Maharaja Ranjit Singh College of Professional Sciences, Indore

Department of Biosciences

Lesson Plan - M. Sc. Biotechnology Sem II (Jan 2019 -June 2019)

Subject - Molecular Biology

Teacher - Zahabiya Saifee

Day/Lecture	Unit	Topic
1	I	Organization of bacterial genome
2		Structure of eukaryotic chromosome
3		Role of nuclear matrix in chromosome organization
4		Matrix binding proteins
5		Hetrochromatin & euchromatin, satellite DNA
6		DNA reassociation kinetics
7		Repetative & unique sequnces
8		DNA melting & buoyant density
9		Nucleosome phasing
10		DNAse I hypersensitive region
11		DNA methylation & methylation
12	II	DNA structure & types
13		Measurement of spectrophotometric properties
14		CD, AFM & electron microscope analysis of DNA
15		Prokaryotic replication
16		Eukaryotic replication
17		Enzymes & proteins involved
18		Repair systems- photoreactivation, excision repair
19		Repair pathways- mis match repair, SOS repair
20		Recombination- homologous & non homologous
21		Site specific recombination & chi sequences
22		FLP/FRT & CRE/LOX recombination
23		Gene targeting & disruption
24	III	Prokaryotic transcription
25		Transcription unit; promoters & operators
26		Intiation, elongation & termination
27		Transcriptional regulation- positive & negative
28		Lac operon
29		Trp operon
30		Ara & His operon
31		Gal operon
32		Eukaryotic transcription
33		RNA polymerase & transcription factors
34		Activators & repressors
35		Transcriptional & post transcriptional gene silencing
36	IV	Processing of rRNA, tRNA, mRNA
37		Capping, Polyadenylation & splicing
38		RNA editing
39		Nuclear export of mRNA & stabillity
40		Catalytic RNA
41		Features of genetic code
42		Translation machinery & mehcanism of translation
43		Co & post translational modifications
44		Genetic code in mitochondria
45		Transport of proteins & chaperon concept
46		Protein stability, turnover & degradation
47	V	Mutations, isolation of mutants
48		Useful phenotype- Auxotrophic, conditional
49		Useful phenotype- lethal, resistant
50		Reversion & supression
51		Physical mutagens
52		Chemical mutagens
53		Mechanism of mutagenesis
54		Ames test

Maharaja Ranjit Singh College of Professional Sciences, Indore

Department of Biosciences

Lesson Plan - M. Sc. Biotechnology Sem II (Jan 2019 -June 2019)

Paper-II: Bacterial Genetics and Genetic Engineering

Teacher - Shaishav Sharma

ay/Lectu	Unit	Topic
1	I	Gene transfer in bacteria: History, Conjugation-F, F', Hfr
2		F transfer, Hfr-mediated chromosome transfer
3		Transformation-natural and artificial transformation
4		Transformation-natural and artificial transformation
5		Transduction-Generalized Transduction
6		Transduction-Specialized transduction
7		Merodiploid generation
8		Gene Mapping
9		Transposable genetic elements, Insertion sequences
10		Composite and complex transposons
11		Replicative and non-replicative transposition
12		Genetic analysis using transposons
13		Genetic analysis using transposons
14	II	Bacteriophage-structure, Assay, Lambda phage-Genetic map
15		Lambda phage-Lysogenic and lytic cycles
16		Lambda phage-Gene regulation
17		Filamentous phages such as M13, Plasmids-natural plasmids
18		Plasmids-properties and phenotypes, Plasmid biology-copy number and its control
19		Plasmid incompatibility, plasmid survival strategies
20		Antibiotic resistance markers on plasmids-mechanism of action and resistance
21		Genetic anaysis using phage and plasmid
22		Restriction-modification (R-M) systems: History, Types of R-M systems and their characteristics
23		Methylation-dependent restriction systems and their applications
24	III	Basic concepts of genetic engineering: Restriction enzymes
25		T4 DNA Polymerase, Klenow enzyme
26		DNA Ligase, Polynucleotide kinase, Alkaline phosphatase
27		Cohesive and Blunt-end ligation, Linkers, Adapters, Homopolymeric tailing
28		Labelling of DNA: Nick translation, Random priming, Radioactive and non-radioactive probes
29		Hybridization techniques: Northern, Southern
30		Colony hybridization, Fluorescence in situ hybridization
31		Chromatin immunoprecipitation, DNA-Protein interactions-Electrophoretic mobility shift assay
32		DNA-Protein interactions-Electrophoretic mobility shift assay
33		DNaseI footprinting, Methyl interference assay
34	IV	Cloning vectors: Plasmids-pUC19
35		Bacteriophage vectors-Lambda vectors, Insertion and replacement vectors
36		M13mp vectors, Phagemids, Bluescript vectors, EMBL
37		Cosmids, Bacterial artificial chromosomes (BACs), Yeast Artificial chromosomes (YACs)
38		Animal-virus derived vectors-SC-40, Vaccinia/Bacculo and retroviral vectors
39		Expression-vectors-pMAL, GST, pET-based vectors
40		Protein purification-His-tag, GST-tag, MBP-tag etc., Intein-based vectors
41		Inclusion-bodies, Methodologies to reduce inclusion-bodies
42		Bacculovirus and Pichia vectors
43		Plant-based vectors-Ti and Ri plasmids as vectors
44		Yeast vectors, Shuttle vectors
45	V	Cloning methodologies: Insertion of foreign DNA into host cells, Transformation
46		Construction of libraries, Isolation of mRNA and total RNA
47		cDNA and genomic libraries
48		cDNA and genomic libraries, cDNA and genomic cloning
49		Expression cloning, Jumping and hopping libraries
50		Southwestern and Farwestern cloning
51		Protein-protein interaction cloning and Yeast two hybrid system
52		Phage display, Principles in maximizing gene expression
53		Principles in maximizing gene expression

Maharaja Ranjit Singh College of Professional Sciences, Indore

Department of Biosciences

Lesson Plan - M. Sc. Biotechnology Sem II (Jan 2019 -June 2019)

Subject - Immunology

Teacher - Poonam Sharma

Day/Lecture	Unit	Topic
1	I	Components of innate & aquired immunity
2		Phagocytosis
3		Complement system
4		Inflammatory responses
5		Haematopoesis
6		Cells of immune system
7		Organs- primary lymphoid organs
8		Organs- secondary lymphoid organs
9		Lymphatic system
10		Lymphocyte circulation & homing
		MALT & CALT
11	II	Structure & properties of antigens
12		Haptens & adjuvants, hapten carrier system
13		Toxins & toxoids
14		Immunoglobulins structure
15		Types properties of Ig
16		Multigene organization of immunoglobulin
17		Immunoglobulin superfamily
18		B & T cell receptors
19		B cell maturation, maturation & differentiation
20		Antibody diversity
21		T cell maturation, activation &differentiation
22		Cell mediated immune response
23		Complement system
25		Complement pathways
26	III	Antigen antibody interaction
27		Affinity, cross reactivity, specifity
28		Agglutination
29		Precipitation
30		Complement mediated immune response
31		Immunofluorescence, ELISA
32		Western blotting, ELISPOT assay
33		RIA, immunoelectron microscopy
34	IV	Active immunization
35		Passive immunization
36		Live, killed & attenuated vaccines
37		Sub unit vaccines
38		Properties of adjuvants
39		Plant based vaccines
40		Reverse vaccinology
41		Peptide vaccines
42		Conjugate vaccines
43	V	MHC & HLA typing
44		Hypersensitivity Type I
45		Hypersensitivity Type II
46		Hypersensitivity Type III
47		Hypersensitivity Type IV
48		Autoimmunity
49		Autoimmune diseases
50		Tranplantation immunology
51		Graft rejection
52		Clinical transplantation
53		Immunosuppresive therapy
54		Tumor immunology & antigens
55		Tumor antigens, immune response to tumor
56		Tumor evasion of immune system
57		Immunodeficiencies

Maharaja Ranjit Singh College of Professional Sciences, Indore

Department of Biosciences

Lesson Plan - M. Sc. Biotechnology Sem II (Jan 2019 -June 2019)

Subject - Analytical Techniques

Teacher - Dr. Sadhana Nighojkar

Day/Lecture	Unit	Topic
1	Unit 1	Buffers
2		Methods of cell disintegration
3		Methods of cell disintegration
4		Enzyme assays and controls
5		Enzyme assays and controls
6		Detergents and membrane proteins
7		Dialysis, Ultrafiltration and other membrane techniques
8		UV, Visible Spectroscopy
9		Raman Spectroscopy
10		Theory and application of Circular Dichroism
11		Fluorescence, MS
12		NMR, PMR
13		ESR and Plasma Emission spectroscopy
14	Unit 2	TLC and Paper chromatography
15		Gel permeation chromatography
16		Ion exchange chromatography
17		Hydrophobic, Reverse-phase chromatography
18		Affinity chromatography; HPLC and FPLC
19		Criteria of protein purity
20		Polyacrylamide and Agarose gel electrophoresis
21		Capillary electrophoresis
22		2D Electrophoresis
23		Disc gel electrophoresis
24		Gradient electrophoresis; Pulsed field gel electrophoresis
25	Unit 3	Basic principles & theory of RCF and Sedimentation coefficient
26		Microcentrifuge, High speed & Ultracentrifuges
27		Preparative centrifugation
28		Differential centrifugation
29		Density gradient centrifugation
30		Applications (Isolation of cell components)
31		Analytical centrifugation
32		Determination of molecular weight by sedimentation velocity & sedimentation equilibrium methods
33		Determination of molecular weight by sedimentation velocity & sedimentation equilibrium methods
34	Unit 4	Radioactive & stable isotopes
35		Radioactive & stable isotopes
36		Pattern and rate of radioactive decay
37		Units of radioactivity
38		Geiger-Muller counter
39		Solid & Liquid scintillation counters
40		Solid & Liquid scintillation counters
41		Brief idea of radiation dosimetry
42		Cerenkov radiation
43		Autoradiography
44		Measurement of stable isotopes- Falling drop method
45		Applications of isotopes in biochemistry
46		Radiotracer techniques
47		Distribution studies
48		Isotope dilution technique
49		Metabolic studies
50		Clinical application; Radioimmunoassay
51	Unit 5	Protein crystallization- Theory and methods
52		Protein crystallization- Theory and methods
53		API-electrospray and MADI-TOF
54		API-electrospray and MADI-TOF
55		Mass spectrometry
56		Enzyme and cell immobilization techniques
57		Enzyme and cell immobilization techniques
58		Enzyme and cell immobilization techniques
59		DNA Synthesis
60		Peptide Synthesis

Maharaja Ranjit Singh College of Professional Sciences, Indore

Department of Biosciences

Lesson Plan - M. Sc. Biotechnology Sem II (Jan 2019 -June 2019)

Subject - Practical 1 Paper I-

Molecular Biotech

Paper II-Bacterial genetics and Genetic Engineering

Teacher - Prof.Zahabiya Saifee/ Dr. Mukesh

Day/Lecture	Topic
1	Isolation of bacterial genomic DNA.
2	Plasmid DNA isolation and DNA quantitation: Plasmid minipreps
3	Restriction digestion
4	Preparation of competent cells.
5	Agarose gel electrophoresis
6	Restriction Enzyme digestion of DNA
7	Purification of DNA from an agarose gel
8	DNA Ligation
9	Transformation of E.coli with standard plasmids, Calculation of transformation efficiency
10	Cloning of genomic DNA in standard plasmid vectors
11	Confirmation of the insert, Miniprep of recombinant plasmid DNA Restriction mapping
12	Transformation of yeast *Saccharomyces cerevisiae*

Maharaja Ranjit Singh College of Professional Sciences, Indore

Department of Biosciences

Lesson Plan - M. Sc. Biotechnology Sem II (Jan 2019 -June 2019)

Subject - Practical 2

Paper I-Immunology

Paper II-Analytical Techniques

Teacher - Prof.Zahabiya Saifee/ Dr. Mukesh

Day/Lecture	Topic
1	Isolation of bacterial genomic DNA.
2	Plasmid DNA isolation and DNA quantitation: Plasmid minipreps
3	Restriction digestion
4	Preparation of competent cells.
5	Agarose gel electrophoresis
6	Restriction Enzyme digestion of DNA
7	Purification of DNA from an agarose gel
8	DNA Ligation
9	Transformation of E.coli with standard plasmids, Calculation of transformation efficiency
10	Cloning of genomic DNA in standard plasmid vectors
11	Confirmation of the insert, Miniprep of recombinant plasmid DNA Restriction mapping
12	Transformation of yeast *Saccharomyces cerevisiae*

Maharaja Ranjit Singh College of Professional Sciences, Indore

Department of Biosciences

Lesson Plan - M. Sc. Biotechnology Sem II (Jan 2019 -June 2019)

Subject - Bioprocess Technology

Teacher - Dr. Sheetal Bhasin

Day/Lecture	Unit	Topic
1	Unit 1	Isolation and screening microorganisms
2		Isolation and screening of microorganisms
3		Primary screening methods
4		Secondary screening methods
5		Secondary screening methods
6		Secondary screening methods
7		Maintainance of microorganisms
8		Maintainance of microorganisms
9		Microbial growth kinetics
10		Microbial growth kinetics
11		Microbial death kinetics
12		Strain improvement
13		Strain improvement
14	Unit 2	Media formulation
15		Media formulation
16		Industrial sterilization
17		Industrial sterilization
18		Aeration and Agitation
19		Scale-up
20		Scale-up
21		Scale-down: Bioseperation
22		Scale-down: Cell disruption methods
23		Scale-down: Extraction
24		Scale-down: Purification by chromatography
25		Scale-down: Purification by chromatography
26		Scale-down: Drying
27		Scale-down: Formulation
28		Treatment of effluent and its disposal
29	Unit 3	Basic fermentor design
30		Batch, Fed-batch, Continuous process
31		Types of fermenters
32		Types of fermenters
33		Types of fermenters
34		Conventional fermentation v/s Biotransformation
35		Conventional fermentation v/s Biotransformation
36		Solid state fermentation
37		Surface fermentation
38		Submerged fermentation
39		Measurements and control of bioprocess parameters
40		Measurements and control of bioprocess parameters
41	Unit 4	Industrial production of Ethanol
42		Industrial production of Lactic acid
43		Industrial production of Glutamic acid
44		Industrial production of Lysine
45		Industrial production of Vitamin B12
46		Industrial production of Penicillin
47		Industrial production of Penicillin
48		Industrial production of Streptomycin
49	Unit 5	Protease- production and purification
50		Amylase- production and purification
51		Enzyme immobilisation
52		Enzyme immobilisation
53		Whole cell immobilisation
54		Applications of immobilization
55		Bioinsecticides and biofertilisers
56		Bioinsecticides and biofertilisers
57		Single cell proteins
58		MEOR

Maharaja Ranjit Singh College of Professional Sciences, Indore

Department of Biosciences

Lesson Plan - M. Sc. IV Biotechnology (Jan 2019 - Jun 2019)

Paper-II: Genomics, Proteomics, IPR and Biosafety

Teacher - Dr. Mukesh /Nikita Chordia

Day/Lecture	Unit	Topic
1	I	DNA sequencing principles and sequencing methods
2		Chemical sequencing of DNA
3		Enzymatic DNA sequencing
4		Enzymatic DNA sequencing
5		Automated DNA sequencing, RNA sequencing
6		Chemical synthesis of oligonucleotides
7		Chemical synthesis of oligonucleotides
8		Recognition of coding and non-coding sequences, Gene annotation
9		Recognition of coding and non-coding sequences, Gene annotation
10		ESTs and SNPs
11	II	Tools for Genome analysis: RFLP, RAPD, DNA Fingerprinting
12		Physical and Genetic mapping
13		Linkage and Pedigree analysis
14		Linkage and Pedigree analysis
15		Primer design
16		PCR: Its types and application
17		PCR: Its types and application, Site-specific mutagenesis
18		Gene silencing techniques: Introduction to siRNA technology
19		Micro RNA, Construction of siRNA vectors
20		Principles and applications of gene silencing
21		Gene knockouts and Gene Therapy, Creation of knockout mice
22		Disease models, Somatic and germ-line therapy- in-vivo and ex-vivo
23		Somatic and germ-line therapy- in-vivo and ex-vivo, Suicide gene therapy
24		Gene replacement, Gene targetting
25		Transgenics
26		cDNA and intragenic arrays
27		cDNA and intragenic arrays
28	III	Proteomics: Protein analysis-Measurement of concentration of proteins
29		Amino acid composition, N-terminal sequencing
30		2-D Electrophoresis of proteins
31		Microscale solution isoelectrofocussing, Peptide fingerprinting
32		LC-MS/MS for identification of proteins and modified proteins
33		MALDI-TOF, SAGE
34		Functional genomics and proteomics: Analysis of Microarray data
35		Analysis of Microarray data
36		Protein and peptide microarray-based technology
37		PCR-directed protein in situ arrays
38		PCR-directed protein in situ arrays
39		Structural proteomics
40		Structural proteomics
41	IV	Introduction to intellectual Property: Types of IP: Patents, Trademarks, Copyright and Related rights
42		Industrial design
43		Traditional knowledge, Protection of GMOs
44		IP as a factor in R & D, IPs of relevance to Biotechnology and few case studies
45		Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition
46		Types of patent applications, Patent databases
47	V	Biosafety: Introduction, Historical background, Introduction to Biological safety Cabinets
48		Primary containment for Biohazards, Biosafety levels
49		Biosafety levels of specific microorganisms, Recommended biosafety levels for infectious agents and infected animals
50		Biosafety guidelines-Govt. of India, Definition of GMOs and LMOs, Roles of Indutrial Biosafety Committee
51		RCGM, GEAC etc. for GMO applications in food and agriculture

Maharaja Ranjit Singh College of Professional Sciences, Indore

Department of Biosciences

Lesson Plan - M. Sc. IV Biotechnology (Jan 2019 - Jun 2019)

Subject - Animal Biotechnology

Teacher - Zahabiya Saifee

Day/Lecture	Unit	Topic
1	I	Structure and organization of animal cell.
2		Equipment and materials for animal cell culture technology
3		Introduction to the balanced salt solutions
4		simple growth medium
5		chemical, physical and metabolic functions of different constituents of culture medium
6		Role of serum and supplements
7		Serum free defined media and their application.
8		Protein free defined media and their application.
9	II	Measurement of viability and cytotoxicty
10		Biology and characterization of the cultured cells
11		Measuring parameters of growth
12		Basic techniques of mammalian cell culture in vitro
13		Disaggregation of tissue and primary culture
14		Maintenance of cell culture
15		Cell separation
16		Primary cell cultures.
17		Primary and established cell line cultures.
18	III	Scaling-up of animal cell culture
19		Cell synchronization
20		Cell fusion
21		Cell cloning
22		Micromanipulation.
23		Cell transformation
24		Somatic cell genetics.
25	IV	Organotypic & organ cultures
26		Histotypic cultures
27		Three dimensional matrices
28		Tissue engineering
29		Measurement of cell death
30		Apoptosis
31	V	Transfection of mammalian cells
32		Application of animal cell culture
33		Production of biopharmaceuticals
34		Cell culture based vaccines
35		Cell culture based vaccines
36		Stem cell cultures
37		Embryonic & adult stem cells
38		Transgenic animals
39		

Maharaja Ranjit Singh College of Professional Sciences, Indore

Department of Biosciences

Lesson Plan - M. Sc. IV Biotechnology (Jan 2019 - Jun 2019)

Subject - Practical 1

Paper I-Bioprocess Technology

Paper II-Genomics, Proteomics

Teacher - Dr. Sheetal Bhasin /Dr. Mukesh

Day/Lecture	Topic
1	Isolation and screening of industrially important microorganisms
2	Determination of thermal death point and thermal death time of microorganisms.
3	Production of microbial products in bioreactors
4	Assay of antibiotics production
5	Studying the kinetics of enzymatic reaction by microorganisms
6	Production and purification of various enzymes from microbes.
7	Comparative studies of Ethanol production using different substrates.
8	Microbial production and downstream processing of an enzyme, e.g. amylase.
9	Various immobilization techniques of cells/enzymes, use of alginate for cell immobilization.
10	PCR amplification gene and analysis by agarose gel electrophoresis
11	Polymerase Chain reaction, using standard 16srRNA eubacterial primers.
12	RFLP analysis of the PCR product
13	Plasmid isolation and confirming recombinant by PCR and RE digestion.
14	Southern hybridization of *B. subtilis* genome with probe and non-radioactive detection

Maharaja Ranjit Singh College of Professional Sciences, Indore

Department of Biosciences

Lesson Plan - M. Sc. IV Biotechnology (Jan 2019 - Jun 2019)
Subject - Practical 2
Animal Biotechnology

Teacher - Prof. Zahabiya Saifee

Day/Lecture	Topic
1	Preparation of single cell suspension from spleen
2	Preparation of single cell suspension from thymus
3	Measurement of phagocytic activity
4	Trypsinization of monolayer and sub-culturing
5	Cryopreservation and thawing
6	Measurement of doubling time
7	Role of serum in cell culture.
8	Preparation of metaphase chromosomes from cultured cells
9	Isolation of DNA and demonstration of apoptosis and DNA laddering.
10	MTT assay for cell viability and growth
11	Cell fusion with PEG

Maharaja Ranjit Singh College of Professional Sciences, Indore

Department of Biosciences

Lesson Plan - M. Sc. I Biotechnology (July 2019 -Dec 2019)

Subject - Biochemistry

Teacher - Dr. Sadhna Nighojkar

Day/Lecture	Unit	Topic
1	I	Amino acids-Structure and functional group properties
2		Amino acids-Structure and functional group properties
3		Peptides and covalent structure of proteins
4		Elucidation of primary and higher order structures
5		Elucidation of primary and higher order structures
6		Evolution of protein structure
7		Evolution of protein structure
8		Structure-function relationships in model proteins-Ribonuclease A
9		Structure-function relationships in Myoglobin, Hemoglobin,
10		Structure-function relationship in Chymotrypsin
11		Tools to characterize expressed proteins
12		Tools to characterize expressed proteins
13	II	Enzyme catalysis-general principles of catalysis
14		Enzyme catalysis-general principles of catalysis
15		Quantitation of enzyme activity and efficiency
16		Enzyme characterization and Michaelis-Menten kinetics
17		Enzyme characterization and Michaelis-Menten kinetics
18		Relevance of enzymes in metabolic regulation, activation, inhibition and covalent modification
19		Relevance of enzymes in metabolic regulation, activation, inhibition and covalent modification
20		Relevance of enzymes in metabolic regulation, activation, inhibition and covalent modification
21		Single substrate enzymes
22		Single substrate enzymes
23	III	Sugars-mono, di, and polysaccharides
24		Sugars-mono, di, and polysaccharides
25		Functions of carbohydrates-Cellular structure, energy storage, signalling,
26		Functions of carbohydrates-Cellular structure, energy storage, signalling,
27		Glycosylation of other biomolecules-glycoproteins and glycolipids
28		Glycosylation of other biomolecules-glycoproteins and glycolipids
29		Lipids-structure and properties of important members of storage and membrane lipids
30		Lipids-structure and properties of important members of storage and membrane lipids
31		Lipid organization, Lipoproteins
32	IV	Biomembrane organization-sidedness and function
33		Membrane-bound proteins-structure, properties and functions
34		Membrane-bound proteins-structure, properties and functions
35		Phase-transitions in lipids, polysaccharides
36		Molecular shapes and conformation
37		Comparison between different membrane models
38		Diffusion, Permeability,Carrier transport, ion transport
39		Active and Passive transport, ion pumps, water transport
40		Use of liposomes for membrane models and drug delivery systems
41	V	Bioenergetics-basic principles, Concept of equilibria and free energy
42		Coupled processes, Glycolytic pathway, Kreb's cycle
43		Oxidative phosphorylation, Photosynthesis
44		Photosynthesis, Elucidation of metabolic pathways
45		Logic and integration of central metabolism
46		Entry/exit of various biomolecules from central pathways
47		Entry/exit of various biomolecules from central pathways
48		Principles of metabolic regulation
49		Regulatory steps, Signals
50		Signals and second messengers

Maharaja Ranjit Singh College of Professional Sciences, Indore

Department of Biotechnology

Lesson Plan - M. Sc. I Biotechnology (July 2019 -Dec 2019)

Subject - Cell and Developmental Biotechnology

Teacher - Dr. Monica Jain and Ms. R. K. Chera

Day/Lecture	Unit	Topic
1	I	Cell Theory & Methods of Study : Structure of Prokaryotic and Eukaryotic cells
2		Microscope and its modifications
3		Light, Phase contrast
4		Interference, Fluoroscence
5		Confocal, Electron (TEM and SEM)
6		Confocal, Electron (TEM and SEM)
7		Electron tunneling and Atomic Force Microscopy
8		Membrane Structure and Function : Structural models; Composition and dynamics;
9		Membrane Structure and Function : Structural models; Composition and dynamics;
10		Transport of ions and macromolecules; Pumps, carriers and channels; Endo- and Exocytosis;
11		Transport of ions and macromolecules; Pumps, carriers and channels; Endo- and Exocytosis;
12		Membrane carbohydrates and their significance in cellular recognition
13		Membrane carbohydrates and their significance in cellular recognition
14		Cellular junctions and adhesions; Structure and functional significance of plasmodesmata
15		Cellular responses to environmental signals in plants and animals
16	II	Organelles : Nucleus
17		Structure and function of nuclear envelope
18		Lamina and nucleolus
19		Macromolecular trafficking
20		Macromolecular trafficking
21		Chromatin organization and packaging
22		Chromatin organization and packaging
23		Cell cycle and control mechanisms
24		Cell cycle and control mechanisms
25		Mitochondria – structure
26		Organization of respiratory chain complexes, ATP synthase
27		Organization of respiratory chain complexes, ATP synthase
28		Structure-function relationship; Mitochondrial DNA and male sterility
29		Structure-function relationship; Mitochondrial DNA and male sterility
30		Origin and evolution
31		Chloroplast– Structure function relationship
32		Chloroplast DNA and its significance
33		Chloroplast biogenesis; Origin and evolution
34		Sub cellular fractionation and criteria of functional integrity
35	III	Endo-membrane System and Cellular Motility
36		Structure and function of microbodies
37		Golgi apparatus
38		Golgi apparatus
39		Lysosomes
40		Endoplasmic Reticulum
41		Endoplasmic Reticulum
42		Organization and role of microtubules and microfilaments
43		Organization and role of microtubules and microfilaments
44		Cell shape and motility; Actinbinding proteins and their significance
45		Cell shape and motility; Actinbinding proteins and their significance
46		Muscle organization and function
47		Muscle organization and function
48		Molecular motors
49		Molecular motors
50		Intermediate filaments
51		Extracellular matrix in plants and animals

52		Cellular Movements and Pattern Formation
53		Cellular Movements and Pattern Formation
54		Laying of body axis planes
55		Laying of body axis planes
56		Differentiation of germ layers
57		Differentiation of germ layers
58		Cellular polarity
59		Model plants like Fucus and Volvox
60		Model plants like Fucus and Volvox
61		Maternal gene effects
62	IV	Maternal gene effects
63		Zygotic gene effects
64		Zygotic gene effects
65		Homeotic gene effects in Drosophila
66		Homeotic gene effects in Drosophila
67		Embryogenesis and early pattern formation in plants
68		Embryogenesis and early pattern formation in plants
69		Cell lineages and developmental control genes in *Caenorhabditis*
70		Cell lineages and developmental control genes in *Caenorhabditis*
71		Differentiation of Specialized Cells
72		Differentiation of Specialized Cells
73		Stem cell differentiation; Blood cell formation
74		Stem cell differentiation; Blood cell formation
75		Fibroblasts and their differentiation
76		Fibroblasts and their differentiation
77		Differentiation of cancerous cells and role of protooncogenes
78		Differentiation of cancerous cells and role of protooncogenes
79		Phase changes in Salmonella
80		Mating cell types in yeast
81		Surface antigen changes in Trypanosomes
82		Surface antigen changes in Trypanosomes
83		Heterocyst differentiation in Anabaena
84		Heterocyst differentiation in Anabaena
85		Sex determination in Drosophila.
86	V	Sex determination in Drosophila.
87		Plant Meristem Organization and Differentiation
88		Plant Meristem Organization and Differentiation
89		Organization of Shoot Apical Meristem(SAM)
90		Organization of Shoot Apical Meristem(SAM)
91		Organization of Root Apical Meristem(RAM)
92		Organization of Root Apical Meristem(RAM)
93		Pollen germination and pollen tube guidance
94		Pollen germination and pollen tube guidance
95		Phloem differentiation
96		Self-incompatibility and its genetic control
97		Self-incompatibility and its genetic control
98		Embryo and endosperm development
99		Embryo and endosperm development
100		Heterosis and apomixes
101		Heterosis and apomixes

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Department of Biosciences

Lesson Plan - M. Sc. I Biotechnology (July 2019 -Dec 2019)

Subject - Microbiology

Teacher - Dr. Sheetal Bhasin, Dr. Mukesh Patidar

Day/Lecture	Unit	Topic
1	Unit 1	Classification of microorganisms- Classical methods
2		Classification of microorganisms- Classical methods
3		Classification of microorganisms- Modern methods
4		Classification of microorganisms- Modern methods
5		Classification of microorganisms- Modern methods
6		Techniques for determining microbial taxonomy and phylogeny
7		Bergey's Manual of Determinative Bacteriology
8		Bergey's Manual of Systematic Bacteriology
9		Ultrastructure of Archaea
10		Ultrastructure of Eubacteria
11		Ultrastructure of Eukaryote (Yeast)
12	Unit 2	Microbial nutrition
13		Nutritional types of bacteria
14		Media and its types
15		Media and its types
16		Media and its types
17		Theory and practice of sterilization
18		Cultivation of aerobic bacteria
19		Cultivation of aerobic and anaerobic bacteria
20		Pure culture techniques and enrichment culture
21		Maintainance of cultures
22		Maintainance of cultures
23		Culture collection centers
24	Unit 3	Microbial growth
25		Bacterial growth curve
26		Growth Kinetics, Generation time, Growth Rate
27		Batch, Fed-batch and Continous culture
28		Synchronous and Diauxic growth
29		Measurements of microbial growth
30		Measurements of microbial growth
31		Factors affecting microbial growth
32		Factors affecting microbial growth
33		Factors affecting microbial growth
34	Unit 4	Host-pathogen interactions
35		Host-pathogen interactions
36		Mechanism of pathogenesis
37		Mechanism of pathogenesis
38		Mechanism of pathogenesis
39		Mechanism of pathogenesis
40		Pathogenecity islands and their role of virulence
41		Pathogenecity islands and their role of virulence
42		Toxins and their types
43		Toxins and their types
44		Toxins and their types
45		Toxins- structure and mode of action
46	Unit 5	Viruses
47		Classification of bacterial, plant and animal viruses
48		Classification of bacterial, plant and animal viruses
49		Classification of bacterial, plant and animal viruses
50		Classification of bacterial, plant and animal viruses
51		Statellite virus
52		Viroids, Virusoids
53		Classification and general features of fungi
54		Classification and general features of fungi
55		Life cycle of *Penicillium*
56		Life cycle of *Saccharomyces*

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Lesson Plan - M. Sc. I Biotechnology (July 2019 -Dec 2019)

Paper-IV-Biostatistics and Bioinformatics

Teacher -Nikita Chordia/ Dr. Pratibha Tiwari

Day/Lecture	Unit	Topic
1	I	Fundamental concepts in Applied probability
2		Probability and analysis of one and two way samples
3		Discrete probability models
4		Continuous probability models
5		Continuous probability models
6		Expectation and variance
7		Expectation and variance, Central Limit Theorem
8		Inference, hypothesis
9		Critical region and Error probabilities
10		Tests for proportions
11		Tests for proportions
12		Equality of proportions
13		Equality of proportions
14		Equality of means of normal population (variance known)
15		Equality of means of normal populations (variance unknown)
16		Chi-square test for independence
17		P-value of the statistic, Confidence-limits
18		Introduction to one- and two-way analysis of variance
19		Data transformation
20	II	Elements of programming languages- C and PERL
21		Elements of programming languages- C and PERL
22		Database concept, Database management system
23		Database concept, Database management system
24		Database browsing and data retrieval, Sequence database and genome database
25		Data structures and databases, GenBank, EMBL, DDBJ databases
26		Swissprot, PIR, MIPS databses
27		Hovergen, TAIR, PlasmoDB, ECDC databases
28		Searching sequence databases using FASTA and BLAST algorithms
29		Searching sequence databases using FASTA and BLAST algorithms
30	III	Cluster analysis
31		Phylogenetic clustering by simple matching coefficients
32		Sequence comparison, Sequence pattern
33		Regular expression based patterns
34		Theory of Profiles and their use in sequence analysis
35		Markov models, concept of HMMS
36		Baum-Welch algorithm
37		Use of Profile HMM for protein family classification
38		Pattern recognition methods
39		Pattern recognition methods
40	IV	Goals of Microarray experiments
41		Normalization of Microarray data
42		Detecting differential gene-expression, Principal component analysis
43		Clustering of microarray data
44		Structure determination by X-ray crystallography
45		Structure determination by X-ray crystallography
46		Structure determination by NMR spectroscopy
47		Structure determination by NMR spectroscopy
48		Protein Data Bank (PDB) and Nucleic acid Data Bank (NDB),
49	V	Methods for modelling: Homology modelling
50		Homology modelling,
51		Threading, Protein structure prediction
52		Protein structure prediction
53		Structure-structure comparison of proteins
54		Force-fields
55		Molecular energy minimization
56		Molecular energy minimization
57		Monte carlo and Molecular dynamics simulations
58		Molecular dynamics simulations

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Department of Biosciences

Lesson Plan - M. Sc. I Biotechnology (July 2019 -Dec 2019)

Subject - Practical 1

Paper I-Biochemistry

Paper II-Cell Biology

Teacher - Dr. Mukesh / Dr. Monica jain

Day/Lecture	Topic
1	To prepare an Acetic-NaAcetate Buffer system
2	Standard graph of BSA using UV-Vis Spectrophotometer
3	Validating the Beer- Lambert's Law.
4	Separation of aliphatic, aromatic and polar amino acids by TLC
5	Nelson Somogyii's and DNS method.
6	Determination of enzyme activity
7	Studying the effect of temperature, pH on enzyme activity
8	Studing the effect of enzyme concentration &substrate concentration on enzyme activity.
9	Isolation of biomolecules from natural sources.
10	Microscopy: Bright field, phase contrast and fluorescence microscopy
11	Microtomy.
12	Subcellular fractionation and marker enzymes
13	Histochemical techniques.
14	Mitosis and Meiosis.

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Department of Biosciences

Lesson Plan - M. Sc. I Biotechnology (July 2019 -Dec 2019)

Subject - Practical 2 Paper

I-Microbiology

Paper II-Biostate and Bioinformatics

Teacher - Dr. Sheetal Bhasin / Nikita Chordia

Day/Lecture	Topic
1	Sterilization, disinfection, safety in microbiological laboratory
2	Preparation of media for growth of various microorganisms
3	Identification and culturing of various microorganisms.
4	Staining and enumeration of microorganisms
5	Growth curve, measure of bacterial population by turbidometry
6	studying the effect of temperature, pH, carbon and nitrogen.
7	Isolation and identification of fungus
8	Isolation of bacteriophage.
9	Introduction to MSEXCEL-Use of worksheet to enter data
10	Use of in-built statistical functions for computations of Mean, S.D.,
11	Correlation, regression coefficients
12	Use of bar diagram, histogram, scatter plots, etc.
13	Graphical tools in EXCEL for presentation of data.
14	Introduction to SYSTAT package.
15	Searching PubMed
16	Introduction to NCBI, NCBI data bases
17	BLAST BLASTn, BLASTp, PSI-BLAST,
18	Sequence manipulation Suite, Multiple sequence alignment,
19	Primer designing, Phylogenetic Analysis.
20	Protein Modeling, Protein structure Analysis, Docking, Ligplot interactions
21	Docking, Ligplot interactions

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Department of Biosciences

Lesson Plan - M. Sc. I Biotechnology (July 2019 -Dec 2019)

Subject - Enzyme Technology

Teacher - Dr. Sadhana Nighojkar

Day/Lecture	Unit	Topic
1	I	Introduction to enzymology
2		Historical developments in enzymology
3		Enzyme classification
4		IUBMB enzyme classification
5		Techniques of enzyme isolation
6		Principle and techniques of enzyme assay
7		Factors affecting enzyme activity
8		Factors affecting enzyme activity
9	II	Intracellular localization of enzymes
10		Mechanism of Enzyme Action
11		Investigation of active site
12		Enzyme activators
13		Co-enzymes and co-factors in enzyme catalysis
14		Techniques of separation
15		Purification of enzyme
16		Purification of enzyme
17		Test of homogeneity
18	III	Enzyme Kinetics
19		Bioenergetics and Catalysis
20		Equilibrium kinetics
21		Steady state kinetics
22		Significance of Km, Vmax & Kcat.
23		Significance of Km, Vmax & Kcat.
24		Multisubstrate reaction kinetics : General rate equation
25		Ordered, random order equation
26		Ping-pong mechanisms
27	IV	Enzyme inhibition and its kinetics
28		Reversible and irreversible inhibition
29		Competitive, non-competitive and uncompetitive inhibition
30		Mixed & partial inhibition
31		Substrate inhibition
32		Effect of temperature on reaction rate
33		Enzyme stability
34		Arrhenius equation
35		Activation energy
36		Allosteric enzymes and sigmoidal kinetics
37		Co-operativity
38		MWC & KNF models
39		Enzyme memory and pneumonical enzymes.
40	V	Isoenzymes
41		Multienzyme complex & their physiological significance
42		Multifunctional enzymes & their physiological significance
43		Biosensors ; Enzymes as analytical reagents
44		Ribozymes and catalytic antibodies

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Department of Biosciences

Lesson Plan - M. Sc. I Biotechnology (July 2019 -Dec 2019)

Subject - Food Biotechnology

Teacher - Fatema Matkawala

Day/Lecture	Unit	Topic
1	Unit 1	Biotechnology in relation to food industry
2		Nutritive value of food
3		Nutritive value of food
4		Types of microorganisms associated with food
5		Types of microorganisms associated with food
6		Types of microorganisms associated with food
7		Types of microorganisms associated with food
8	Unit 2	General principles of food preservation
9		Bioprocessing of meat
10		Bioprocessing of meat
11		Bioprocessing of fisheries
12		Bioprocessing of vegetables
13		Bioprocessing of dairy products
14		Bioprocessing of dairy products
15		Enzymes used in food processing
16		Enzymes used in food processing
17		Chemicals used in food processing
18		New Preservation Technologies
19		New Preservation Technologies
20		New Preservation Technologies
21	Unit 3	Microbial spoilage of food
22		Microbial spoilage of food
23		Microbial spoilage of food
24		Microbial spoilage of food
25		Food infenctions - Gastroenteritis
26		Food infenctions - Salmonellosis
27		Food infenctions - Shigellosis
28		Food intoxications- Botulism
29		Staphylococcal intoxication
30		Mycotoxins
31	Unit 4	Fermented dairy products
32		Fermented dairy products
33		Fermented dairy products
34		Non-beverage plant products
35		Non-beverage plant products
36		Beverages
37		Beverages
38		Beverages
39		Beverages
40		Baked products
41		Baked products
42		Single cell proteins
43		Single cell oils
44		Probiotics and Prebiotics
45		Probiotics and Prebiotics
46	Unit 5	Microbiological examination of food
47		Microbiological examination of food
48		Microbiological examination of food
49		Quality assurance
50		Quality standards of food
51		Government regulatory practices and policies
52		Government regulatory practices and policies
53		FDA
54		FDA
55		Food hygiene
56		EPA, HACCP, ISI

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Lesson Plan - M. Sc. I Biotechnology (July 2019 -Dec 2019)

Subject - Enviornmental Biotechnology

Teacher - Zahabiya Saifee

Day/Lecture	Unit	Topic
1	1	Environment: Basic concept
2		Environment: Issues
3		Pollution: Types of pollution
4		Pollution: Types of pollution
5		Pollution: Methods for measurement of pollution
6		Pollution: Methods for measurement of pollution
7		Pollution: Methods for measurement of pollution
8		Methodology for environment management
9		Methodology for environment management - Problem solving Ap.
10		Limitations of enviornmental management
11	2	Air pollution - Introduction
12		Air pollution - Control through biotechnology
13		Air pollution - Control through biotechnology
14		Water as scarce natural resources
15		Need for water management
16		Measurement of water pollution
17		Measurement of water pollution
18		Source of water pollution
19		Waste water treatment: Physical and Chemical
20		Waste water treatment: Biological
21		Microbiology of waste water treatment
22		Microbiology of waste water treatment
23	3	Aerobic process: Activated sludge
24		Aerobic process: Oxidation ditches and Trickling filter
25		Aerobic process: Towers and Rotating disc
26		Aerobic process: Rotating drums and Oxidation ponds
27		Anaerobic digestion and anaerobic filters
28		Up flow anaerobic sludge blanket reactor
29		Treatment schemes for waste water of dairy
30		Treatment schemes for waste water of distillery
31		Treatment schemes for waste water of Tannery
32		Treatment schemes for waste water of Sugar
33		Treatment schemes for waste water of Antibiotic
34	4	Microbiological degradation of xenobiotic in Environment
35		Microbiological degradation of xenobiotic in Environment
36		Microbiological degradation of xenobiotic in Environment
37		Ecological consideration
38		Decay behavior
39		Degradative plasmid
40		Hydrocarbons
41		Oil pollution
42		Surfactants
43		Pesticides
44	5	Bioremediation Introduction
45		Bioremediation of contaminated soils
46		Bioremediation of waste land
47		Biopesticides in integrated pest management
48		Biopesticides in integrated pest management
49		Soil waste source and management - Composting
50		Soil waste source and management - Vormiculture
51		Soil waste source and management - Methane production
52		Global environmental problems
53		Ozone depletion
54		UV-B and Green house effect
55		Acid rain and their impact
56		Biotechnological approaches for management

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Lesson Plan - M. Sc. I Biotechnology (July 2019 -Dec 2019)

Subject - Biotechnology

Teacher - Dr. Monica Jain

Day/Lecture	Unit	Topic
1	I	Introduction to cell and Tissue Culture
2		Tissue culture media (composition and preparation)
3		Tissue culture as a technique to produce novel plants and hybrids
4		Tissue culture as a technique to produce novel plants and hybrids
5		Initiation and maintenance of callus and suspension culture; single cell clones
6		Initiation and maintenance of callus and suspension culture; single cell clones
7		Organogenesis
8		somatic embryogenesis
9		Transfer and establishment of whole plants in soil.
10		Shoot-tip culture: rapid clonal propagation and production of virus-free plants.
11		Shoot-tip culture: rapid clonal propagation and production of virus-free plants.
12		Embryo culture and embryo rescue.
13		Protoplast isolation, culture and fusion; selection of hybrid cells
14		Protoplast isolation, culture and fusion; selection of hybrid cells
15		Regeneration of hybrid plants; symmetric and asymmetric hybrids, cybrids.
16		Regeneration of hybrid plants; symmetric and asymmetric hybrids, cybrids.
17		Anther, pollen and ovary culture for production of haploid plants and homozygous lines.
18		Anther, pollen and ovary culture for production of haploid plants and homozygous lines.
19	II	Plant transformation Technology: basis of tumor formation, hairy root
20		Features of Ti and Ri plasmids
21		Mechanisms of DNA transfer, role of virulence genes
22		Use of Ti and Ri as vectors, binary vectors, use of 35S and other promoters,
23		Genetic markers
24		Use of reporter genes with introns, use of scaffold attachment regions
25		Methods of nuclear transformation
26		Viral vectors and their application, multiple gene transfers
27		Vectors-less or direct DNA transfer, particle bombardment, electroporation, microinjection, transformation of monocots.
28		Vectors-less or direct DNA transfer, particle bombardment, electroporation, microinjection, transformation of monocots.
29		Transgene stability and gene silencing.
30		Chloroplast transformation: Vectors, advantages.
31		Chloroplast transformation: Vectors, advantages.
32	III	Application of plant Transformation for productivity and performance
33		Herbicide resistance
34		Herbicide resistance
35		Insect resistance
36		Insect resistance
37		Virus resistance
38		Virus resistance
39		Disease resistance, nematode resistance
40		Abiotic stress, post-harvest losses
41		Long shelf life of fruits and flowers
42		Long shelf life of fruits and flowers
43		Male sterile lines, bar and barnase systems
44		Male sterile lines, bar and barnase systems
45	IV	Metabolic Engineering and Industrial Products
46		Plant secondary metabolities
47		Plant secondary metabolities
48		Control mechanisms and manipulation of phenyl propanoid pathway
49		Control mechanisms and manipulation of phenyl propanoid pathway
50		Shikimate pathway; alkaloids
51		Shikimate pathway; alkaloids
52		Polyhydraxybutyrate
53		therapeutic proteins
54		Lysosomal enzymes
55		Antibodies Production in plants
56		Edible vaccines
57		Purification strategies, oleosin partitioning technology.
58	V	Molecular Marker aided-Breeding
59		Basic techniques or rDNA techniques
60		RFLP maps linkage analysis
61		RAPD markers
62		STS, microsatellites
63		SCAR (sequence characterizedamplified regions)
64		SSCP (single strand conformational polymorphism),
65		AFLP
66		QTL Map based cloning
67		Molecular marker assisted selection
68		Cryopreservation
69		DNA Banking for germplasm conservation

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Department of Biosciences

Lesson Plan - M. Sc. I Biotechnology (July 2019 -Dec 2019)

Subject - Practical 1 Paper

I-Enzyme technology

Paper II-Food Biotechnology

Teacher - Dr. Sheetal Bhasin / Pooja Tiwari

Day/Lecture	Topic
1	Enzyme Production
2	Determination of Enzyme activity
3	Effect of pH on enzyme activity
4	Effect of temperature on enzyme activity
5	Effect of substrate concentration on enzyme activity
6	Determination of Km / Vmax
7	Effect of heavy metals on enzyme activity
8	Activator/ inhibitors study
9	Qualitative / Quantitative analysis of food sample
10	MPN analysis of food sample
11	MPN analysis of milk sample
12	MBRT
13	Resazurin test of milk
14	Standard plate count of food sample
15	Standard plate count of milk
16	Preparation of bread

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Lesson Plan - M. Sc. I Biotechnology (July 2019 -Dec 2019)

Subject - Practical 1 Paper I-Environmental Biotechnology
Paper II-Plant Biotechnology

Teacher - Dr. Sheetal Bhasin/ Dr. Monica jain

Day/Lecture	Topic
1	Preparation of media
2	Surface sterilization.
3	Organ Culture.
4	Callus propagation, organogenesis, transfer of plants to Soil.
5	Protoplast isolation and culture
6	Anther culture
7	Production of Haploids
8	Cytological examination of regenerated plants.
9	Agro bacterium culture, selection of transformants, reporter gene (GUS) assays.
10	Preparation of tissue culture medium and membrane filtration
11	Area monitoring
12	Analysis of air
13	Qualitative and quantitative analysis of sewage
14	Qualitative and quantitative analysis of water
15	Qualitative and quantitative analysis of soil
16	MPN analysis of water/ sewage sample
17	Isolation of rhizobium fromroot nodules
18	Isolation of azatobator from soil