Department of Biotechnology
Chaudhary Charan Singh University, Meerut

Programme Syllabus
Master of Science in Biotechnology
(M.Sc. Biotechnology)

(Effective from Academic Year 2009-10)

Ch. Charan Singh University, Meerut –250004

DEPARTMENT OF BIOTECHNOLOGY (SFS COURSE)

M.Sc. BIOTECHNOLOGY, 2009

Distribution of Marks in different courses:

I Semester	**Course Title**	**Theory External**	**Theory Internal**	**Total Marks**
Course I	Fundamental of Genetics	50	50	100
Course II	Cytogenetics and Molecular Genetics	50	50	100
Course III	Statistical Methods and Bioinformatics in Biology	50	50	100
Course IV	Tools and Techniques in Biotechnology	50	50	100
Practical I (4 hours)		100(External)	100(Internal)	200
Total Marks		300	300	600

II Semester	**Course Title**	**Theory External**	**Theory Internal**	**Total Marks**
Course V	Fundamentals of Biochemistry	50	50	100
Course VI	Plant Genetic Resources: - Conservation and Sustainable use	50	50	100
Course VII	Biotechnology in Crop improvement	50	50	100
Course VIII	Recombinant DNA Technology and Genetic Engineering	50	50	100
Practical II (4 hours)		100 (External)	100(Internal)	200
Total Marks		100	300	600

III Semester	**Course Title**	**Theory External**	**Theory** Internal	**Total Marks**
Course IX	Microbial, Industrial and Environmental Biotechnology	50	50	100
Course X	Concepts of Nanotechnology	50	50	100
Course XI	Animal biotechnology and Immunology	50	50	100
Course XII	Genomics and Proteomics	50	50	100
Practical III (4 hours)		100(external)	100(Internal)	200
Total Marks		300	300	600

IV Semester	**Course Title**	Dissertation, presentation, viva-voce	**Total Marks**
	Project	400	400
Grand Total of Marks		2200	2200

A minimum of 30% marks separately in internal and external assessment of each course and an aggregate of 40% marks in all the courses is required for passing. In case of failing to obtain 30 % marks in internal assessment of any paper, the candidate will not be eligible to appear in external examination of that course.

CURRICULUM: M.Sc. BIOTECHNOLOGY (2009)

I Semester

1. Fundamental of Genetics

2. Cytogenetics and Molecular Genetics

3. Statistical Methods and Bioinformatics in Biology

4. Tools and Techniques in Biotechnology

Lab.: Fundamental of Genetics; Cytogenetics and Molecular Genetics; Statistical Methods and Bioinformatics in Biology; Tools and Techniques in Biotechnology

II Semester

5. Fundamentals of Biochemistry
6. Plant Genetic Resources: - Conservation and Sustainable use
7. Biotechnology in Crop improvement
8. Recombinant DNA Technology and Genetic Engineering

Lab.: Fundamentals of Biochemistry; Plant Genetic Resources: - Conservation and Sustainable use; Biotechnology in Crop improvement; Recombinant DNA Technology and Genetic Engineering

III Semester

9. Microbial, Industrial and Environmental Biotechnology
10. Concepts of Nanotechnology
11. Animal biotechnology and Immunology
12. Genomics and Proteomics

Lab.: Microbial, Industrial and Environmental Biotechnology; Concepts of Nanotechnology; Animal Biotechnology and Immunology; Genomics and Proteomics

IV Semester

Project: 1. Report of work

2. Presentation of work.

3. Viva-voce examination.

ABOUT OF THEDEPARTMENT

PROGRAMME OUTCOMES (PO's)

The M.Sc. Program of Biotechnology at Ch. Charan Singh University, Meerut, started in 1996, aims to train students in Biotechnology wherein engineering and technology principles could be used to probe biological questions or to develop technologies, devices and systems that require substantive expertise in Biology, Agriculture, Pharmaceutical, Industrial, as well as Clinical Research components. The students in this program acquire knowledge, critical thinking skills and experience in conducting cutting edge research. This program develops human capital for advanced scientific research and entrepreneurship. The syllabus of M.Sc. Biotechnology is designed in such a way that all the 16 courses have their own objectives and methodologies to achieve their respective course outcomes. All the papers combine theoretical inputs with specific practicals related to the needs of various fields of biotechnology teaching and research. To achieve the programme specific outcomes, teachers have to use various direct or indirect methods to achieve overall pedagogical objectives. Due to time limitations in semester system, it is very difficult to achieve all outcomes / targets at the same time. That is why, programme uses different simple and direct measurement tools to assess the extent to which course outcomes have been attained maximum. The new and advanced competency based curriculum emphasizes on the acquisition of competencies as a requisite for progression in the course. The programme adopted advanced and active learning process for the students to develop their skills. The achievement of competencies/pre-determined tasks of students is periodically assessed through internal and summative assessments. A record of activities completed and competencies acquired through each course of the programme is necessarily done to ensure the identification of fast and slow learner and also we recorded that what they gained from the key competencies. The programme periodically encourages student's participation in all the curricular activities organized by different governmental and non-governmental organizations and such activities forms an integral part of the formative/continuous assessment program. To measure course outcomes and attainment level of each student, the department conducts continuous assessment tests, written quizzes, oral quizzes, assignments, small projects, short training, seminar presentations, class discussions, lab practical knowledge in each course and at programme level, project work with dissertation is compulsory. The department finds the attainment level of each student on the basis of marks obtained in these tests, quizzes, seminar and assignments. Other co-curricular activities such as field visits, industrial trips, participation in social, environmental and ethics awareness in public domain are also considered for measuring / assessing the attainment of each course outcome and specific program outcome of each student. The targets thus set for the attainment of POs, PSOs and COs are updated every year. From time to time, the university authorities' takes stock of the attainment of programme and course outcomes and suggest corrective measures, which are then implemented by the department.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: Postgraduate students will be able to demonstrate and apply their knowledge of cell biology, biochemistry, microbiology and molecular biology to solve the problems related to the field of biotechnology.

PSO2: Postgraduate students will be able to demonstrate and apply the principles of bioprocess engineering in the design, analysis, optimization and simulation of bioprocess operations.

PSO3: Students will be able to gain fundamental knowledge in animal and plant biotechnology and their applications.

PSO4: Students will be equipped to understand three fundamental aspects in biological phenomenon: a) what to seek; b) how to seek; c) why to seek?

PSO5: Student will be able to (a) Describe fundamental molecular principles of genetics; (b) Understand relationship between phenotype and genotype in human genetic traits; (c) Describe the basics of genetic mapping; (d) Understand how gene expression is regulated.

PSO6: Students will be able to (a) To elaborate concepts of biochemistry with easy to run experiments; (b) To familiarize with basic laboratory instruments and understand the principle of measurements using those instruments with experiments in biochemistry.

PSO7 Students will be able to understand various facets of molecular procedures and basics of genomics, proteomics and metabolomics that could be employed in early diagnosis and prognosis of human diseases.

PSO8: Students will be able to gain hands on experience in gene cloning, protein expression and purification. This experience would enable them to begin a career in industry that engages in genetic engineering as well as in research laboratories conducting fundamental research.

COURSE OUTCOMES (COs)

M.Sc. Biotechnology			
Semester	Course Name	Course Code	Course Outcome
I	Fundamentals of Genetics	101	CO-1: The students will be able to understand the classical and modern concepts of genetics. CO-2: Students are able to understand the basic principles of inheritance biology. CO-3: Students will be able to understand the sex linked inherited characters and diseases. CO-4: They will get in-depth knowledge about gene interaction, penetrance and expressivity. CO-5: The student will demonstrate proficiency in understanding the basic structure of atom and interpret the inheritance of characters by using linkage and crossing over.
	Cytogenetics and Molecular Genetics	102	CO-1: Explain the concepts of DNA replication, DNA damage and repair, and gene expression in eukaryotic and prokaryotic organisms. CO-2: Be able to take a family history and construct and interpret a pedigree. CO-3: Be aware of the different laboratory techniques to investigate genetic material and their advantages and limitations. CO-4: Be able to interpret a standard cytogenetic and molecular genetics. CO-5:Be able to understand Duplication and deficiencies, Translocation, Inversion, Trisomic and Tetrasomic,Monosomic and Nullisomic.
	Tools & Techniques in Biotechnology	103	CO-1: Enable the student to get sufficient knowledge in principles and applications of bio instruments. CO-2: The properties of biomolecules that are used for their analysis CO-3: The principle concepts in using analytical and preparatory techniques CO-4: How to quantify and assay for a biomolecules. CO-5: On successful completion of the course the students will be aware of microscopic techniques, electro physiological methods, biomolecules structure determination using spectroscopy, centrifugation and radiolabelling

			techniques.
	Statistical Methods and Bioinformatics in Biology	104	CO-1: Students will acquire independent ability to carry out statistical analysis of data and interpretation of results. CO-2: Students will be able to statistically analyze the phenotypic data of plant traits. CO-3: The students will recognize and examine the relationships between inputs and outputs in their agricultural field to make effective and profitable decisions. CO-4: Students will demonstrate an ability to engage in critical thinking by analyzing situations and constructing and selecting viable solutions to solve problems. CO-5: Student will be able to demonstrate the ability to analyse data and draw appropriate statistical conclusions. CO-6: Students will be well equipped to handle field level data for analysis and modeling purposes. They will learn how to draw a good sample from a population in order to draw valid inference. CO-7: Students will be able to develop strategies for experimental designs. CO-8: Students will understand computational basis of genetic analysis that use genome data sets in system biology. CO-9: Students will be able to explain about the methods to characterize and manage the different types of biological data. CO-10: Student will know about various biological databases that provides information about nucleic acids and protein. CO-11: Student will understand the basics of sequence alignment and analysis. CO-12: Students will be able to design and execute the programmes related to structural and functional aspects of genes and proteins
II	Fundamentals of Biochemistry (Core Course)	201	CO-1: This course presents the chemical reactions or metabolic functions in the living system and their regulations. CO-2: To make the student to understood the concept of biochemical regulations CO-3: On successful completion of the subject the student should have understood: basic biomolecules, viz protein fats, enzymes and

			their relevance to biological molecular stabilization.
	Plant Genetic Resources: - Conservation and Their Sustainable Use	202	CO-1: Students will have knowledge on the conservation of biodiversity. CO-2: They will acquire knowledge on various organizations involved in conservation and their policies. CO-3: The students will have knowledge on plant quarantine regulations. CO-4: The students will be able to promote human capacity to appreciate, maintain, and promote utilization of plant genetic resources. CO-5: Students will understand different forms of IPRs and legislations related with IPRs. They will be well aware of Farmers' and Plant Breeders' rights.
	Biotechnology in Crop Improvement (Core Course)	203	CO-1: Ability to apply the concepts and principles of plant tissue culture techniques on research problems pertinent to crop improvement. CO-2: Dissemination of skills on usage of the acquired knowledge on practical biotechnology tools to augment agricultural research. CO-3: The knowledge required to execute, analyze and apply molecular marker systems for crop improvement. CO-4: Students will know about different mapping populations. CO-5: Establish different types of plant cultures. CO-6: Apply the technical skills learnt to establish nurseries for horticultural and agricultural crops. CO-7: Compare the pros and cons of transgenic plants on environment CO-8: Explain the concepts of intellectual property management and handling of GMOs.
	Recombinant DNA Technology and Genetic Engineering	204	CO-1: Explain the basic principles and, the tools and techniques of Genetic engineering CO-2: Describe the applications of genetic engineering in various fields. CO-3: Debate on ethical issues concerned with Genetic engineering.
III	Microbial, Industrial	301	CO-1: The objectives of this course are to

	and Environmental Biotechnology		introduce students to developments/ advances made in field of microbial technology for use in human welfare and solving problems of the society. On completion of this course, students would develop deeper understanding of the microbiology and its applications. CO-2: Explain the principle and application of various types of Microscopy. CO-3: Describe the structure and Classification, staining, culturing, physiology, of microorganism.
	Concepts of Nanotechnology	302	CO-1: Basic knowledge of nanoscience and its advancement in present time, future aspects of nanoscience CO-2: Introduction, Properties and Characterization of nanomaterials, use of quantum dots in biology CO-3: Study of Protein and Peptide based Nanostructures, DNA based Nanostructures, DNA based devices, nanosensors CO-4:Self assembling nanostructures, Synthesis and Assembly using Bio-Derived Templates. CO-5: Use of Pharmaceutically important nanomaterials for controlled drug delivery CO-6:Nanomaterials and Toxicity Evaluation at cellular level.
	Animal biotechnology and Immunology	303	CO-1: Explain the concepts of innate and adaptive immune response and techniques for clinical diagnosis. CO-2: Illustrate the methodology to establish animal cell culture. CO-3: Describe the importance of engineering animal cells for the production of therapeutic proteins
	Genomics and Proteomics	304	CO-1: Learning about genome, the types and significance of repeats in the genome. CO-2: Learn strategies for Whole Genome Sequencing. CO-3: Perform procedures for the De novo and reference based assembly, Genome finishing and annotation. CO-4: Perform ORF, ab initio and homology based Gene prediction. CO-5: Assessing genomic variations- using

			DNA marker systems. CO-6: Knowledge on DNA chips and their use in transcriptome analysis. CO-7: Learn about the role of mutants and RNAi in functional genomics. CO-8: Acquire skills in the techniques of Site directed mutagenesis, Transposon tagging and targeted genome editing technologies. CO-9: Perform protein 3D structure modelling and proteome analysis. CO-10: Understand protein- protein interaction by FRET, yeast two hybrid and co-immunoprecipitation.
IV	Thesis Work		CO-1: The purpose of this course is to help students organize ideas, material and objectives for their dissertation and to begin development of communication skills and to prepare the students to present their topic of research and explain its importance to their fellow classmates and teachers. CO-2: Students should be able to formulate a scientific question CO-3: Students should be able to present scientific approach to solve the problem CO-4: Students should be able to interpret, discuss and communicate scientific results in written form. CO-5: Students should be able to gain experience in writing a scientific proposal CO-6: Students should be able to learn how to present and explain their research findings to the audience effectively.

Course-I

Fundamental of Genetics

Unit-I

Introduction: History of Genetics, its scope and significance, Mendel's experiments, Principles of Segregation and Law of Independent Assortment, Lethality and Interaction of genes**.**
(4)

Unit-II

Linkage and crossing over: Linkage in higher eukaryotes, Coupling and Repulsion Hypothesis, measurement of Linkage, Detection of linkage, Breakdown of Linkage, Four- strand crossing over, Three-Point Test cross, cytological basis of crossing over, Interference and Coincidence, Crossing over and Chisma formation, Factor affecting recombination frequencies.
(4)

Unit-III

Genetics of Sex Determination and Differentiation: Sex-linked, Sex- limited and Sex- influenced traits in *Drosophila* and Human beings, Theories of Sex-determination- Chromosomal theory, environmental theory and genic balance theory, Sex- determination in dioeciously plants, Sex reversal and Gynandromorphs, Human sex anomalies (Klinefelter's Syndrome and Turner's Syndrome), brief idea of Dosage Compensation and Lyon's hypothesis. **(6)**

Unit-IV

Mutation and Mutagenic Agents: Brief history of mutation, physical and chemical Mutagens, Detection of mutation in *Drosophila* (CIB method, Muller-5 method), Detection of mutation in plants and their practical application in crop improvement.

(6)

Unit-IV

Multiple Alleles: Concepts of multiple alleles, self incompatibility alleles in Nicotiana, coat color in rodents, Blood group in Humans, antigen-antibody interaction in inheritance of A, B, AB and O blood groups, H-antigens, MNS system, Rh Factor, Epitasis and multiple allelism (Bombay blood group).
(6)

Unit-V

Genetics of Inbreeding Depression and Heterosis: Definition and Historical aspects of heterosis and Inbreeding depression, manifestation and application of heterosis, apomixis and fixation of heterosis, application of molecular marker in heterosis breeding**.** **(8)**

Unit-VI

Extra -chromosomal Inheritance: Criteria for extra- chromosomal inheritance, plastid inheritance in *Mirabilis,* iojapa in corn, Kappa particles in *Paramecium*, Coiling in snails, male sterility in plants**.** **(6)**

Unit-VII

Biochemical Genetics: Inborn errors of Metabolism in man, eye transplantation in *Drosophila*, biochemical mutations in Neurospora, biosynthetic pathways and biochemical mutations**.** **(4)**

Unit-VIII

Concepts of Genes: Classical and modern gene concepts, Pseudoallelism, position effects, intragenic crossing over and complementation (cistron, recon, muton), Benzer's work on rII locus in T4 phases. **(6)**

Course-II

Cytogenetics and Molecular Genetics

PART-A: - Cytogenetics

Unit-I

Cell Division: Cell Cycle, differences between mitosis and meiosis, mechanism of chromosome moment, reduction division and equational division, double reduction. **(6)**

Unit-II

Duplication and deficiencies: Classification, methods of production, meiotic pairing and Phenotypic effects. (4)

Unit-III

Translocation: - Classification, methods of production, identification, meiotic pairing and role in evolution. (4)

Unit-IV

Inversion: Classification, methods of production, identification, meiotic pairing and crossing over in different regions, Role in evolution. (6)

Unit-V

Trisomic and Tetrasomic: - Classification, methods of production, Identification, meiotic pairing and utility in Chromosome mapping. (2)

Unit-VI

Monosomic and Nullisomic: - Methods of Production, Identification, meiotic behavior, monosomic analysis, alien additions/substitution lines. (2)

PART-B: - Molecular Genetics

Unit-VII

Genetic Material: DNA and RNA as genetic material (experimental evidences), structure of DNA(including Z-DNA and 5- hasisekharan's RL model), super coiling of DNA, Different type of RNAs and their roles, difference between DNA and RNA. (6)

Unit-VIII

DNA Duplication (in prokaryotes and Eukaryotes):- Unwinding proteins, Role of RNA Polymerases and DNA polymerases in prokaryotic and eukaryotic DNA replication, Semi-conservative, Discontinuous and Bi-directional replication, RNA primers, Role of proteins in prokaryotic and eukaryotic DNA replication, Models of replication. (8)

Unit-IX

Organization of Genetic Material: Chromosome ultra structure and nucleosome concept, packing of DNA as nucleosomes in eukaryotes, techniques used for discovery of nucleosome, structure and assembly of nucleosomes, solenoid, phasing of nucleosomes, DNA concept and C-value paradox, repetitive and unique sequences, overlapping, pseudo, crying and split genes, satellite DNA's, selfish DNA. (8)

Unit-X

Genetic Code (including mitochondrial genetic code):- Deciphering of code in vitro and in vivo (use of mutations-base replacement, frame-shift and suppressor mutation). (4)

Course-III

Statistical Methods and Bioinformatics in Biology

PART-I: Statistical Methods

Unit-I

Presentation of Data: Frequency distributions, graphical presentation of data by histogram, frequency polygon, frequency curve, and cumulative frequency curves. (4)

Unit-II

Measures of central tendency and dispersion: - Mean, Median, Mode and their simple properties (without derivations), and calculation of median by graphs, range, mean derivation, standard deviations, coefficient of variation. (6)

Unit-III

Test of Significance: - Sampling distribution of mean and standard error, large scale sample tests(tests for an assumed mean and equality of two population means with known S.D.), small sample tests(t-tests for an assumed mean and equality of means of two populations when sample observations are independent, paired and unpaired t- test, t- test for correlation and regression coefficients), t-test for comparison of variances of two populations, chi-square test for independent of attributes, goodness of fit and homogeneity of samples. (10)

Unit-IV

Experimental Designs: Principles of experimental designs, completely randomized, randomized block and Latin square designs, simple factorial experiments (mathematical derivation not required), analysis of variance (ANOVA) and its uses. (8)

PART-II: Bioinformatics

Unit-V

Introduction: - History, aims of Bioinformatics, Definition and Concepts, Components of Bioinformatics, Basic tools, Scope of Bioinformatics in molecular biology and Computers, Role of internet in Bioinformatics, Applications of Bioinformatics. (6)

Unit-VI

Bioinformatics- Approaches and applications: - Introduction, DNA-the staff of life, molecular sequence alignments, databases, molecular visualization integrated molecular biology database.

(8)

Unit-VII

Protein and Nucleic acid databases: - Introduction, Protein and Nucleic acid databases, databases accession, database searching, NCBI based study. (8)

Course-IV

Tools and Techniques in Biotechnology

Unit-I

Microscopy: Principles, Resolving Power and applications of Light Microscopy, Electron Microscopy (SEM, TEM) and Confocal Microscopy. (6)

Unit-II

Centrifugation: Brief history, type of centrifugation, theory of centrifugation, types of centrifuges and centrifugation techniques, Types of rotors. (8)

Unit-III

Electrophoresis: - History, Principles, Application and factor affecting of electrophoresis with detail reference to Agarose, PAGE, PFGE, Capillary electrophoresis, continuous, 2D-PAGE, IEF. (8)

Unit-IV

Nuclear Magnetic Resonance Spectroscopy: - History of NMR, theory and principles of NMR, NMR spectrometer, Detection of frequencies and Measurement by NMR. (6)

Unit-V

Radioisotope Technique: - Nature of Radioactivity, characteristics of different radiolabels, detection and measurement in Radioactivity, applications of radioisotopes in biological sciences.

(6)

Unit-VI

Spectroscopy: - Introduction, theory and principles of different types of Spectroscopy and their applications in biotechnology. (6)

Unit-VII

Chromatography: - General principles and techniques of HPLC, LPLC, GLC, Adsorption Chromatography, partition chromatography, IEC, permeation Chromatography, Affinity Chromatography. (10)

Course-V

Fundamentals of Biochemistry

Unit-I

Structural and Biochemical Organization: - Amino Acids, Carbohydrates, Lipids and Fatty Acids and Nucleotides. (6)

Unit-II

Secondary metabolites: - Hormones, Alkaloids, Porphyrins. (6)

Unit-III

Enzymology: - Enzymes, Elementary Kinetics, Mechanism of enzymes action, assay types, reaction rates, Extremozymes engineering, enzyme activity and substrate specificity, Non-aqueous enzymology, coenzymes and vitamins, Isozymes and allosteric enzymes. (12)

Unit-IV

Protein as base unit: - Structure and function, Protein folding, Protein sequencing, Ramachandran's plot and Protein catabolism (10)

Unit-V

Major intermediary metabolic pathways, biosynthesis and catabolism of saturated and unsaturated fatty acid, nucleotides. (8)

Unit-VI

Glycolysis, Kreb's cycle, ETS of respiration and oxidative phosphorylation substrate level phosphorylation, Anaplerotic pathway. (8)

Course-VI

Plant Genetic Resources: - Conservation and Sustainable use.

Unit-I

Biological species: Concepts and its limitation**.** (2)

Unit-II

Centers of Diversity and Centers of Origin. (2)

Unit-III

A brief idea of the evolution of crop plants: - Wheat, Barley, Rice, Maize, Cotton, Sugarcane, Potato, Cole crops, Rapeseeds and mustard. (6)

Unit-III

Biodiversity vs. Genetic Resources: - Definition and Explanation, alpha vs. beta biodiversity and methods of their study, present levels of Biodiversity and rate of loss of biodiversity, causes for the loss of biodiversity, uses of biodiversity, extent of biodiversity in plants, exploration and germplasm collection, introduction and exchange of PGR, Red Data Books and Endangered plant species. (8)

Unit-IV

Plant Genetic Resources: - Different kinds of PGR, Taxonomical Classification of PGR, Basic, derived and molecular, core collections, principles of germplasm characterization, evaluation, maintenance and regeneration, Plant quarantine aspects- Sanitary and Phytosanitary Systems (SPS). (8)

Unit-V

Techniques for conservation of plant germplasm: - *In-situ* and *Ex-situ* methods of conservation, Cryopreservation of genetic materials. Gene banks and Cryobanks. (2)

Unit-VI

IPGRI, NBPGR, FAO and CGIAR: - Their role is conservation of PGR. (6)

Unit-VII

Future Harvest Centers and CBD: -A Brief Idea, CBD and Cartagena protocol. (6)

Unit-VIII

UPOV, Plant Breeders Rights (PBRs) and farmers Right (FRs), Protection of plant varieties and farmers right act (PPV and FRA) 2001. (4)

Unit-IX

PGR and IPRs (Intellectual Property Rights):- Patents, copyrights, Trademarks, GATT and TRIPs, Terminator and Traitor Techniques (v-GURT and t- GURT), Biodiversity Bill 2002, Geographic indicator bill. (6)

Course-VII

Biotechnology in Crop improvement

Unit-I

Plant organ, tissue and cell culture: - Somaclonal variation and its use in crop improvement, embryo culture and its utility in hybridization programmes, Anther culture, haploid production and their uses, micro propagation in horticultural crops and forestry and its uses, artificial seeds, techniques of protoplast culture, regeneration and somatic cell hybridization, achievements , limitations, utility in improvement of crop plants. (12)

Unit-II

Biofertilizers, Bioinsecticides and Molecular Farming. Concept and utility (4)

Unit-III

Methods of Gene Transfer in Plants: *Agarobacterium* mediated gene transfer, direct DNA delivery methods (microinjection, particle gun, electrophoration). (6)

Unit-IV

Hybridization: - Distant hybridization and Somatic hybridization in crop improvement. (4)

Unit-V

Transgenic Plants in dicots and monocots: - Utility of Transgenic in basic studies and in crop improvement (resistance for herbicides, viruses, insects and abiotic stresses, Barnase and Barstar for hybrid seed production), Biosafety issues including risks associated with transgenic crops, biosafety regulations. (8)

Unit-VI

Improvement of Nutritional quality of plants: - seed storage proteins e.g. Glycinin, Conglycinin, Legumin, Phytohaemaglutinin, Phaseolin, Prolamins, Albumins and Designer-proteins, Engineering for vitamins and Iron-Deficiency, Engineering Traits related to hybrid seed Production (e.g. Male Sterility) (8)

Unit-VII

Plant genome Programs: - Impact of genetically modified crops and genomics research in agriculture and biology, Evaluation of Transgenic plants as to their commercial value, Efficacy and Environmental concerns, Legislation for Transgenic plants, Economic viability of Transgenic plants (8)

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Course-VIII

Recombinant DNA Technology and Genetic Engineering

Unit-I

Genetic Engineering: - Definition and explanation, scope of GE, Concept and importance of GE, RDT in prokaryotes and eukaryotes, Restriction enzymes, modifying enzymes, Isoschizomers and cloning into mutagenesis, DNA Fingerprinting. (12)

Unit-II

Cloning and expression vectors:-Plasmid, Phage, M13, Phagemid, BAC, YAC, MAC, Expression vectors, Use of Promoters, Expression through Strong and Regulatable Promoters, Binary and Shuttle Vectors. (8)

Unit-III

Libraries and molecular probes: - Construction and Screening of genomic and cDNA libraries, BAC libraries and assembly of BACs into contigs, Molecular probes and their preparation, labeling and applications, Southern, Northern, Western blotting, Chromosome walking, Chromosome jumping. (12)

Unit-IV

Polymerase Chain Reaction: - Basic principles and its modifications, designing of primers, Different schemes of PCR, application of PCR, RACEs, Electronic PCR (e-PCR), RT- PCR, Real- Time PCR (8)

Unit-V

Gene Sequencing: - Different methods of gene isolation, techniques for sequencing (Maxam & Gilbert degradation method, Sanger's Dideoxy method), Organo-chemical gene synthesis mechanism, cDNA using reverse transcriptase. (10)

Course-IX

Microbial, Industrial and Environmental Biotechnology

Unit-I

Introduction: - Concepts, Growth curve, sterilization techniques, Isolation and Characterization. (2)

UNIT II

Microbes: - Definition, classification, sources of useful microbes and their characteristics. (4)

Unit-III

Use of Microbes in food and dairy, single cell proteins, physiological aspects SCP from CO_2, waste materials and renewable resources, improvement in single cell protein production, Probiotic foods. (8)

Unit-IV

Industrial source of enzymes: - Cellulases, Xylanases, Pectinases, Amylase, Lipase and Proteases their production and applications. (6)

Unit-V

Commercial production of important antibiotics, amino acids, insulin, steroids, Fermentation and production of Ethanol, Acetone, Butanol, Glycerol, Vitamins and Alkaloid (8)

Unit-VI

Pollution: - Types, causes, Prevention and Control, methods of reducing environmental impacts of chemicals, weedicides, Pesticides and fertilizers, Biotechnological advances in pollution control through GEMs, Sewage treatment, Newer approaches to sewage treatment, treatment of solid waste, Energy production- Bio-fuels. (8)

Unit-VII

Bioremediation and pollution control through microbes and plants, Biodegradation of Natural Products, microbial desulphurization, biodegradation of xenobiotics, hydrocarbons. (8)

Unit-VIII

Biotechnology of fermentation: Methods and types of fermentation, dual/multiple fermentation, continuous fermentation and late nutrient addition, growth kinetics of microorganisms, fermenter systems and fermentation. (6)

Course-X

Concepts of Nano-biotechnology

Unit-I

Introduction: - Concept, scope, vision, application, present and future prospects in biological sciences. (6)

Unit-II

Applications of Quantum Dots in Biology: - An overview, Introduction, General properties, applications. (6)

Unit-III

Assembly and Characterization of Bio-molecules: - Gold Nano-particle conjugates and their use in intracellular imaging (introduction, different methods). (6)

Unit-IV

Surface-functionalized Nano-particles for controlled drug delivery: - Introduction and different Methods. (4)

Unit-V

Structural DNA nanotechnology- An overview: - Introduction, DNA objects, DNA Arrays, DNA nanomechanical devices, DNA based computational studies. (8)

Unit-VI

Nanostructure DNA templates: - Introduction, synthesis and purification of Plasmid templates, Fabrication and preparation of ultrathin carbon-coated TEM Grids, Preparation of Q-Cds/pUCLen4 or Q-Cds/Φx174 RF11 samples, their characterization. (8)

Unit-VII

Probing DNA structure with Nanoparticles: -Introduction, Different methods. (4)

Unit-VIII

Synthetic Nanoscale Elements for Delivery of Material into Viable cells: - Introduction, different Material required, Different methods. (8)

Course-XI

Animal biotechnology and Immunology

Part-A: Animal Biotechnology

Unit-I

Introduction: - Animal Tissue and Organ Culture, Plasma clot method, Raft method, Agar-gel method, Grid method, cyclic exposure to medium and Gas phase, advantages, limitations and applications, artificial skin. (6)

Unit-II

Cell Culture: - Substrate and suspension culture, Culture Media, natural and artificial, initiation of cell culture, sub-cultures, Evaluation and Maintenance of cell culture lines, Large scale culture of cell lines, Monolayer, Suspension culture, Immobilized cultures, Somatic cell fusion, mechanism and applications, cell culture products and their applications, Interferon's. (8)

Unit-III

Cloning: -In-vitro Fertilization and Embryo transfer, Application of Embryo transfer technology, Embryo transfer in cattle, , Animal cloning, Ethical and Social Issues relating to Human cloning, Transgenic and their future Prospective. (8)

PART B: Immunology

Unit-IV

Introduction: - History, concept and Scope of Immunology. (2)

Unit-V

Immunity: - Innate and Acquired immunity, Passive and Active Immunity, Lymph and organs, Humoral and Cell Mediated immunity, Specificity and Memory, Transplantation immunity, Major Histocompatibility Complex (MHC) and Complements. (6)

Unit-VI

Interactions: - Antigen-Antibody reactions, Antigen type-hapten, Immunoglobulin's (fine structure of IGg and diversity), serological reactions, Agglutination, Precipitation, Immuno-electrophoresis, ELISA, RIA, Immuno-electromicroscopy. (6)

Unit-VII

Hybridoma Technology: - Monoclonal antibody production, myeloma cell lines, Fusion of myeloma cells without antibody producing B-cells, selection and screening methods for positive hybrids, production, purification and characterization of monoclonal antibodies without Hybridoma, Genetic manipulation of immunoglobins. (6)

Unit-VIII

Diseases and Vaccines: - T-cell cloning, mechanism of antigen recognition by T-and B-lymphocytes, Genetic control of immune response, autoimmune diseases, immunodiagnosis, AIDS, types of vaccines, Strategies for the development of vaccines, infectious diseases. (8)

Course-XII

Genomics and Proteomics

PART A: Genomics

Unit-I

Origin and Evolution of genomics: - Origin of genomics, the first DNA genomes, microcollinearity and lack of it, DNA based phylogenetic trees, genomes and human evolution, evolution of nuclear and organellar (mitochondrial and Chloroplast genome, the concept of minimal genome and possibility of synthesizing it. (6)

Unit-II

Molecular maps of genomes and comparative genomics: - Genetic maps, physical maps, EST and transcript maps, functional maps, comparative genomics and collinearity/synteny in maps.(4)

Unit-III

Whole Genome sequencing: - Whole genome shotgun sequencing, clone-by-clone or 'hiererchical stotgun' sequencing, microbial genomes (including yeast), plant genomes (Arabidopsis and rice), Animal genomes (fruit fly, mouse, human). (6)

Unit-IV

Annotation of whole genome sequence and functional genomics: - *In silico* methods, insertion mutagenesis (T-DNA and transport insertion), TILLING, management of data, gene expression and transcript profiling, EST contigs and unigene sets, use of DNA chips and microarrays. (6)

Unit-V

Pharmacogenomics: - Use in biomedicine involving diagnosis and treatment of diseases, genomics in medical practice, personalized medicine, DNA polymorphism and treatment of diseases, use of SNP in pharmacogenomics, pharmacogenomics and industry. (6)

PART B: Proteomics

Unit-VI

Study and Scope: - Introduction, definition concepts and approaches of proteomics studies and activities. (2)

Unit-VII

Quantitative and Qualitative proteome analysis technique: - Separation technique- 2D-PAGE, 2-DE (BN-PAGE), image analysis, Mass- spectrophotometery, LC-TMS, MALDI, and SALDI (8)

Unit-VIII

Protein interaction and Protein complex: - Protein interaction, DNA- Protein interaction, Yeast two hybrid system and their applications. (4)

Unit-IX

Drug Discovery and Development: - Current issues, drug targets, Drug efficacy, Drug toxicology, Protein chips and Antibody Microarray. (4)

Unit-X

Cancer Proteomics: - An overview of cancer, origin and types of cancer, proteomics in cancer research, techniques of proteomics in cancer research, future approaches of proteomics and cancer research. (4)