Linked genes, Coupling and repulsion, Crossing over and recombination with linked genes, Linkage and recombination between two genes and three genes, Linkage mapping with recombination frequency, Physical chromosome mapping, Effect of multiple crossovers, Tetrad analysis. Quantitative genetics & polygenic inheritance - Inheritance of quantitative traits, Genetic analysis of quantitative traits using statistics, Polygenic inheritance, Determining gene number for a polygenic character, Usage of heritability in predicting the variation of phenotypes.

Unit 4:

Genetics of organelles - Biology of mitochondria & chloroplasts. Mitochondrial genome, Chloroplast genome, Organelle heredity, Evolutionary origin of organelles, Cytoplasmic inheritance, Patterns of extra nuclear inheritance, Inter genomic exchange of genetic Information,

Unit 5:

Microbial genetics - Bacterial genetics, Mutant phenotype, Mechanism of genetic exchange, DNA-Transduction, mediated transformation, Conjugation, Genetic mapping prokaryotes, in Developmental genetics of drosophila, Population genetics, Environment and genetics, Clinical genetics, Evolutionary genetics.

Suggested Reading:

- Principles of Genetics by Snustad& Simmons, 6th edition
- Genetics: A conceptual approach by Benjamin Pierce, 4th edition
- Essential Genetics A genomic perspective by Hartl& Jones, 4th edition
- Genetics: A molecular approach by Peter Russell, 2nd edition •
- Principles of Genetics by Robert H Tamarin, 7th edition •
- Schaum's outline genetics by Elrod & Stansfield, 4th edition •

Plant Tissue Culture PBT 516

4 + 0

Unit 1:

History of plant cell and tissue culture; Culture media; various types of culture; callus, suspension, nurse, root, meristem, etc.; In vitro differentiation; organogenesis and somatic embryogenesis.Micropropagation; Anther and microspore culture; Somaclonal variation; In vitro fertilization; In vitro germplasm conservation; Production of secondary metabolites; Synthetic seeds. Unit 2:

Embryo culture and embryo rescue; Protoplast isolation, culture and fusion; selection of hybrid cells and regeneration of hybrid plants; symmetric and asymmetric hybrids, cybrids. Conventional versus non-conventional methods for crop improvement; Present status and recent developments on available molecular markers, transformation and genomic tools for crop improvements. Molecular marker-aided breeding, QTL, molecular marker assisted selection.

Unit 3:

Plant transformation technology: *Agrobacterium* mediated, Particle bombardment, Electroporation; transgene stability and gene silencing. Chloroplast Transformation, Genetic engineering for resistance against abiotic (drought, salinity, flooding, temperature, etc.) and biotic (insect pest, fungal, viral and bacterial diseases, weeds, etc.) stresses; Genetic engineering for increasing crop productivity by manipulation of photosynthesis, nitrogen fixation and nutrient uptake efficiency; Genetic engineering for quality improvement (protein, essential amino acids, vitamins, minerals nutrients, etc.) etc.

Unit 4:

Metabolic Engineering and Industrial Products: Plant secondary metabolites, control mechanisms and mainipulation of phenylpropanoid pathway, shikimate pathway; alkaloids, biodegradable plastics, therapeutic proteins, edible vaccines, purification strategies.

Suggested Reading:

- Plant Tissue Culture: Application and Limitation by S. S. Bhojwani and M. K. Razdan, Elsevier Publication
- Plants, Genes and Agriculture by *Maarten J Chrispeels and David E. Sadava*, Jones & Bartlett Publishers
- An Introduction to Plant Tissue Culture by *M. K. Razdan*, Oxford & IBH Publishing Co. Pvt. Ltd.
- Plant Biotechnology: The genetic manipulation of plants by *Adrian Slater, Nigel Scott, and Mark Fowler*, Oxford University Press

PBT-517 Plant Physiology and Metabolism

4+0

Unit 1

Photosynthesis and chemosythesis, Quantasomes, biosynthesis of chlorophylls, conversion of solar energy into chemical energy and its utilization in CO2 reduction cycles, Efficient and inefficient plants, bacterial photosynthesis and its utility in nature. Organic acid metabolism, succulent, CAM pathway and their significance Plant Energetic as controlled by Photosynthesis, Respiration and

Unit 2

Photorespiration Respiration: Biological oxidations of carbohydrates and inter conversions of the products, terminal oxidation electron transport, role of cytochromes and other heme compounds.

Nitrogen Metabolism: Synthesis and activation of amino acids, transcription and translations, genetic code the template, chemical regulation and biosynthesis of proteins and enzymes, Biochemistry of biological nitrogen fixation and its significance.

Unit 3

Phosphorus metabolism, Metabolism of phosphorylated compounds and their role Lipid Metabolism: Classification of fat and fatty acids, biosynthesis and breakdown of fat and lipids, its significance, Unsaturated fatty acids. Secondary plant products and their biosynthesis

Unit 4

Growth analysis and control mechanism, biological clocks Germination of photo and nonphotoblastic seeds; physiology of seed and dormancy Factors affecting growth and plant growth under different stresses, role of phytochrome and mechanism of its action in growth, morphogenesis and differentiation Physiology of abscission; biosynthesis of auxins; gibberellins and cytokinins and their mechanism of action Physiology of flower initiation and floral expression Physiology and biosynthesis of alkaloids, vitamins and sterols

Suggested Reading:

- Biochemistry & Molecular Biology of Plants. Authors: Buchanan BB, Gruissem W and Jones RL (2000), American Society of Plant Physiologists.
- Lehninger Principles of Biochemistry, Authors: David L. Nelson and Michael M.Cox.
- Plant Physiology. Authors: Taiz L, and Zeizer E, (2006), Sinauer Associates, Inc. Biochemistry. Authors: Berg JM, Tymoczko, JL, and Stryer L (2006). W. H. Freeman.
- Plant Pathology. Authors: Agrios GN 5 ed; 2005, Elsevier Academic Press, 2005

PBT 518 Plant Stress Biology

4+0

Unit 1

Water stress: a. Membranes and water stress b. Stomatal response to water stress. Role of ABA c. Photosynthesis and water stress d. Osmotic adjustment e. Mechanism of drought tolerance 2. Flooding stress a. Flooding injury b. Metabolic damage c. Hormonal imbalance d. Soil toxins e. Tolerance mechanisms

Unit 2

Low temperature stress a. Chilling and freezing effects on germination b. Physiological and molecular mechanism of low temperature tolerance c. Effect of low temperature on plant productivity 4. Heat stress a. Cellular responses to high temperature: enzyme activities, photosynthesis, ultra structural effects b. Molecular responses to high temperature. Heat shock proteins. c. High temperature tolerance mechanisms in plants

Unit 3

Metal stress a. Metal toxicity and tolerance with special reference to i) Aluminum ii) Manganese iii) Iron iv) Zinc b. Phytochelations c. Differential plant tolerance to heavy metals 6. Allelochemicals a. Chemical nature of allelochemicals b. Mode of release of allelochemicals c. Regulation of allelochemical production and release d. Mode of action of allelochemicals on plant physiological processes

Unit 4

Salt stress a. Effect of high salt concentration of plants – water stress, nutrient ion deficiency, ion toxicity b. Regulation of salt content – Salt exclusion, salt elimination, salt succulency c. Mechanism of salt resistance and tolerance 8. Ultra violet – B (UV-B radiation): a. Plant response to UV radiation b. Effect of UV-B on chemical composition c. Effect of UV-B radiation on photosynthesis d. UV-B defense and gene expression

Suggested Reading:

- Doby, G.: Plant Biochemistry. Inter Science Publishers, New York
- Lehninger, A. L., D. L. Nelson and M. M. Cox 2000: Principles of Biochemistry. CBS Publishers and Distributors, New Delhi.
- Witham et. al. Experiments in Plant Physiology. Van Nostrand Renhold Company, New York. Meidner, H. Class experiments in Physiology. George Allen & Unwin Publishers Ltd., London
- Kalra, Y. P. (ed.). Hand book of reference methods for plant analysis. CRC Press, USA.
- Hopkins, W. G., Introduction to Plant Physiology. 3rd Edition. John Wiley & Sons, New York. Salisbury, F. B. and Ross, C. W., Plant Physiology, 4th Edition. Wadsworth Publishing Company, California.
- Marschner, H., Water relations of plants. Academic Press, New York

PBT 519 Molecular Plant Breeding

Unit 1

The dynamic plant genomes: Natural genetic Variation; mechanisms and causes of DNA polymorphisms: Recombination and DNA rearrangements, Point mutations-topolyploidy; SNP as a concept. Genome Organization: Nuclear and organellar genomes; C-Value paradox, Unique and repeat DNA sequences; Classification of Repeat elements: Tandem, Interspersed (Impact of transposable elements in modelling genomes), Micro-satellites, Minisatellites, hyper-variability of VNTRs,

Unit 2

Assessment of genetic diversity: Introduction to geographical diversity, center of origin and diversity of plant species, gene pools (primary, secondary and tertiary), Principles of numerical taxonomy, Case studies, binary matrix to phenetic dendograms, structure analysis and other software tools for phenetics,. Forward mapping for gene discovery and functional genomics: Traits (simple and complex; continuous and dis-continuous variation), Construction of genetic linkage maps; Linkage mapping software packages and interfaces; Trait Mapping; Map based cloning/ positional cloning for gene discovery, Navigating from genetic to physical map (methodologies and challenges).

Unit 3

Mapping populations in plants: F2 populations, RILs (recombinant inbred lines), Backcross lines, NILS (Near Isogenic Lines), HIF (Heterogeneous Inbred Families), AILs (Advanced Intercross Lines), Pseudo-test-cross mapping, NAM (Nested Association mapping), MAGIC (Multi-parent advanced generation inter-cross), Biparental mapping vs Multi-parent mapping.. Breeding by design: Marker Assisted Selection (MAS), gene/QTL introgression and pyramiding, Foreground and back ground selection for introgression of QTL by SSR markers, BSA (Bulked Segregant Analysis), Leveraging genetic resources from wild (Exotic genetic libraries and introgression lines)..

Unit 4

Genotyping tools as plant variety protection, DNA bar-coding technology, hybrid purity tests, diagnostics (transgenics, forensics), establishing clonal fidelity, Fingerprinting for BAC assembly for physical maps. Supplementary mapping tools and methodologies: Radiation Hybrid Maps, HAPPY mapping, Comparative/Synteny mapping.. Genomics platforms for genome-wide analysis: DARTseq, GBS (genotyping by sequencing) and other third generation sequencing platforms, GEBVs (Genomics estimated breeding values), GWAS (Genome-wide association studies).

Suggested Reading:

- Kole C, Genome mapping and molecular breeding in plants. Springer Verlag, Berlin H John Newbury (2003) Plant Molecular Breeding. CRC Press, US
- Kole C and Abott AG Molecular breeding: principles and practices of plant genomics. Science Publishers, US
- Griffiths AF, Miller JH, Suzuki DT, Lewontin RC, Gelbart WM An introduction to genetic analysis. WH Freeman & Co, US
- Vos P, Hogers R, Bleeker M, Reijans M, van de Lee T, Hornes M, Frijters A, Plot J, Peleman J, Kuiper M, Zabeau M AFLP: a new technique for DNA fingerprinting. Nucl Acids Res 23: 4407-4414
- Peleman JD and van der Voort JR Breeding by design. Trends in Plant Science.8: 330-339.
- Collard BCY, Jahufer MZZ, Brouwer JB and Pang ECK An introduction to markers, quantitative trait loci (QTL) mapping and marker assisted selection for crop improvement: The basic concepts. Euphytica 142: 169-196

PBT-520 Molecular Plant Pathology

Unit 1

An overview of nature of pathogens and pests, pathogen penetration, establishment, colonization in host., Genetic and molecular basis for disease resistance, Flor's hypothesis, Koch postulates, disease epidemics and epidemiology.

Unit 2

Preformed plant defenses, induced host defenses, biochemical and physiological responses, hostpathogen interaction mechanisms, Physiology and biochemistry of plant disease, Primary metabolism, Secondary metabolism, role of cell wall in plant defense

Unit 3

Molecular determinants of pathogenicity, effectors, elicitors, defensins, phytoalexins, common phenolics, plant cell wall degrading enzymes, host specific toxins, host nonspecific toxins, hormones and signaling.

Unit 4

Plant disease resistance, classes of resistance genes, adapted host resistance, non-adapted host resistance, Systemic acquired resistance, Induce Systemic acquired resistance, Pathogenesis-related (PR)-proteins, Transgenic and genetic manipulation approach and molecular marker approach to tag disease resistance and avirulence genes

Suggested Reading:

- Diseases of Crop Plants in India, Rangaswamy & Mahadevan.
- Plant Pathology, GN Agrios (2006), fifth Edn, Elsevier Academic Press.
- Molecular Plant Pathology, Dickinson CM (2003), Bios Scientific Publisher
- Plant Pathology: Concepts and Laboratory Exercises, NT Robert, MT Windham, AS Windham (2003), CRC Press.
- Plant Diseases, RS Singh (2008), Oxford and IBH Publishing Co. Pvt Ltd 15. Principles of Plant Pathology, RS Singh (2008), Oxford and IBH Publishing Co. Pvt Ltd

PBT 521 Molecular Diagnostics

Unit I

Basic idea of Molecular Diagnostics, Technologies related to Molecular Diagnostic: PCR-Based Methods for Mutation Detection, Other Methods for Mutation Detection. Sequencing of DNA for Disease Association, Gene Expression Analysis through Microarray Approaches, Methods for Analysis of DNA Methylation, Other Clinical Diagnostic Technologies: Flow Cytometry, Medical Cytogenetics, Fluorescence In Situ Hybridization, Immunohistochemistry, Laser 22 Capture Microdissection (FFPE).

Unit 2

Quality Assurance in the Molecular Diagnostics Laboratory: Framework for Quality Assurance in Molecular Diagnostics, Verification of Molecular Assays, Standards and Standardization of Molecular Diagnostics, Laboratory Developed Tests in Molecular Diagnostics.

Unit 3

Applications of Molecular Diagnostics for Genetic Diseases, Molecular diagnostics of Coagulation, Cystic Fibrosis; Prenatal Genotyping for Identification of Fetuses at Risk for Immune Cytopenic

4+0

Disorders. Applications of Molecular Diagnostics for Human Cancers and Infectious Diseases. Molecular Analysis for Forensic Casework and Parentage Testing.

Unit 4

Personalized Medicine, Genetic Counseling Considerations in Molecular Diagnosis, Ethical, Social, and Legal Issues Related to Molecular Genetic Testing...

Suggested Reading:

- 1. Molecular Diagnostics: For the Clinical Laboratorian / Edition 2 William B. Coleman (Editor), Gregory J. Tsongalis (Editor) Publisher: Springer-Verlag New York, LLC.
- 2. Molecular Diagnostics: Fundamentals, Methods and Clinical Applications, April 2019 by Lela Buckingham (Author), Publisher: FA Davis Company.
- 3. Molecular Diagnostics, Edited by George Patrinos, Wilhelm Ansorge, Phillip B. Danielson, Elsevier Publication
- 4. Molecular Diagnostics For the Clinical Laboratorian, Edited by <u>William B. Coleman</u>, <u>Gregory</u> <u>J. Tsongalis</u>. Springer publication.

PBT 522Laboratory Courses (based on core and optional courses)0+4

Laboratory course will be based on core and optional courses

PBT 523 Project/Review/Industrial training

Each student must conduct a project/review/ industrial training in the third semester under the guidance of the allotted advisor/supervisor. The evaluation of the same will be done at the end of the fourth semester as per the guideline issued by the university authority.

Semester-IV

PBT 524 Genomics for crop improvement

4+0

Unit 1

Introduction to science of omics for crop improvement, Introduction to the plant genomenuclear, chloroplast and mitochondrial genomes, genome size and complexity, mapping of genome: genetic and physical maps, map-based cloning, molecular markers in plant genome analysis; RFLP, RAPD, STS, Microsatellite, SCAR (Sequence characterized amplified regions), SSCP (single strand conformational Polymorphism), and AFLP analysis, FISH and GISH for genome analysis.

Unit 2

Plant gene expression and regulation, functional genomics-expression analysis using microarrays, transposon tagging and Insertional mutagenesis - methods and significance, TILLING and EcoTILLING, Diversity Array Technology, transcriptomics.

Unit 3

Whole genome analysis: Genome size, strategies for sequencing genome, ordered genomic libraries (Cosmid, YAC, BAC libraries), Genome sequencing in plants–Principles and Techniques; Next generation sequencing technologies, Applications of sequence information in plant genome analyses; Comparative genomics, Detection of Single Nucleotide Polymorphism; Role of transcriptomics, proteomics and metabolomics in linking genome and phenome.

Unit 4

Marker assisted selection (MAS), Genomic assisted breeding approaches, Genomics and genoinformatics for crop improvement; Integrating functional genomics information on agronomically/economically important traits in plant breeding, tagging of agronomically important traits, RNA interference in crop improvement.

Suggested Reading:

- Genomes by T.A. Brown, John Wiley & Sons Ltd, New York
- Genome analysis (Volume I, II, III and IV) a Laboratory Manual by Bruce Birren, Eric D. Green, Sue Klapholz, Richard M. Myers and Jane Roskams, Cold SpringHarbor Laboratory Press.
- Discovery Genomics, Proteomics and Bioinformatics, Campbell AM & Heyer L, 2004,

PBT 525BIOINFORMATICS

4+0

Unit I:

Introduction to Bioinformatics, use of Internet and search engines (WWW, HTML, URLs, Netscape, Explorer, Google, PUBMED), database management system, database browsing, data retrieval, sequence and genome database, databases such as GenBank, EMBL, DDBJ, Swissprot, PIR, TIGR, TAIR, Searching for sequence database like FASTA and BLAST algorithm, multiple sequence alignment, phylogenetic analysis and detection of open reading frames (ORFs). **Unit II**

DNA sequence analysis: gene bank sequence database; submitting DNA sequences to databases and database searching; sequence alignment; pairwise alignment techniques; motif discovery and gene prediction; local structural variants of DNA, their relevance in molecular level processes, and their identification; assembly of data from genome sequencing

Unit III

Multiple sequence analysis: multiple sequence alignment; flexible sequence similarity searching with the FASTA3 program package; use of CLUSTALW and CLUSTALX for multiple sequence alignment; submitting DNA protein sequence to databases: where and how to submit, SEQUIN, genome centres; submitting aligned sets of sequences, updating submitted sequences, methods of phylogenetic analysis. **Unit IV**

Computational structural biology and Biostatistics: computational structural biology, in-silico methods for structural predictions, Homology threading and modeling, ab-initio modelling; Validation of in-silico determined 3D structures of proteins, Computer aided drug design-tools and applications.

Selection of sample or sampling, theory: qualitative, random and non-random sample. Collection of data, their classification, tabulation, graphic representation and diagrammatic representation, measures of central tendency and dispersion: mean, median, mode.

Suggested Reading

- Bioinformatics: A practical guide to the analysis of genes and proteins (3rd Edition) D. Baxevanis and F. Oulette, Wiley Indian Edition.19
- Bioinformatics Methods And Applications: Genomics Proteomics And Drug Discovery (3rd Edition) Rastogi SC, Rastogi P, Mendiratta N., PHI Learning Pvt. Ltd.; 2008.
- Mount, D.W., Bioinformatics: 2001, Sequence and Genome Analysis. CSHL Press.
- Claverie, J.M. and Notredame C. 2003 Bioinformatics for Dummies. Wiley Editor

PBT 526 Proteomics and Metabolomics

4+0

Unit 1

Proteomics technology: Gel electrophoresis of protein- SDS-PAGE, Native gel electrophoresis, zymography, identification and analysis of proteins by 2D analysis, mass spectrometry, MALDITOF, NMR and X-ray crystallography.

Unit 2

Differential display proteomics, protein-protein interactions, yeast two hybrid system and phage display, GFP and RFP, western blot, metabolic engineering.

Unit 3

Chemical, physical and biological properties of biomaterials and bioresponse, biomineralization, biosynthesis and properties of natural materials (protein, DNA &polysaccharides).

Unit 4

Introduction to metabolomics: Metabolome, Metabolomics, Metabolite profiling, Metabolome fingerprinting, Role of Biomarker in metabolomics, Tools of metabolome studies: NMR, MS, GC, LC, IR and its application, Metabolome projects of plant, Future prospective of metabolomics.

Suggested Reading:

- Discovery genomics, proteomics and bioinformatics, Campbell AM & Heyer L, 2004, Pearson education.
- Methods in proteome and protein analysis, Kamp RM, 2004, Springer.
- Handbook of nanostructured biomaterials and their applications in Nanobiotechnology, Nalwa HS, 2005, American Scientific Publication
- Mark Y. Stoeckle and Paul D. N. Hebert, Barcode of Life, Scientific American.
- Sujeevan Ratnasingham and Paul D. N. Hebert, BOLD: The Barcode of Life Data

System (http://www.barcodinglife.org), Molecular Ecology Notes,

PBT-527 Plant Developmental Biology

Unit 1

Introduction to plant development- Comparison of Plant and animal development, Evolution of developmental complexity from algae to angiosperm. $\Box \Box$ Role of Plant Cell Division and Expansion in development, Plant cell cycle and control of plant cell size.

Unit 2

Regulation of Plant Architecture, Shoot apical meristem, Root apical meristem and positional control of root development, Phyllotaxy, Lateral organ development- Leaf primordia imitation, Leaf development, Generation of patterns regulation of stomatal patterning in plants.

Unit 3

Plant Hormones- biosynthesis and mode of action of Auxin, Gibberellins, Cytokinins, Ethylene, Abscisic acid, Brassinosteroids, Salicyclic and Jasmonic acid, Strigolactones, karrikins, Peptide and other novel hormones of plants. Environmental regulation of Plant Development, Photoperiodism and circadian rhythms and biological clock, Phytochrome, cryptochrome, UVR8 and phototropins, Vernalization of plants.

Unit 4

Seed germination and dormancy, Plant Senescence, Reproductive development of Plants, Inflorescence initiation, Flower development in plants, Embryogenesis in higher plants.

Suggested Reading:

- Cutter, D. F., Applied Plant Anatomy, Logman, London.
- Cutter, E. G. Plant Aatomy : Experiment and Interpretation : Part 2 Orgnas. Edward Arnold, London. Cutter, E. G., Plant Anatomy : Part 1 Cells and Tissues, 2nd Edition, Edward Arnold, London.
- Eames, A. J. and Mac Daniels, L. H. An Introduction to Plant Anatomy, 2nd Edition, McGraw Hill, New York.
- Fahn, A., Plant Anatomy, 4th Edition, Butterworth, Heinemann Ltd.
- Fosket, D. E., Plant Growth and Development : A Molecular Approach. Academic press,
- San Diego. Kozolowski, T. T., Growth and Development of Trees. Vols. I and II. Academic Press, New York.
- Lyndon, R. F., Plant Development: The cellular basis. Unwin Hyman, London.
- Maheswari, P. An Introduction to the Embryology of Agiosperms. McGraw-Hill Book Co., New York. Mauseth, J. D. Plant Anatomy, The Benjamin/Cummings Publishing Co. California.
- , Oxford. Murphy, T. M. and Thompson, W. F. Molecular Plant Development, Prentice Hall, New Jersey

PBT 528 Scientific Writing and Communication

4+0

Unit 1

Presentation techniques: structure of presentations, interacting with PowerPoint, slide design, body language and positioning, presentation of participants, feedback. **Unit 2**

Scientific writing: academic language, structure of scientific documents, scientific sources, thesis writing, Selection of journal with appropriate Impact factor, Effective Literature Review, Inclusion and sequencing of authors based on their roles.

Unit 3

Preparation of title and abstract of manuscript, Preparation of Experimental Design, Discussion and conclusion, Graphical abstract/Image representation, obtaining permission for reproduction of data from other journals, Statistical tools in research.

Unit 4

Compilation of discussion and future directions in a review article, Respond to the reviewer's comments, Inter- and intra-departmental collaborations, Guide for SCOPUS/WOS/SCI Journals and Predatory Journals

Suggested Reading

- Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
- Day, R.A., 1992. How to write and publish a Scientific paper, Cambridge University Press.
- Fink, A.,2009. Conducting Research Literature Reviews: From the internet to paper. Sage Publications.

PBT 529 BIOSAFETY, IPR AND BIOETHICS

4+0

Unit-1

Introduction To Intellectual Property; types of IP: patents, trademarks, copyright & related rights, industrial design, traditional knowledge, geographical indications, IP as a factor in R&D; IPs of relevance to biotechnology; introduction of GATT, WTO, WIPO, and TRIPS; plant variety protection and farmers rights act; concept of prior art': invention in the context of "prior art"; patent databases - country-wise patent searches (USPTO, EPO, India); analysis and report formation.

Unit-2:

Basics of patents: types of patents; Indian Patent Act 1970; recent amendments; WIPO Treaties; Budapest Treaty; Patent Cooperation Treaty (PCT) and implications; procedure for filing a PCT application; the role of a Country Patent Office; filing of a patent application; precautions before patenting-disclosure /non-disclosure -patent application forms and guidelines including those of National Bio-diversity Authority (NBA) and other regulatory bodies; patent infringement.

Unit-3

Biosafety and Biosecurity; introduction to biological safety; primary containment for biohazards; biosafety levels; GRAS organisms, biosafety levels of specific microorganisms; recommended biosafety levels for infectious agents and infected animals; definition of GMOs LMOs; principles of safety assessment of transgenic plants. International Regulations –Cartagena Protocol, OECD consensus documents, and Codex Alimentarius; India Regulations –EPA act and rules, guidance documents, regulatory framework–RCGM, GEAC, IBSC, and other regulatory bodies.

Unit-4

Introduction, ethical conflicts in biological sciences - interference with nature, bioethics in health care - patient confidentiality, informed consent, euthanasia, artificial reproductive technologies, prenatal diagnosis, genetic screening, gene therapy, transplantation. Bioethics in research – cloning and stem cell research, human and animal experimentation, animal rights/welfare, Genetically engineered food, environmental risk, labeling, and public opinion, biopiracy

Suggested Reading:

• Ganguli,P.(2001).Intellectual Property Rights: Unleashing The Knowledge Economy. New Delhi: Tata McGraw-Hill Pub.

- National IPR Policy, Department of Industrial Policy & Promotion, Ministry of Commerce, GoI
- Complete Reference to Intellectual Property Rights Laws. (2007). Snow White Publication.
- Kuhse, H. (2010). Bioethics: An Anthology. Malden, MA: Blackwell.
- Karen F.Greif and Jon F. Merz, Current Controversies in the Biological Sciences -Case Studies of Policy Challenge

PBT 530 Molecular Genetics

Unit 1

Molecular pathology of Chromosome anomalies: Numerical chromosomal disorders, Structural chromosomal disorders, Chromosome instability syndromes.

Unit 2

Inherited biochemical diseases: Enzyme defects- amino acid metabolism, Lipid metabolic disorders, Carbohydrate associated disorders: Complex genetic diseases – Hypertension, Diabetes mellitus, Mitochondrial diseases, Cancer as a genetic disease.

Unit 3

Low resolution mapping: Sub- chromosomal mapping, Chromosomal break points, FISH, cytogenetic methods, Somatic cell hybrid mapping, Radiation hybrid mapping.

Unit 4

High resolution mapping: DNA FIBRE FISH, Restriction mapping, VNTR microsatellite markers for mapping, EST mapping, STS mapping, SNP mapping, Conserved region mapping: IRE, CpG site mapping, Promoter site recognition

Suggested Readings:

- 1. Concepts of Genetics by Clugs, Cummings, Spencer etc
- 2. Molecular Biology of the Gene, 6th Ed., Watson et al, CSH Press,
- 3. Genes IX (VII, VIII), Benjamin Lewin, Jones and Bartlett
- 4. Genes and Genome, Singer & Berg, USB,
- 5. Genetic Analysis of Genes and Genomes, 6th Ed, Hartl & Jones, Jones and Bartlett,
- 6. Fundamental Bacterial Genetics, Trun & Trempy, Blackwell,
- 7. Genomes 3, TA Brown, Garland,

PBT 531 Photochemistry and Pharmocognosy

4+0

Unit 1

Secondary metabolism; role of compartmentation and metabolite trafficking; Biosynthetic pathways for secondary metabolism; Biosynthesis of fatty acids and polyketides, phenols, flavonoids, tannins, lignans and lignins, alkaloids, terpenoids, steroids; turnover and degradation of secondary metabolism.

Unit 2

Classification, Phytochemical sources in plant kingdom, phytoconstituents and biological activities of secondary metabolites (Phenols and phenolic glycosides, sterols, steroidal alkaloids, stanols, miscellaneous isoprenoids, saponins, alkaloids, volatile oils, lipids and carbohydrates).

Unit 3

Antibiotics and their chemical nature, mode and mechanism of actions and bases of toxicity of antibiotics derived from amino acid metabolism, acetate metabolism and carbohydrate metabolism.

Unit 4

Methods for phytochemical analysis, tissue culture and biotechnology for the discovery and production of phyto – molecules; immunoassay; metabolomics: terms and definitions, different metabolomic technologies, merits and demerits, data acquisitions and applications; Ethnopharmacology: importance in drug developments

Suggested Reading

- Evans V.C., Trease and Evans Pharmacognosy, Harcourt Publishers Ltd., Sydney.
- Harbone J.B., Phytochemical Dictionary, Handbook of Bioactive Compounds from Plants, Taylor and Francis Ltd, Oxfordshire. 3. Wagner H., Plant Drug Analysis, Springer, Berlin.
- Zhang L., Demain A.L., Natural Products, Drug Discovery and Therapeutic Medicines, Human Press, New York.
- Kokate, C.K, Purohit A.P., Ghokhale S.B., Text book of Pharmacognosy, Nirali Prakashan, Pune.
- Rangari V.D., Text book of Pharmacognosy and Phytochemistry, Part I and II, Career Publication, Nasik.

PBT 532 Project/Review

0+8

Each student must conduct a project/review/ industrial training in the fourth semester under the guidance of the allotted advisor/supervisor. The evaluation of the same will be done at the end of the fourth semester as per the guideline issued by the university authority.