Punjab Technical University, Jalandhar
M. Sc. Biotech
Study Scheme

1st Semester

Course Code	Subject Titles	Teaching Load In Hours			Marks Distribution		Credits
		L	T	P	Internal	External	
MSBT 101	Biomolecules and Metabolism	4	-	-	40	60	4
MSBT 103	Biostatistics and Computer Applications	3	1	-	40	60	4
MSBT 105	Cell biology	3	-	-	40	60	3
MSBT 107	Immunotechnology	3	-	-	40	60	3
MSBT 109	Principles of Microbiology	3		-	40	60	3
MSBT 111	Lab in Biochemistry	-	-	3	40	60	2
MSBT 113	Lab in Computer Application	-	-	2	40	60	1
MSBT 115	Lab in Immunology	-	-	3	40	60	2
MSBT 117	Lab in Microbiology	-	-	3	40	60	2
	Total	16	1	11	360	540	24

Punjab Technical University, Jalandhar
M. Sc. Biotech
Study Scheme

2nd Semester

Course Code	Subject Titles	Teaching Load In Hours			Marks Distribution		Credits
		L	T	P	Internal	External	
MSBT 102	Biochemical and Biophysical Techniques	3	1	-	40	60	4
MSBT 104	Bioprocess Engineering & Technology	3	1	-	40	60	4
MSBT 106	Environmental Biotechnology	3	-	-	40	60	3
MSBT 108	Enzyme Technology	3	1	-	40	60	4
MSBT 110	Molecular Biology	4	-	-	40	60	4
MSBT 112	Lab in Bioprocess Engineering and Technology	-	-	3	40	60	2
MSBT 114	Lab in Molecular Biology	-	-	3	40	60	2
MSBT 116	Lab in Environmental Biotechnology	-	-	3	40	60	2
	Total	16	3	9	240	480	25

3rd Semester

Course Code	Subject Titles	Teaching Load In Hours			Marks Distribution		Credits
		L	T	P	Internal	External	
MSBT 201	Proteomics and Genomics	3	1	-	40	60	4
MSBT 203	Fermentation Technology	3	1	-	40	60	4
MSBT 205	Industrial Biotechnology	3	1	-	40	60	4
MSBT 207	Plant Tissue Culture	3	-	-	40	60	3
MSBT 209	Animal Tissue Culture	3	-	-	40	60	3
MSBT 211	Lab in Bioinformatics	-	-	3	40	60	2
MSBT 213	Lab in Fermentation Technology	-	-	3	40	60	2
MSBT 215	Lab in Plant and Animal Cell Culture	-	-	3	40	60	2
	Total	15	3	9	240	480	24

Semester 4

Course Code	Subject Titles	Load Allocation	Marks Distribution		Credits
			Internal	External	
MSBT 216	Industrial Training/ Project Work	20 Hrs. / Week	400	400	20

MSBT-101 Biomolecules and Metabolism

Unit 1

Carbohydrates- monosaccharides, disaccharides, polysaccharides, Glycolysis (key structure and reactions formation of pyruanvate and generation of ATP, Conversion of Pyruvate into acetyl Co-A and ethanol/ lactate), pentose phosphate and its regulation (generation of NADPH and its interconnection with glycolysis, Gluconeogenesis and its regulation (synthesis of Carbohydrates by non-carbohydrate precursors, synthesis of glucose from pyruvate),

Unit 2

Citric acid cycle and its regulation (formation of Acetyl Co-A from pyruvate, condensation of oxaloacetate with acetyl Co-A from citrate, pyruvate dehydrogenase complex and its control), conversion of ammonium into urea, linkage with citric acid cycle, electron transport and oxidative phosphorylation, energetics of oxidative phosphorylation- energy yield by oxidative phosphorylation

Unit 3

Biosynthesis of amino acids (conversion of nitrogen to ammonia, conversion of ammonia into amino acids by way of glutamic and glutamine, conversion of citric acid intermediates to amino acids, and feedback regulation of amino acid biosynthesis) Biosynthesis and degradation of nucleotides (purine biosynthesis and its regulation, pyrimidine biosynthesis - salwage pathway for purine and pyrimidine) degradation of purines and pyrimidines to urea

Unit 4

Lipids- fatty acids, glycerol, waxes, phospholipids, sphingolipids, sterols, lipo-proteins, fatty acid oxidation (oxidation of saturated and unsaturated and odd chain fatty acids, ketone bodies), biosynthesis of fatty acids (formation of melonyl Co-A, fatty acid synthase complex, citric acid and regulation of fatty acid biosynthesis)

Text Books:

1. Voet & Voet (2004) Biochemistry 3rd ed. John Wiley & sons Inc. New York
2. Keith Wilson & John Walker (2007) Principles and Techniques of Biochemistry & Molecular Biology Publisher Cambridge Univ. Press 6th ed.
3. Berg, Lymoeko & Stryer (2002) Biochemistry 5th Ed. W.H.Freman & Co. San Francisco

Reference Books:

1. Lehninger A.L, Nelson D.L. & Cox M.M. (1993) Principles of Biochemistry 2nd Ed. Worth publishers New York.

MSBT-103 Biostatistics and Computer Applications

UNIT 1

Introduction: Statistics and computer, Tabular and graphical presentation (histograms and curves), Measure of central tendency of grouped and ungrouped data (mean, median and mode), Measure of dispersion of grouped and ungrouped data (mean and standard deviation)

UNIT 2

Sampling: Statistical population, sample from population, random sample, sampling techniques.

Correlation and Linear Regression

Probability: Probability distribution. Binomial, poisson and normal distribution

Applications: Application of Biostatistics in biotechnology, applications of computer in biostatistics.

UNIT 3

Test of Analysis: Test of significance, test for proportion, means and standard deviations, F-and t-test and chi-square tests for goodness of fit. Analysis of variance for one and two-way classification, Nonparametric tests

UNIT 4

Design of experiments: Least squares, randomization, replication, completely randomized and randomized block design.

Theory of errors, errors and residuals, precision, measure of precision.

Books

Biostatistics: A foundation for Analysis in Health Sciences (2004) by *Wayne W. Daniel* Publisher: Wiley, Edition:I

Statistical Methods by S.P.Gupta, Publisher S.Chand & Co, New Delhi

Statistics by R.S.N. Pillai & V. Bagavathi, Publisher S.Chand & Co, New Delhi

MSBT – 105 Cell Biology

Unit I

History of Cell Biology: Development of cell theory
Diversity of Cell size and Shape: General organization of Prokaryotic and eukaryotic cells, Morphological Diversity of Prokaryotic and eukaryotic cells.
Microscopic Techniques for study of cell: Bright field, Fluorescence, Phase contrast, DIC, Darkfield, and Electron microscopy, Application of light Microscopy and EM in Cell Biology.

Unit II

Cellular Organelles: Plasma membranes, cell wall, their structural organization, mitochondria, chloroplast, nucleus and other organelles and their organization.
Transport of nutrients, ions and macromolecules across the membrane: Active and passive Transport, different classes of pumps and their mechanisms.

Unit III

Cellular energy transduction: Role of mitochondria and chloroplast
Cell Cycle and its regulation in Mitosis: Cyclin-CDK Regulation during mitosis in *Saccharomyces cerevisiae.*
Cell Signaling: Signal transduction, Types of cellular responses, Mechanism of signal transduction. Signaling pathways-Ras/ MAPK, JAK-STAT, TGF beta, and their activation.

Unit IV

Biosynthesis of proteins in Eukaryotic Cell: Molecular Mechanisms of Transcription, Repression and Activation.
Vesicular Traffic: Techniques and Molecular mechanism of vesicular traffic, Secretory pathways, Receptor mediated Endocytosis.
Cellular Basis of differentiation and development: Meiosis, gametogenesis, fertilization and upto formation of three germinal layers (in human)

Text Books

Cell Biology. Robert M. Dowben, Kalyani publication.
Cell & Molecular Biology. P. Sheeler & D.E. Bianchi, John Wiley & Sons,Inc.
Cell & Molecular Biology. S.C. Rastogi, New Age Intr.(P) Ltd

Reference Books

Cell & Molecular Biology. De Robertis & De Robertis, Waverly publication.
Molecular Cell biology, Sixth Edition. Harvey Lodish, W.H. Freeman and Co.
Cell and Molecular Biology, Gerald Karp, John Wiley & Sons, Inc.

MSBT-107 Immunotechnology

UNIT 1

Overview of Immune System- Historical perspective, Innate and Adaptive immunity, Humoral and Cellular component of immune response

Immune system- Cells involved in immune response, lymphoid organs and interactions

Antigen and Antibody- Antigenicity and immunogenicity, epitopes and haptens, structure and function of Antibody , antigenic determinants on immunoglobulins, monoclonal Antibody production and their uses.

UNIT 2

Major Histocompatibility Complex- MHC molecules and genes, expression and regulation of MHC molecules.

Antigen Presentation- Role of antigen presenting cells and different antigen presentation and processing pathways.

T-cell Receptor- T-cell receptor complex, thymic selection of T-cell – positive and negative selection

B-cell- Maturation, progenitor B-cells, selection of self reactive B-cells

UNIT 3

Complement System- components of complement system, complement system activation through classic and alternate pathway, regulation of complement system

Antigen-antibody Interaction- Agglutination, precipitation, ELISA, RIA, Western blotting, Immunoprecipitation and immunoflourescence

UNIT 4

Autoimmune Diseases- Organ specified autoimmune diseases and systematic treatment of autoimmune diseases

Hypersensitivity Reactions- Type-I, II, III, AND IV Hypersensitivity

Cytokines- Properties of cytokines, cytokine receptors, cytokines antagonist and their secretion by TH-I and TH-II complex

Recommended Books:

1. Kuby Immunology, 4th Edition – R.A. Godsby Thomas J. Kindt, Barbara, A. Osbarne (Freeman)
2. Cellular and Molecular Immunology by Abbas, A.K. Lichtman, A.H. Pober, J.S. W.B. Saunders Co., Philadephia, 1994.
3. Essential Immunology: 7th Edn., Roitt I.M. Blackwell Scientific Pub., 1992.
4. Immunology, Tizard, I.R. Saunders College Publishing, Philadelphia, 1988.
5. The experimental Foundation of Modern Immunology, Clark, W.R. 3rd Ed. John Wiley and Sons. New York, 1986.

MSBT-109 Principles of Microbiology

Unit-1

The Beginnings of Microbiology, Controversy over Spontaneous Generation, contributions of Lister, Pasteur, and Koch to the germ theory of disease and to the treatment or prevention of diseases.

Methods in Microbiology: Pure Culture Techniques, Theory and Practice of Sterilization, Microbial Culture Media, Enrichment Culture Techniques, Culture collection, Purification & Preservation.

Procaryotic Cell Structure : With special reference to cell shape, size and arrangement, Cell Wall of Gram positive and Gram negative bacteria, Capsules, Slime Layer, Pili, Flagella, Motility and Bacterial Endospore

Unit II

Microbial Taxonomy, Characteristics used in Taxonomy - Morphological, Physiological, Ecological and Molecular viz. Base Composition, Nucleic Acid Hybridization and Sequencing. A brief account of Bergey's system of bacterial classification

Viruses: Discovery, Structure, Classification and replication of DNA and RNA viruses. Lysogeny: Phage Lamda Type and Phage P1 Type.

Fungi: Distribution, Importance, Structure, Nutrition and Metabolism, Reproduction, characteristics of the fungal divisions

Algae: Distribution, classification, structure, nutrition, reproduction and characteristics of algal divisions

Unit III

Microbial Nutrition: Principles of Microbial Nutrition, Nutritional Categories of Microorganisms

Microbial Growth : Growth Curve, Growth Measurement, Continuous Culture of Microorganisms- Chemostat and Turbidostat, Effect of environmental conditions on growth- Water activity, pH, temperature, oxygen concentrations, pressure and radiation.

Microbial Control: Physical Agents of Microbial Control- Heat, Low temperature, Filtration, radiation. Chemical Agents of Microbial Control- Alcohol, phenol, heavy metals, detergents, aldehydes and sterilizing gases

Unit IV

Microbial Interactions: Symbiotic Interactions, Parasitism, Amensalism and Competition

Nutrient Cycling Interactions: C, N and S cycles

Antibiotics: Antimicrobial drugs- characteristics, mechanism of action and factors influencing the effectiveness. Antibacterial Drugs- Sulfa drugs, Penicillins, Cephalosporins and Chloramphenicol. Mechanism of Drug Resistance

Toxigenicity: Toxins (Exo and Endo), specific host site exotoxins, role of exotoxins in disease, virulence and pathogenesis

TEXT BOOKS:

Prescott LM Harley JP and Klein DA (2003). Microbiology (5th edition) McGraw Hill, Newyork.

Stainer, R.Y. 1995. *General Microbiology*,. Macmillan Press,London.

Pelezar, M.T. 1995. *Microbiology,* Tata McGraw Hill Publishing, New Delhi.

REFFERENCE BOOKS:

Tortora, G.J. Funke, B.R. and Case, C.L. 1994. *Microbiology: An Introduction* : 5th Ed. The Bejnamin cummings Publishing Company, Inc.

Holt, J.S., Kreig, N.R., Sneath, P.H.A and Williams, S.T. Bergey's Manual of Determinative Bacteriology (9th Edition), Williams and Wilkins, Baltimore.

MSBT-111 Lab in Biochemistry

1. Determination of Carbohydrates (Benedict Test and Fehling reagent test)
2. Lipids
3. Determination of Sugars (reducing and non-reducing)
4. Determination of proteins (Biuret and Folin's Method)
5. Assay of α-amylase
6. Purification of proteins by salt precipitation
7. DNS Method for Glucose estimation
8. Paper Chromatography
9. Thin Layer Chromatography
10. Column Chromatography
11. SDS- PAGE
12. HPLC

MSBT-113 Lab in Computer Applications

1. Introduction of MS Excel and creating tables
2. Creating XY charts in MS Excel
3. Creating bar diagrams in MS Excel
4. Creating formula and calculating mean and standard deviation
5. Calculating Correlation
6. Calculating Regression
7. Applying T-Test
8. Applying F-Test
9. Applying one way ANOVA
10. Applying two-way ANOVA
11. Response Surface Designs

MSBT-115 Lab in Immunotechnology

1. Measurement of TLC and DLC
2. Blood group test
3. Agglutination test
4. ELISA
5. DID
6. Immuno Electrophoresis
7. Western Blotting
8. Study of Lymph nodes in rats
9. Immunization of mice
10. Bleeding of mice

MSBT-117 Lab in Microbiology

1. Instrumentation and Rules of Microbiology Laboratory
2. Media preparation and sterilization
3. Microscopy
4. Counting of Cells using Haemocytometer
5. Size measurement of purified bacterial strain.
6. Gram staining of purified bacterial culture
7. Spore staining
8. Negative staining
9. Growth curve of microorganisms.
10. Determination of microbial growth of microorganism (turbidity and viable count)
11. Isolation, purification and preservation of microorganisms from soil/ water
12. IMViC Test
13. Antibiotic sensitivity test of bacteria
14. MIC test of antibiotic sensitivity

Recommended Books

Experiments in Microbiology, Plant Pathology and Biotechnology by K.R. Aneja. Published by New Age International Publishers.

2nd Semester

MSBT-102 Biochemical and Biophysical Techniques

Unit-I

Chromatography: Introduction, principles, types-paper, two dimensional, HPLC, ion exchange chromatography etc. Uses , advantages and limitations

Spectroscopy: Introduction, UV/Visible and spectrophotofluorimeter basic principle involved different types of spectrometry involved-NMR, magnetic resonance spectroscopy-Scope and uses in biotechnology. Structural determination and analysis of biological structures. Absorption spectroscopy and other optical techniques like fluorescence, infrared and Raman.

Radioisotopy: Use of Radioisotope, Detection and measurement of radioactivity, Specific activity,applicationa in biological system, Autoradiography.

Unit-II

Microscopy: Brief introduction, types of microscopes and role in microbiology. Structure and function of microscopes-Compound microscope, dissecting microscope, phase contrast microscope, Electron microscope –Scanning electron microscopy. CT scan, Digital microscopy and its role in biotechnology.

Unit-III

Centrifugation: Theory and application.
Electrophoresis: Colloidal Solution of Biopolymers and their electrochemical properties different methods for proteins and N.A.

Unit-IV

Cytochemistry: Principles and Applications, Quantitative Chemistry.
Molecular diagnostic techniques: PCR, Southern, Nothern , Western Blotting, and Microarray.

Suggested Readings:

Physical Biochemistry,1982. Frifelder Freeman and Co. New York.

Lab Techniques in Biochemistry and Molecular Biology, 1984, Elseveir, New York.

Sepration, Recovery and Purification in Biotechnology by Juan H, and Sengo, A.A. 1985, American Chem Society, Washington.

Principles and Techniques of Biochemistry and molecular biology – Keith Wilson and John Walker, Cambridge University Press.

MSBT-104 Bioprocess Engineering and Technology

Unit-1

Applications of Bioprocess engineering in biotechnology industry, steps involved in bioprocess development.

Basic Concepts in Bioprocess: Physical variables, dimensions and units, material balance and energy balance, Unit operation involved in bioprocesses (general process flow sheet)

Unit-II

Fluid Flow: Classification of fluids, fluid in motion, Reynolds number, Newtonian and non- Newtonian fluids, Bernoulli's equation, viscosity.

Heat Transfer: Fourier's Law, conduction, convection, Individual and overall heat transfer coefficient, general equipment for heat transfer.

Mass Transfer: Molecular diffusion, diffusion theory, analogy between heat, mass and momentum transfer, role of diffusion in mass transfer, convective mass transfer, Liquid-solid mass transfer, Liquid-liquid mass transfer, Liquid-gas mass transfer, oxygen uptake in cell culture, factors affecting cellular oxygen demand, oxygen transfer from gas bubble to cell.

Unit-III

Microbial Growth Kinetics: Batch, Fed batch and continuous systems.

Sterilization: Thermal death time, F value, z value, TDT curve, D value. Medium sterilization (batch and continuous sterilization) sterilization of fermentor, filter sterilization (Theory and design of depth filter, filter sterilization of medium and air)

Bioreactors: Basic design and construction of bioreactor, Stirred tank reactor, bubble column reactor, airlift reactor, packed bed reactor, fluidized bed reactor, trickle bed reactor.

Monitoring and Control: Monitoring and control of temperature, pressure, dissolved oxygen, pH and agitation, basics of Biosensors.

Unit-IV

Aeration and Agitation: oxygen requirements of fermentor, factors efeecting oxygen uptake rate.

Unit Operation: filtration, centrifugation, cell disruption, adsorption, chromatography (adsorption, ion-exchange, gel permeation, affinity, reverse phase chromatography, HPLC), Membrane processes (Ultra-filtration, reverse osmosis).

Books

1. Bioprocess Engineering Principles by P.M.Doran, Academic Press.
2. Bioprocess Engineering by M.L.Shuler, F.Kargi. Prentice Hall.
3. Principles of Fermentation Technology by P.F.Stanbury, A. Whitaker, S.J.Hall.

MSBT-106 Environment Biotechnology

Unit-1

Environment: Basic concepts and issues.

Environment Pollution: Types of pollution, methods of measurement of pollution, methodology of environment management – the problem solving approach, its limitations.

Air Pollution and its control through biotechnology

Unit-II

Water Pollution and its control: water as a scarce natural resources, need for water management, measurement of water pollution, sources of water pollution, waste water collection, waste water treatment, physical, chemical and biological treatment processes.

Microbiology of waste water treatments: aerobic process, activated sludge process, oxidation ditches, trickling filter, towers, rotating disc, rotating drums, oxidation ponds
.
Anaerobic Processes: anaerobic digestion, anaerobic filters, upflow anaerobic sludge blanket reactors

Treatment Schemes of waste water of dairy, distillery, tannery, sugar and antibiotic industry.

Unit-III

Microbiology of degradation of xenobiotics in Environment: Ecology consideration, decay behavior and degradative plasmids, hydrocarbons, substituted hydrocarbons, oil pollution, pesticides, surfactants

Unit-IV

Bioremediation of contaminated soil and waste land, Biopesticide in integrative pest management
Solid Waste: Sources and management (Composting, vermiculture and methane production
Global Environment Problems: Ozone depletion, UV-B, Green House effect a,d acid and rain, their impact and biotechnological approaches for management.

1. Waste Water Engineering – Treatment, Disposal and reuse, Metcalf and Eddy, Inc., Tata McGraw Hill, New Delhi

2. Comprehensive Biotechnology, Vol. 4. M. Moo-Yang, Pergamon Press, Oxford.
3. Environment Biocehemistry, A.K. De. Wiley Eastern Ltd., New Delhi
4. Inroduction to Biodeterioration, D.Allsopp and K.J. Seal, ELBS/Edward Arnold.

MSBT-108 Enzyme Technology

Unit –I

Enzyme nomenclature and classification. General properties of enzymes like effect of pH, temperature, ions etc. , effects of organic solvents on enzyme catalysis and structural consequences.Protein primary secondary and tertiary and quartinary structure
Extraction, assay and purification of enzymes.

Unit –II

Steady state kinetics. Michaelis – Menten, Lineweaver –Burke, Eadie- Hosfstee and Hanes- Woolf equation and Km value. Enzyme inhibitors. Pre-steady state kineticts.

Unit – III

Enzyme specificity. Evidences for enzyme substrate complex. Nucleophilic and electrophilic attack. Role of metal ions in enzyme catalysis. Mechanism of enzyme action eg. Lysozyme, chymotrypsin, DNA polymerase etc. zymogens and enzyme activation.
Ribozymes and catalytic antibodies.

Unit – IV

Allosteric interaction and product inhibition:
Immobalization and Membrane bound enzymes – extraction, assay, lipoprotein interaction and effect of fluidity on enzyme activity

Industrial Application of Enzymes : The important uses use of enzymes: Large scale and economically important uses for enzymes e.g. detergent, amino acid production, food and clothing applications, pharmaceuticals.

Recommended Books

1. Methods in Enzymology Vol. 152, Guide to Molecular Cloning Techniques, S.L. Berger and A.R.Kimmel, Academics Press, Inc. San Diego, 1998.

2. Methods in Enzymology Vol. 185 Gene Expression Technoloigy, D.V. Goeddel, Academic Press Inc. San Diego, 1990.

3. Enzymology By Rehm and Reed

MSBT-110 Molecular Biology

Unit-I

Introduction : Structure of DNA, RNA and polypeptide. The concept of template surfaces: Physical properties of DNA: Cot curve, kinetic and sequence complexity, Tm, buoyant density (centrifugation), satellite DNA. Molecular definition of gene.

Packaging of DNA as nucleosomes in eukaryotes. Repetitive and unique DNA sequences. Chromosomal DNA contents and C-value paradox. Structural changes in the chromosomes: Deficiency, duplication inversion and translocation of chromosomes.

Unit-II

DNA Replication in Different Organism**:** Bacterial DNA replication phage DNA replication M13, and SSRNA phage (MS-2) replication, plasmid DNA replication, double stranded phage DNA replication Eukaryotic DNA replication, SV40 virus and retroviral genome replication, synthesis of telomeric DNA, Organellar DNA replication.

Genomic Rearrangement and DNA Repair **:** Molecular mechanism of recombination of prokaryotes and eukaryotes. Mechanism of mutagenesis, Transposable elements in prokaryotes and eukaryotes. Mechanism of transposition. Ribosomal frame shift, DNA restriction and modification, DNA repair (Excision, mismatch and SOS repair). Understanding on double strand break repair in prokaryotes and eukaryotes.

Unit-III

Fundamentals of Gene Expression: Prokaryotes- RNA polymerases, mechanism of DNA dependent RNA polymerization, regulation of gene expression at transcription and post transcription levels. Biosynthetic and catabolic operons and their regulations (lac operon, trp operon and arabinose operon), mechanisms of DNA binding proteins at molecular level, Lambda phage genes expression.

Eukaryotes: Different RNA polymerases. Structure of promoters' enhancer's transcription factors, initiations complex formation. Gene silencing, Methylation.

RNA Processing: Modification and Maturation, RNA splicing. Group I Introns and Group 2 introns; splicing. Spliceosome and snurposome formation, ribozymes. RNA editing, RNA amplification. Control of diversity in protein synthesis through alternate RNA splicing mechanisms.

Unit-IV

Protein Synthesis: Genetic codes Wobble hypothesis, Initiation, Elongation and termination. Difference in Prokaryote and Eukaryotes protein synthesis, translation in mitrochondria chloroplast. Post translation modification of proteins such as phosphorylation, adenylation, acylation and glycosylation

Recommended Books

1.Stryer L (1995) Biochemistry, 4 th edition, W. H. Freeman & company, New York.

2. Watson J. D., Hopkins, N. H., Roberts, J. W., Steitz, J. A. and Weiner, A. M. (1988) Molecular biology of the gene, 4 th edition, The Benjamin/Cummings publishing companies, inc, California.

3. Benjamin Lewin (1999) Genes VII, oxford University Press, Oxford.

4. Weaver R. F. (1999) Molecular biology, WCB McGraw-Hill companies, Inc, New York.

5. Genes and Genomes Maxine Singer and Paul Berg

MSBT- 112 Lab in Bioprocess Engineering and Technology

1. Study of Fermentor
2. Study of energy balance and heat transfer in a bioreactor
3. Study of mass balance in a bioreactor
4. Production of alcohol in a reactor
5. Estimation of alcohol
6. Determination of Thermal death point and thermal death time of microorganism
7. Media sterilization in fermentor.
8. Study of growth curve in a batch process in a bioreactor.
9. Determination of substrate degradation profile.

MSBT-114 Lab in Molecular Biology

1. Isolation of genomic DNA
2. Isolation of plasmid DNA
3. Quantification of nucleic acid and protein
4. Determination of Tm of nucleic acid
5. Demonstration of DNA-protein interaction
6. RFLP analysis
7. Isolation of total RNA from tissue

Recommended Books

1. Brown T A (1995) Essential molecular biology, vol. I, A practical approach, IRL press, Oxford.

2.Sambrook J et al.2000.Molecular Cloning:A Laboratory Manual(Third Edition).

MSBT-116 Lab in Environment Biotechnology

1. Determination of dissolved oxygen
2. Determination of Biological oxygen Demand
3. Determination of Chemical oxygen demand
4. Determination of total dissolved solids
5. Determination of pH, acidity and alkalinity
6. Detection of Coliforms for determination of purity of potable water
7. Isolation of pesticide degrading organism from soil
8. Isolation of Dye degrading organism from soil

Experiments in Microbiology, Plant Pathology and Biotechnology by K.R. Aneja. Published by New Age International Publishers.

Punjab Technical University, Jalandhar.
M.Sc Biotechnology
Study Scheme

3rd Semester

	COURSE CODE	SUBJECT TITLES	TEACHING LOAD IN HOURS				
			L	T	P	Internal	External
1	MSBT 201	Proteomics and Genomics	4	-	-	40	60
2	MSBT 203	Fermentation Technology	4	-	-	40	60
3	MSBT 205	Recombinant Biotechnology	4	-	-	40	60
4	MSBT 207	Plant Tissue Culture	4	-	-	40	60
5	MSBT 209	Animal Tissue Culture	4	-	-	40	60
6	MSBT 211	Lab in Bioinformatics	-	-	3	40	60
7	MSBT 213	Lab in Recombinant & Industrial Biotechnology	-	-	3	40	60
8	MSBT 215	Lab in Plant and Animal Cell Culture	-	-	3	40	60
		Total	20		9	320	480

4th Semester

	COURSE CODE	SUBJECT TITLES	TEACHING LOAD IN HOURS				
			L	T	P	Internal	External
	MSBT 214	Seminar on Recent Advances in Biotechnology			4	100	
	MSBT 216	Industrial Training/ Project Work			24	400	300

MSBT 201 Proteomics and Genomics

UNIT-I

Introduction to Bioinformatics: What is Bioinformatics, its goals and scopes, Application of Bioinformatics ,Introduction to Biological Databases (Nucleotides Databases ,Protein Database ,Conserved Databases)

UNIT-II

Sequence Analysis: Pairwise alignment , Global alignment, Local alignment and Gap penalty .Scoring Matrices: PAM, BLOSUM , Sequence alignment methods: Dynamic Programming ,Dot Matrix, Multiple sequence alignment , CLUSTALW. Molecular phylogenetic : Molecular evolution and Phylogenetics , Terminology of Phylogenetic Trees, Rooted and Unrooted tree.

UNIT-III

Organization and Structure of Genomes: Genome Size, Sequence Complexity-Intron and Exons , ORFs , Splice Variants repetitive Content of eukaryotic Genome . Genome Sequencing Strategies: Hierachical (Clone conting) and shotgun method.

Genome Sequencing: Genetic, Physical, cytological.Polymorphism, molecular markers - RFLP, VNTR, AFLP, SSR, RAPD.SNP, SNP detection methods-SSCP, PCR based, DGGE, TGGE, SNP diseases, SNP databases-dbSNP.

UNIT-IV

Introduction to proteomics, Protein : Determination of sizes (Sedimentation analysis, gel filtration, SDS PAGE, Native PAGE).Protein Protein Interaction,co-immunoprecipitation. Mass Spectrometry based methods for protein identification: De novo sequencing using Mass spectrometric data, use of MALDI TOF and related methods for protein mass determination .

Recommended Books

1.Essential Bioinformatics by Jin Xiong.
2. Bioinformatics : Sequence and Genome Analysis by David W. Mount.
3.Introduction to Bioinformatics by Singhal and Singhal.
4.Bionformatics: A Practical Guide to analysis of Genes and Genomes by Andreas D. Baxevanis and b. F. Francis Ouellette.
5.Setubal Joao and Meidanis Joao.Introduction to computational molecular Biology, PWS Publishing Company (An International Thomson Publishing Company), (1997) Indian low priced Edition harbour Laboratory Press (2004).
6. Bioinformatics: sequence and Genome Analysis by David Mount, second Edition. Cold Spring
7. Discovering Genomics, Proteomics and Bioinformatics,2/E by A. Malcolm Campbell and Laurie J.Heyer, Publisher :Benjamin Cummings(2007)

MSBT-203 Fermentation Technology

UNIT-1

Fermentation: Types of fermentation (solid and submerged), Role of fermentation, Scale up of fermentation, problems in scale up, Difference between large scale and small scale production, Environmental and metabolic control of metabolic pathways.

Antibiotic Fermentation: Classification of antibiotics, mode of action, production of penicillin, streptomycin and tetracycline.

Microbial Enzymes: Production and application of amylases, proteases, rennin, cellulase, lipase, pectinase and lactases.

UNIT-II

Microbial Cells: Bakers yeast, Single cell protein (composition, factors effecting SCP production, uses, economic parameters and constrains), mass culture of spirulina, mushrooms (Technology of mushroom production), safety aspects of SCP

Organic Acid: Production and uses of Citric acid, acetic acid (vinegar), lactic acid and gluconic acid.

Alcohol Production: Classification of alcoholic beverages, Beer, wine (Grape wine, table wines, fortified wines and sparkling wines), brandy and whiskies. Acetone-butanol production, Biofuel: algal fuel, bioethanol, hydrogen production.

UNIT-III

Amino Acids: Commercial use of amino acids, method of production, Production of glutamic acid, lysine, tryptophan, aspartic acid, butyric acid.

Microbial Polysaccharides: Microbial vs. plant derived gums, structure, properties and applications, production and recovery, production of xanthan, pullulan and alginate.

Microbial Production of Fats: Biosynthesis of triacylglycerols, fats production technology.

UNIT-IV

Food Fermentations: Role of starters, fermentative changes in milk, Cheese, yoghurt, sauerkraut, temph, miso. High fructose corn syrup, idli and dosa.
Functional Foods: Probiotic and prebiotics foods, neuraceuticals and their role as therapeutic agent.

Fermentation Economics: Market potential, Fermentation and product recovery cost.

Recommended Books:

1. Biotechnology: Food Fermentation vol. I & II by V.K.Joshi and A.K.Pandey. (1999)
2. Industrial Biotechnology by L.E.Casida (2008)
3. Biotechnology: A textbook of Industrial Biotechnology by Cruger & Cruger (2005)

MSBT-205 Recombinant Biotechnology

UNIT-1

Tools of Genetic Engineering: Cloning vehicles, Modifying enzymes, DNA ligase, DNA polymerase, Polynucleotide kinase, T4 DNA ligase, Nick translation system, Terminal deoxynucleotidy1 transferase, Reverse transcriptase Restriction endonucleases Type I & II. etc.

Cloning Vectors: Plasmids, Lambda phage, Phagemids, Cosmids, Artificial chromosomes, yeast vectors, Shuttle vectors, virus based vectors.

UNIT-II

Methods of gene transfer: Transformation, transduction, Particle gun, Electroporation, liposome mediated, microinjection, *Agrobacterium* mediated gene transfer.

Preparation and application of molecular probes: DNA probes, RNA probes, Radioactive labeling, Non radioactive labeling, use of molecular probes, DNA fingerprinting.

UNIT-III

Analysis and expression of cloned gene in host cells: Expression vectors, Restriction enzyme analysis, Southern blotting, Northern blotting, Western blotting, In-situ hybridization.Colony and plaque hybridization, Factors affecting expression of cloned genes, Reporter genes, Fusion proteins.

Gene libraries - cDNA synthesis, Genomic DNA libraries, Amplification of gene libraries, identifying the products of cDNA clones.

Isolation, Sequencing and synthesis of gene: Different methods of gene isolation, Techniques of DNA sequencing, Artificial DNA synthesis.

UNIT-IV

Applications of r-DNA Technology*:* Gene cloning in medicine (Insulin, Blood clotting factor VIII) High level expression of proteins in different host systems (E. coli, yeast, Insect, mammalian cells) Limitation and advantages and novel technologies generation of transgenic animals. Applications of PCR (DNA finger printing)

Gene therapy: (Ex vivo & In vivo gene therapy), case study of ADA as an example.Gene therapy prospect and future, DNA vaccine, Transgenic plants, Advantages and limitations of Gene therapy , Antisense and ribozyme technology, Micro RNA Technology, Human genome project and its application, Current production of rDNA products, Bio-safety measures and regulations for rDNA work.

Recommended Books;

1. "Principles of Gene Manipulation" by R.W.Old and S.B.Primrose Sixth Edition Blackwell Scientific Publication (2001)
2. "Genes VIII" by B.Lewin
3. "From Genes to Clones" by E.L.Winnecker.
4. "Gene Cloning " by T.A.Brown 5th Edition, 2001
5. Glick B., Pasternak J. 2003. Molecular Biotechnology: Principles and Applications of Recombinant DNA, 3rd Ed. ASM Press.

MSBT- 207 Plant Tissue Culture

UNIT-1

Introduction to cell and tissue culture Conventional plant breeding; tissue culture as technique to produce novel plants and hybrids, tissue culture media (composition and preparation)

Initiation and maintenance of callus and suspension cultures; Single cell clones. **Organogenesis; Somatic embryogenesis;** Transfer and establishment of whole plants in soil. Shoot tip culture; Rapid clonal propagation . Embryo culture and embryo rescue.

Protoplast isolation, culture and fusion, selection of hybrid cell and regeneration of hybrid plants, symmetric and asymmetric hybrids, cybrids, Cryopreservation , slow growth and DNA banking for germplasm conservation

UNIT-2

Plant transformation technology: basis of tumor formation , hairy root , features of TI and RI plasmids, mechanism of DNA transfer, role of virulence genes, use of TI and RI as vectors, binary vectors , genetic markers, use of reporter genes, reporter gene with intron, methods of nuclear transformation , viral vectors and their application , multiple gene transfer, vectorless or direct DNA transfer (particle bombardment, elctroporation, microinjection), transformation of monocots , transgene stability and gene silencing

UNIT-3

Application of plant transformation for productivity and performance : herbicide resistance, (phosphoinothricin, glyphosphate, sulfonyl urea, atrazine), insect resitance (Bt genes,non-Bt like protease inhibitors, alpha amylase inhibitor), virus resistance (coat protein mediated, nucleocapsid gene), disease resistance (chitinase, 1-3 beta glucanase, RIP, antifungal proteins, thionins,PR proteins), Nematode resistance, abiotic stress,post harvest losses, use of ACC synthase (polygalactrouranase, ACC oxidase), male sterile lines, bar and barnase systems,carbohydrate composition and storage, ADP glucose pyrophosphatase. BIosafety and ethical issues associated with transgenic plants.

UNIT-4

Chloroplast transformation : Advantages ,vectors , success with tobacoo and potato

Metabolic engineering and industrial products: plant secondary metabolites, role of bioreactors for scaling up, biotransformation .

Biodegradable plastics, polyhydroxybutyrate

Molecular pharming in plants – production of therapeutic proteins, edible vaccines antibodies, purification statergies.

Recommended Books:

1. Biotechnology in Crop Improvement by H.S Chawla

2. Plant Biotechnology BY J.Hammond , P.McGravey and V.Yusibov
3. Elements of Biotechnology by P.K Gupta
4. Practical application of Plant Molecular Biology by R.J Henry

MSBT-209 Animal Tissue Culture

Unit-I Introduction:-Historical Background, Advantages of tissue culture (Environmental control, characterization and homogeneity of sample), Types of tissue culture, Limitations and applications. **Design and layout of Laboratory**: General method and culture parameters (cell quantification, equipment and reagents, practical consideration, growth kinetics, medium and nutrients, pH , oxygen, types of culture process).

Unit-II Cell line preservation: Introduction, cell line banking, cell freezing and quantification of recovery (Equipment, preparation and freezing, reconstruction and quantization recovery), cell line authentication (species verification, tests for microbial contamination, testing for interspecies cross contamination).

Unit-III Culture Environment: Development of media, role of serum and other undefined tissue extracts in cell culture systems, Response curves (Proliferating culture, non proliferating culture), Choice of materials (cell type, sources of tissue, subculture, selection of medium, gas phase, culture system). **Biology of Cultured cells:** Cell adhesion, Cell proliferation, apoptosis, differentiation and de- differentiation, Cell signaling, stem cell cultures, embryonic stem cells and their applications. **Mammalian cell products:** Use of animal cell culture for production, viral vaccines, transfection methods (embryonic stem cell transfer, electroporation, microinjection, macroinjection), tissue engineering.

Unit-IV Safety, Bioethics, and Validation: Laboratory safety, Standard operating procedures, Safety regulation, Biohazards (Levels of biological containment, Microbiological safety cabinets, human biopsy material, genetic manipulation, Disposal of Biohazardous materials, Bioethics (Animal tissue, human tissue), Validation (Authentication, provenance, contamination),Rrisk associated with cell culture products

Recommended Books:

1. Culture of Animal cells by R. IAN Freshney 5th edition, 2005
2. Animal cell culture and technology by M. Butler, 2nd edition, 2008
3. Animal cell culture by W. Masters, (Practical Approach) 3rd edition, 2000.
4. Animal cell culture by Griffth and Smith

MSBT-211 Lab in Bioinformatics

1. Explore NCBI.
2. To explore Expasy:Swiss Prot.
3. To explore EBI.
4. Perform local alignment using BLAST .
5. Perform Multiple sequence alignment using Clustal W.
6. Web Cutter
7. Working with complete viral genomes .
8. Working with complete Bacterial genomes.
9. Producing Phylogenetic Tree
10. Retrieving and Displaying a 3-D Structure with Cn3D.

MSBT-213 Lab in Recombinant & Industrial Biotechnology

1. Bacterial culture and antibiotic selection media
2. Preparation of competent cells.
3. PCR of DNA and RFLP analysis
4. Transformation by calcium chloride method
5. Isolation and production of Industrially important enzymes (Amylase, protease, cellulase and lipase)
6. Production of sauerkraut
7. Production of yogurt
8. Production of alcohol
9. Production of lactic acid
10. Production of citric acid

MSBT- 215 Lab in Plant & Animal Cell culture

1. Preparation of primary culture
2. Preparation and maintenance of secondary culture
3. Isolation of cells of animal tissue
4. Culturing of lymphocytes and hepatocytes
5. Analysis of cell proliferation.
6. Embryo Culture
7. Media preparation for plant tissue culture (with different growth regulators)
8. Surface sterilization and primary inoculation in plant tissue culture
9. Agrobacterium mediated transformation
10. Callus propagation and transfer of plants to soil.