Study Scheme & Syllabus of Master of Science in Biotechnology /

(M. Sc. Biotechnology)

Batch 2018 onwards

By

Board of Study Biotechnology
Department of Academics
IK Gujral Punjab Technical University

IK Gujral Punjab Technical University
M. Sc. Biotechnology

Master of Science in Biotechnology (M. Sc. Biotechnology)
It is a Post Graduate (PG) Programme of 2 years duration (4 semesters)

Courses & Examination Scheme:

First Semester

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
MBT101	Core	Biomolecules and Metabolism	4	-	-	30	70	100	4
MBT 102	Core	Applied Microbiology	4	-	-	30	70	100	4
MBT 103	Core	Genetics and Molecular Biology	4	-	-	30	70	100	4
MBT 104	Core	Biotechnology Laboratory -I	-	-	8	50	25	75	4
MBT 105	Core	Computer Applications	3	1	-	30	70	100	4
MBT XX	DSE	Elective -I	3	-	-	30	70	100	3
MBT 106	GE	Personality Development and General Aptitude	-	-	2	Satisfactory/ Unsatisfactory			1
Total			**18**	**1**	**10**	**200**	**375**	**575**	**24**

Second Semester

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
MBT201	Core	Cell and Developmental Biology	4	-	-	30	70	100	4
MBT 202	Core	Immunology and Immunotechnology	4	-	-	30	70	100	4
MBT 203	Core	Enzyme Technology	4	-	-	30	70	100	4
MBT 204	Core	Biotechnology Laboratory -II	-	-	8	50	25	75	4
MBT 205	Core	Bioprocess Engineering	3	1	-	30	70	100	4
MBT XX	DSE	Elective -II	3	-	-	30	70	100	3
MBT 206	GE	Journal Club	-	-	2	Satisfactory/ Unsatisfactory			1
Total			**18**	**1**	**10**	**200**	**375**	**575**	**24**

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Third Semester

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
MBT301	Core	Genetic Engineering	4	-	-	30	70	100	4
MBT 302	Core	Biostatistics	3	1	-	30	70	100	4
MBT 303	Core	Genomics and Proteomics	4	-	-	30	70	100	4
MBT 304	Core	IPR, Good Lab Practices and Bioethics	4	-	-	30	70	100	4
MBT 305	Core	Biotechnology Laboratory -III	-	-	8	50	25	75	4
MBT XX	DSE	Elective -III	3	-	-	30	70	100	4
MBT 306	GE	Journal Club	-	-	2	Satisfactory/ Unsatisfactory			1
		Total	**15**	**1**	**10**	**200**	**375**	**575**	**24**

Fourth Semester

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Credits
			L*	T*	P	Internal	External	
MBT 401	Core	One Semester Dissertation / Thesis	-	-	24	Satisfactory/ Unsatisfactory		12

Elective -I
MBT 111 Environment Biotechnology
MBT 112 Nanobiotechnology
MBT 113 Viruses and Human Diseases

Elective -II
MBT 211 Plant Tissue Culture
MBT 212 Drug Discovery and Development
MBT 213 Molecular Carcinogenesis and Therapy

Elective -III
MBT 311 Animal Tissue Culture
MBT 312 Food Biotechnology
MBT 313 Clinical Research

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MBT101 Biomolecules and Metabolism

Unit – I

Molecular design of Life; Proteins-classification, levels of structure, function, specificity and dynamics; Overview of techniques of protein purification and characterization; Physiological and structural proteins- ribosomes, haemoglobin, myoglobin, collagen.

Unit -II

Enzyme classification, kinetics and catalysis; Enzyme inhibition: Enzyme mechanisms and regulation.

Unit -III

Nucleic acids-DNA, RNA, nomenclature, properties, DNA sequencing and chemical synthesis; Carbohydrates-Classification, structure, function; Lipids-Classification, structure, function; Biomembranes and glycoproteins.

Unit -IV

Metabolism, basic concepts and design; Carbohydrate metabolism - Glycolysis, citric acid cycle, oxidative phosphorylation; Lipid, amino acid and nucleotide metabolism; Coordinated control and regulation of metabolism.

Suggested Books:

Author(s)/ Title/ Publisher	Year of Publication/Reprint
Stryer, L., "Biochemistry" 4th edition, W. H. Freeman.	2002
Horton, H.R., Moran, L.A., Ochs R.A., Rawn, J. D. and Scrimgeor, R.S., "Principles of Biochemistry" 3rd edition Prentice Hall,.	2001
Voet, D. and Voet, J. G., "Biochemistry" 3rd edition, John Wiley and Sons.	2004
Nelson, D.L. and Cox, M.M.,"Lehninger Principles of Biochemistry", 5th edition, W.H. Freeman.	2009
Wilson, K. and Walker, J., "Principles and Techniques of Practical Biochemistry" 5th edition, Cambridge University Press.	2000

IK Gujral Punjab Technical University
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MBT102 Applied Microbiology

Unit -I

Discovery of microorganisms, morphological and structural organization of microbes. Ultrastructure of Archea, Eubacteria, Unicellular eukaryotes(Yeast) and Viruses (Bacterial, animal and tumour viruses),

Unit -II

Microbial growth and nutrition, media formulation, sterilization, effect of physiological parameters. Growth kinetics: Batch, fed batch, continuous kinetics, screening of new metabolites; strain development-mutation and selection of mutants.

Unit -III

Microbial interactions and infection, host-pathogen interactions, microbes infecting humans, veterinary animals and plants, pathogenicity islands and their role in bacterial virulence, quorum sensing

Unit -IV

Preservation of food, fermentation, food additives and supplements, nutritional requirements and growth curve, aerobic and anaerobic bioenergetics. Production of primary and secondary metabolites, metabolite genes and functions, representative examples of ethanol, organic acids and antibiotics

Suggested Books:

Author(s)/ Title/ Publisher	Year of Publication/ Reprint
Darnell, J., Lodish, H. and Baltimore, D., "Molecular Cell Biology", W.H.Freeman & Co.	1999
Madigan, M.T. and Martinko, J.M., "Biology of Microorganisms", Person, Prentice Hall	2006
Watson, J.D., "Molecular Biology of The Cell", Taylor & Francis	2002
Talaron, K., Talaron, A., Pelczar, C. and Reid, A., "Foundations In Microbiology", W.C.Brown Publishers	1993
Pelczar, M.J., Chan, E.C.S. and Krein, N.R., "Microbiology", Tata McGraw Publication	1997
Prescott, L.M., Harley, J.P. and Klein, D.A., "Microbiology", W. C. Brown Publications	1996

IK Gujral Punjab Technical University
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MSBT 103 Genetics and Molecular Biology

Unit- I

Mendelian Principles: Dominance, allele, complementation tests, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, Extra-chromosomal inheritance. Gene mapping methods: Linkage maps, tetrad analysis, mapping genes by interrupted mating, fine structure analysis of genes. Recombination. Mutation: Types, causes and detection, germinal verses somatic mutants, insertional mutagenesis.

Unit -II

Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications. Human genetics: Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders. Developmental Genetics: Genes in early development, maternal effect genes, Pattern formation genes, Homeotic genes. Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTL mapping.

Unit-III

Chromosome organization, chromatin structure, complexity of eukaryotic chromosome, cot curve. DNA replication in prokaryote and eukaryotes, enzymes and accessory proteins, telomere replication.

Unit -IV

Transcription process in prokaryote and eukaryotie, Types of RNAs, transcriptional factors, regulation of transcription; RNA processing and RNPs- spliceosome, splicing of mRNA, tRNA and rRNA; Nuclear export and stability of mRNA., regulation of gene regulation Translation Process- genetic code, translation mechanism of prokaryotes and eukaryotes, translational control, post translation modification.

Suggested Books:

Author(s)/ Title/ Publisher	Year of Publication/Reprint
Alberts, B, Johnson, A., Laws, J., Raff, M., Robert, K. and Walter, P., "Molecular Biology of the cell" 4th edition, Garaland Publishing.	2002
Watson, J.D., Baker, T. A., Bell, S. P., Gann, A., Levine, N. and Lovisk, R., "Molecular Biology of the gene "5th Edition, Pearson Education.	2004
Lewis, B. "Gene VI" 8th edition. John Wiley and sons	2006
Gardner, Simmons and Snustad; Principles of Genetics, 8th Edition. John Wiley & Sons	2012
Griffith, Wessler, Lewontin and Carroll; Introduction to Genetic analysis; 9th Edition. Freeman, W. H. & Company	2007

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MBT104 Biotechnology Laboratory -I

(Any 08 practical to be performed)

S. No.	List of Experiments:
1.	To determine the absorption maxima of two dyes using spectrophotometer. Demonstration of the Beer's law.
2.	To prepare the standard curve for protein estimation and to determine protein concentration by Biuret assay and Bradford method.
3.	Determination of Ascorbic acid concentration in citrus using 2, 6 dichlorophenol Indophenol.
4.	To detect Cholesterol in the given unknown sample by TLC.
5.	Ion-Exchange chromatography, gel filtration chromatography, affinity chromatography.
6.	Study of Enzyme kinetics.
7.	SDS-PAGE for protein separation.
8.	To understand the basic concept of cloning and perform few steps using GFP cloning.
9.	Electrophoretic separation of DNA in agarose gel.
10.	Isolation of RNA from animal tissues.
11.	The estimation of DNA by diphenyl amine.
12.	The estimation of RNA by means of orcinol reaction.
13.	Basic concept of southern blotting
14.	Media Preparation and Sterilization
15.	Study of Microbial Interactions through models
16	Antibiotic Sensitivity test of bacteria

Suggested Books:

Author(s)/ Title/ Publisher	Year of Publication/Reprint
Joshi R A., and Saraswat M., "A text book of Practical Biochemistry".	2002
Wilson, K. and Walker, J., "Principles and Techniques of Practical Biochemistry" 5th edition, Cambridge University Press.	2000
Holtzhawer, Mertin, "Basic Method for the Biochemical Lab" (Springer lab manual).	2006
Singh S.P., "Practical Manual of Biochemistry" 6 edition, CBS Publisher & Distributer.	2009
Plummer, D. T., "An Introduction to Practical Biochemistry". 3rd Edition, Tata McGraw- Hill.	2006
Sambrook,J., Russel, D.,"Molecular Cloninga Lab Manual" Vol. 3, 3rd Edition, Cold spring harber lab press.	2001

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MBT 105 Computer Applications

(To be taught in the classroom equipped with computers and internet)

Unit -I Introduction to computers and system software concept. Binary representation of data.

Unit -II Programming fundamentals of C++, control structures, operators, arrays and strings.

Unit -III Object Oriented Programming: classes, function, overloading, inheritance, containership. Function/ operator overloading and concepts of generic programming

Unit -IV Elementary word processing, spreadsheets and database concepts.

Suggested Books:

Author(s)/ Title/ Publisher	Year of Publication/ Reprint
Robert, L., "Object -Oriented Programming in C++", Sams	2002
Douglas, C., Schmidt, Stephen, D. and Huston, "C++ Programming", Cook Book.	2008
Balaguruswamy, "Object -Oriented Programming in C++" Tata McGraw-Hill	2008
Rajaraman, V., " Fundamentals of Computers", PHI Learning	2003

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MBT 111 Environment Biotechnology

Unit -I

Introduction, parameters of pollution monitoring. Waterborne infectious agents, detection and control of pathogenic microbes in water Wastewater treatment methods – Preliminary treatment, clarification, coagulation; aerated laggons; oxidation ponds; trickling filters; rotating biological contractors; wastewater treatment efficiency assessment

Unit -II

Metagenomics and culture based approaches for bioremediation; Phyoremediation; waste treatment of dairy, distillery and pharmaceutical industries.

Unit -III

Biomass as a source of energy; biocomposting; vermiculture; organic farming; bio-mineralization, biofuel. Biodegradation of lignocelluloses, PAH, agricultural chemicals, oil pollution; biosurfactants; microbial leaching,

Unit -IV

Municipal techniques for prevention and biomedical solid wastes and their treatment, innovative techniques for prevention and control of pollution.

Suggested Books:

Author(s)/ Title/ Publisher	Year of Publication/ Reprint
Hurst, C.J., Crawford, R.L., Knudsen, G.R., MacInerney, M.J., Stetzenbach, L.D., "Manual of Environmental Microbiology", ASM press, Washington, DC, Second edition.	2002
Metcalf & Eddy, INC, "Wastewater Engineering- Treatment, Disposal and Reuse, 3rd Edition, Tata MacGraw-Hill publishing company Limited, New Delhi.	1995
Pickup R.W and Saunders J.R., "Molecular approaches to environmental microbiology", Ellis Horwood Limited, First Edition, UK.	1996
Scragg, A," Environmental Biotechnology", First Edition, Pearson Education Limited, UK.	1999
Evans, G.M., Furlong, J C.," Environmental Biotechnology- Theory and application", John Wiley & Sons, Ltd, USA.	2003

IK Gujral Punjab Technical University
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MBT 112 Nanobiotechnology

Unit -I

Overview of Nanobiotechnology - Historical perspective of Integration of biology, chemistry, and material science. Opportunities and Promises of nanobiotechnology. Functional Principles of Nanobiotechnology- Structure and functional properties of Biomaterials, Bimolecular sensing, Molecular recognition and Flexibility of biomaterials.

Unit -II

Protein and DNA based Nanostructures - Protein based nanostructures building blocks and templates – Proteins as transducers and amplifiers of biomolecular recognition events – Nanobioelectronic devices and polymer nanocontainers – Microbial production of inorganic nanoparticles – Magnetosomes. DNA based nanostructures – Topographic and Electrostatic properties of DNA and proteins – Hybrid conjugates of gold nanoparticles – DNA oligomers

Nanomaterials used in Biotechnology -

Unit -III

Nanoparticles, carbon nanotubes, quantum dots and buckyballs interface with biological macromolecules. Biological perspectives of nanomaterials – impact of nanomaterials in biological processes – tolerance by immune systems and toxicity. Nucleic acid Engineering- Modifications of DNA for nano-technological applications. Nanostruture assembly using DNA.

Unit -IV

Nanotechnology in Agriculture and Food technology - Insecticides development using nanotechnology and Nanofertilizers. Nanotechnology in food processing, food safety and biosecurity, toxin and contaminant detection, Smart packaging.

Author(s)/ Title/ Publisher	Year of Publication/Reprint
ChaChalla, S.S.R. Kumar, Josef Hormes, Carola Leuschaer, Nanofabrication Towards Biomedical Applications, Techniques, Tools, Applications and Impactll, Wiley – VCH.	2005
D.S. Goodsell, Bionanotechnology: Lessons from Nature, Wiley Press	2004
C. M. Niemeyer and C. A. Mirkin- (Editor), Nanobiotechnology: Concepts, Applications and Perspectives, Wiley Press	2004
Jennifer Kuzma and Peter VerHage, Nanotechnology in agriculture and food production, Woodrow Wilson International Center	2006
Neelina H. Malsch (Ed.),Biomedical Nanotechnology, CRC Press	2005
Mark A. Ratner and Daniel Ratner,Nanotechnology: A Gentle Introduction to the Next Big Idea, Pearson	2003
S. Klussman, The Aptamer Handbook: Functional Oligonucleotides and their Applications , Wiley- VCH Press	2006

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MBT 113 Viruses and Human Diseases

Unit -I

Introduction to viruses and virus infection, virus classification, the replication cycle of viruses, virus hosts and effect of infection on the host cell, viral epidemiology. Structure of viruses: Enveloped and Non-enveloped viruses, helical and icosahedral symmetry, virus structure determination. Viral multiplication and translation strategies: Transcription, assembly, maturation and release of virions.

Unit -II

Plus-strand RNA virus: Virus entry, replication, assembly, maturation and pathogenesis, origin and evolution, Polio virus, Chikungunya virus, Dengue virus, JEV, HCV, SARS coronavirus Minus-strand RNA virus: Introduction, virus entry and replication, assembly, virus pathogenesis, Mealses virus, Mumps virus, Rabies virus, Influenza viruses, Ebola virus etc

Unit -III

Double stranded RNA virus, reteroviruses and DNA viruses: Virus life cycle, replication and transcription, Rotavirus, HIV and AIDS, HTLV, Small pox virus, Monkey pox virus etc

Virus-host interaction: Immune response to viral infection, Innate and acquired immunity, B-cells, T-cells, virus induced immunopathology and immunosuppression

Unit -IV

Viral pathogenesis: Viral strategy to inhibit eukaryotic translation, cytopathic effect, plaque assay, tropism, virulence, viral replication vs viral disease; Virus vector system and gene therapy. Diagnosis, treatment and vaccination: different types of vaccines, antiviral drug targets and antiviral drug discovery, immuno-therapeutics, resistance to antivirals

Suggested Books:

Author(s)/ Title/ Publisher	Year of Publication/ Reprint
Strauss, E. G. and Strauss, J. H., "Viruses and Human Disease", Academic Press	2007
Flint, S.J., Enquest, L.W., Krug, R. M., Racaniello, V. R., and Skalka, A. M., "Principles of Virology: Molecular Biology, Pathogenesis and Control", ASM Press.	2000
Bernard N. Fields and David Mahan Knipe, "Fundamental Virology", Raven Press	2001
John Carter and Venetia A. Saunders, "Virology: Principles and Applications, 2nd edition, John Wiley & Sons Inc.	2013
Antiviral Drug Discovery for Emerging Diseases and Bioterrorism Threats. Paul F. Torrence (Editor), John Wiley & Sons, Inc.	2005

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MBT 201 Cell and Developmental Biology

Unit -I **12 Hrs**

Structure and function of cells; plasma membrane; molecular organization of cytoskeleton; endoplasmic reticulum- structure, role in glycosylation, lipid biosynthesis, intracellular transport and secretion; Golgi apparatus- organization & role in cell secretion; lysosomes, peroxisomes, glyoxisomes; nucleus-organization of DNA into chromosomes. Chromosome structure and functions; chromosome organization; chromatin structure, complexity of eukaryotic chromosome, cot curve.

Unit -II **12 Hrs**

Cellular fates; signal transduction; malignant growth; cell differentiation; programmed cell death; aging and senescence. Basic concepts of development; potency; commitment; specification; induction; competence; determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells.

Unit -III **12 Hrs**

Production of gametes, cell surface molecules in sperm-egg recognition in animals; embryo sac development and double fertilization in plants; zygote formation; cleavage; blastula formation; embryonic fields; gastrulation and formation of germ layers in animals; embryogenesis; establishment of symmetry in plants; seed formation and germination.

Unit -IV **12 Hrs**

Cell aggregation and pattern formation in *Drosophila*; amphibia and chick; organogenesis – vulva formation in *Caenorhabditis elegans*; eye lens induction; limb development and regeneration in vertebrates; organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy

Suggested Books:

S. No.	Author(s)/ Title/ Publisher	Year of Publication/Reprint
1.	Alberts, B , Johnson, A., Laws, J., Raff, M., Robert, K. and Walter, P., " Molecular Biology of the cell" 5th edition, Garaland Publishing.	2007

2.	Watson, J.D., Baker, T. A., Bell, S. P., Gann, A., Levine, N. and Lovisk, R., "Molecular Biology of the gene "5th Edition, Pearson Education.	2004
3.	Gilbert, S. F., "Developmental Biology" 10th Edition, Sinauer Associates, Inc. USA	2013
4.	Wolpert, L., Tickle C., "Principles of Development" 4th Edition, Oxford University Press, UK	2010

IK Gujral Punjab Technical University
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MBT 202 Immunology and Immunotechnology

Unit -I **12 Hrs**

General principles of immune system, cells and tissues of the immune system, blast formation, differentiation into effector and memory cells, phagocytes and lymphoid tissues. Molecular structure of antibodies, antibody diversity; types and functions of antibodies, antigen antibody interaction, B-cell maturation, rearrangement of immunoglobulin genes, expression of different classes of immunoglobulins, class switching.

Unit -II **12 Hrs**

Discovery and structure of MHC, genomic organization and regulation of MHC expression, antigen processing and presentation to T cells, MHC restricted CD4 and CD8 T cells physiological significance, receptors and co-receptors involved in T cell. Cytokines-characteristics, receptors, cytokine related diseases and therapies; immunological tolerance and auto immunity, organ specific and systemic auto immune diseases

Unit -III **12 Hrs**

Transplantation- immunologic basis of graft rejection, clinical manifestations, immunosuppressive therapy; Cancer and immune system-oncogenes and cancer induction, tumor antiges, tumor evasion of immune system, cancer immunotherapy

Unit -IV **12 Hrs**

Production and purification of antibodies, hybridomas, isolation and fractionation of lymphocytes, precipitation techniques, immunoelectrophoresis, radiommunoassay, enzyme linked assays, immunocytochemistry, immunohistochemistry and immunodiagnostics.

Suggested Books:

S. No.	Author(s)/ Title/ Publisher	Year of Publication/Reprint
1.	Hildeman, W.H., “Essentials of immunology”, Elsevier Scientific.	2002
2.	Abbas, A.K., Litchman, A.H. and Pobes, J,S,, WB “Cellular and Molecular Immunology”, Saunders Co.	2000

3.	Sites, D.P., Stobo, J.D. and Wells, J.U., "Basic and clinical immunology", Prentice Hall.	1982
4.	Kindt, T.J., Goldsby, R.A., and Osborne, B.A., " Kuby Immunology", W.H. Freeman.	2007
5.	Roitt, I.M, Brostoff, J. and Male, D.K., "Immunology " Gower Medical Publishing.	1996

IK Gujral Punjab Technical University
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MBT 203 Enzyme Technology

Unit -I

Introduction and classification; Structure of enzymes- active site structure determination, identification of binding and catalytic sites, trapping of enzyme substrate complex. Extraction, purification, assay and analysis of enzymes

Unit -II

Catalysis and kinetics, factors affecting rates of reaction; Kinetics of single substrate enzyme catalysed reactions, Michaelis-Menton equation, Briggs- Haldane modification, Lineweaver- Burk plot, Kinetics of multisubstrate enzyme catalysed reactions, ping-pong, random order and compulsory order mechanisms; Enzyme inhibition – competitive, uncompetitive and non-competitive inhibition, substrate inhibition, allosteric and irreversible inhibition.

Unit -III

Investigation of reaction mechanisms- steady and non-steady state methods; Monomeric enzymes- serine proteases, oligomeric enzymes, lactate dehydrogenase and lactose synthase; Mechanism of enzyme catalysis: metals and coenzymes. Binding of ligands to proteins, cooperativity, allosteric enzymes and metabolic regulation, sub-cellular compartmentalization.

Unit -IV

Clinical aspects of enzymes, plasma enzymes, inborn errors of metabolism, enzymes as reagents, large scale production and purification of enzymes; Immobilized enzymes- preparation and application; Application of enzymes and enzymes technology.

Suggested Books:

S. No.	Author(s)/ Title/ Publisher	Year of Publication/Reprint
1.	Chaplin, M.F. and Bucke, C., “Enzyme technology,” Cambridge University Press.	1992
2.	Palmer, T., “Understanding Enzymes”, Prentice Hall.	1985
3.	Boyer, P.D., “The Enzymes V” , Academic Press	1992
4.	Buchholz, K., Kasche, V. and Bornscheuer, U. T.,	2005

	"Biocatalysts and Enzyme Technology", Wiley-VCH.	
5.	Shanmugam, S., **"**Enzyme Technology**",** I. K. International.	2009

IK Gujral Punjab Technical University
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MBT 204 Biotechnology Laboratory -II

S. No.	List of Experiments
1.	Preparation and sterilization of culture media.
2.	Isolation of bacteria from different sources (soil, water, air).
3.	Characterization of the isolated bacteria obtained from different source samples.
4.	Identification of isolated bacterial calories using microscopic & staining techniques.
5.	To plot a growth curve of isolated bacterial strain.
6.	To carry out bacterial transformation conjugation and transduction using gene transfer methods.
7.	To prepare a survival curve for the given bacterial culture using germicidal UV radiation as a mutagen.
8.	To carry out Ame's test for detection of a possible chemical carcinogen.

Suggested Books:

S. No.	Author(s)/ Title/ Publisher	Year of Publication/Reprint
1.	William, M., O'Leary, "Practical handbook of microbiology", CRC Press.	1989
2.	Albert, B., John H. H., "Practical bacteriology, microbiology and serum therapy (medical and veterinary)", Green.	1913
3.	Roy, D. and Cullimore, "Practical manual of groundwater microbiology:, CRC Press.	2008
4.	Goldman E., Lorrence, H. "Greenpractical handbook of microbiology", CRC Press.	2008

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MBT 205 Bioprocess Engineering

Unit -I

Basic principle of Biochemical engineering: Isolation, screening and maintenance of industrially important microbes; Microbial growth and death kinetics (an example from each group, particularly with reference to industrially useful microorganisms); Strain improvement for increased yield and other desirable characteristics.

Unit -II

Concept of basic mode of fermentation processes: Bioreactor designs; Types of fermentation and fermenters; Concepts of basic modes of fermentation – Batch, fed batch ad continuous; Conventional fermentation v/s biotransformation; Solid substrate, surface and submerged fermentation; Fermentation economics; Fermentation media; Fermenter design- mechanically agitated; Pneumatic and hydrodynamic fermenters; Large scale animal and plant cell cultivation and air sterilization; Upstream processing: Media formulation; Sterilization; Aeration and agitation in bioprocess; Measurement and control of bioprocess parameters; scale up and scale down process.

Unit -III

Downstream processing: Bioseparation – Filtration, Centrifugation, Sedimentation, Flocculation; Cell disruption; Liquid-liquid extraction; Purification by chromatographic techniques; Reverse osmosis and ultra filtration; Drying; Crystallization; Storage and packaging; Treatment of effluent and its disposal.

Unit -IV

Application of Microbes in food process operations and production: Fermented foods and beverage; Food ingredients and additives prepared by fermentation and their purification; fermentation as a method of preparing and preserving foods; Microbes and their use in pickling, producing colours and flavour, alcoholic beverages and other products; Process wastes-whey, molasses, starch substrates and other food wastes for bioconversion to useful products; Bacteriocins from lactic acid bacteria – Production and application in food preservation.

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Suggested Books :

S.No.	Author(s)/ Title/ Publisher	Year of Publication/
1	Stanbury, P.F., Hall, S. and Whitaker A., "Principles of Fermentation Technology" Second Edition Macmillian	**2009**
2	Doran, P.M., "Bioprocess engineering Principles" 2nd Edition Academic press	**2012**
3	Shuler, M.L., and Kargi, F. Bioprocess engineering:Basic concepts 2nd Edition, Prentice Hall	**2001**

IK Gujral Punjab Technical University
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MBT 211 Plant Tissue Culture

Unit -I

Elements of plant tissue culture, micropropagation of disease free plants, protoplast isolation, culture and fusion, genetic transformation, transgenic plants.

Unit -II

Somoclonal variation and its applications, anther and microspore cultures, chromosome elimination in wild crosses, diploid plants.

Unit -III

Tissue culture technique for plant improvement, cryopreservation of germplasm. *in vitro* production of secondary metabolites and biotransformation.

Unit -IV

Plant Growth regulators: Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action.

Suggested Books:

S. No.	Author(s)/ Title/ Publisher	Year of Publication
1.	Gupta, P. K., "Plant Biotechnology", Rastogi Publication.	2004
2.	Chawla, H. S., "Introduction to Plant Biotechnology" 2nd Edn, Science Publishers Inc.	2002
3.	Razdan, M.K., "Introduction to Plant Tissue Culture", 2nd End, Science Publishers Inc.	2003

IK Gujral Punjab Technical University
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MBT212 Drug Discovery and Development

Unit -I Target identification

Identification of target or drug leads associated with a particular disease by a number of different techniques including combinations of molecular modeling, combinatorial libraries and high-throughput screening (HTS); Conceptualizing the automation of the HTS process and the importance of bioinformatics and data processing in identification of lead compounds; Rational drug design, based on understanding the three-dimensional 38 structures and physicochemical properties of drugs and receptors;

Unit -II Lead optimization

Identification of relevant groups on a molecule that interact with a receptor and are responsible for biological activity; Understanding structure activity relationship; Structure modification to increase potency and therapeutic index; Concept of quantitative drug design using Quantitative structure–activity relationship models (QSAR models) based on the fact that the biological properties of a compound are a function of its physicochemical parameters such as solubility, lipophilicity, electronic effects, ionization, stereochemistry, etc.

Unit -III Preclinical development

Principles of drug absorption, drug metabolism and distribution - intestinal absorption, metabolic stability, drug-drug interactions, plasma protein binding assays, metabolite profile studies, Principles of toxicology, Experimental design for preclinical and clinical PK/PD/TK studies, Selection of animal model; Regulatory guidelines for preclinical PK/ PD/TK studies; Scope of GLP, SOP for conduct of clinical & non clinical testing, control on animal house, report preparation and documentation Integration of non-clinical and preclinical data to aid design of clinical studies.

Unit -IV Drug manufacturing

Requirements of GMP implementation, Documentation of GMP practices, CoA, Regulatory certification of GMP, Quality control and Quality assurance, concept and philosophy of TQM, ICH and ISO 9000; ICH guidelines for Manufacturing, Understanding Impurity Qualification Data, Stability Studies.

Recommended Textbooks and References:

1. Krogsgaard-Larsen et al. Textbook of Drug Design and Discovery. 4th Edition. CRC Press.
2. Kuhse, H. (2010). Bioethics: an Anthology. Malden, MA: Blackwell.
3. Nally, J. D. (2006) GMP for Pharmaceuticals. 6th edition. CRC Press
4. Brody, T. (2016) Clinical Trials: Study Design, Endpoints and Biomarkers, Drug Safety, and FDA and ICH Guidelines. Academic Press.

IK Gujral Punjab Technical University
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MBT 213 Molecular Carcinogenesis and Therapy

Unit -I

Introduction to carcinogenesis, origin of cell line, normal and transformed cell lines, growth requirements, cell cycle, mutation in proliferating cells. Growth factors, regulation of cell proliferation PDGF, IGF & EGF receptor interaction, secondary message, erythropoietin, TCGF

Unit -II

Characteristic feature of cancer cells, loss of normal cellular affinities, cytoskeletal changes, differential expression of genes, factor affecting carcinogenesis, chemical carcinogens, tumor promoters, viruses, DNA & RNA tumor viruses.

Unit -III

Role of large T antigen, oncogen carrying retro viruses, molecular features of oncogenes, human cancer genes: H-ras, K-ras and N-ras genes, chromosomal abnormalities in human tumors: abl and myc protooncogene, retinoblastoma gene 1. Human cancer viruses- EB virus, Hepatitis B virus, HTLV, Papiloma virus, Cervical carcinoma.

Unit -IV

Primary screening of anti tumor compounds, chemo therapy of Hodgkin's disease, lymphosarcoma & bronchiogenic carcinoma, cancer gene therapy and vaccines, future prospects.

Suggested Books:

S. No.	Author(s)/ Title/ Publisher	Year of Publication/ Reprint
1.	Ross, D.W., " Introduction to Oncogenes and Molecular Cancer Medicine" Springer-Verlag.	1998
2.	Franks, L. M. Teich, N.M., "Introduction to Cellular and Molecular Biology of Cancer", Oxford University Press.	1997
3.	Larionow, L. "Cancer Chemotherapy", Pergamon Press.	2003
4.	Rosenberg, S.A., "Principles and Practice of the Biologic Therapy of Cnacer" Lippincott Williams & Williams	2000

Third Semester

IK Gujral Punjab Technical University
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MBT301 Genetic Engineering

Unit -I

Introduction and historical background Restriction enzymes; Other enzymes used in DNA manipulation; Cohesive and blunt end ligation, Linkers, Adaptors, Homopolymeric tailing; Preparation of DNA and RNA probes; Hybridization techniques: Southern, Northern and colony hybridization; Fluorescence in situ hybridization; Chromatin Immunoprecipitation; DNA protein interaction-Electromobility shift assay; DNaseI footprinting; Methyl interference assay

Unit II

Plasmid and bacteriophage vectors: pUC19 and bluescript vectors, lambda vectors, M13mp vectors, insertion and replacement vectors, phagemids; Cosmids; Artificial chromosome vectors: Animal virus-derived vectors: SV40, vaccinia/baculo and retroviral vectors; Expression vectors; Protein purification: His-tag, GST-tag, MBP-tag, etc.; Intein-based vectors; Inclusion bodies: Methodologies to reduce formation of inclusion bodies; Baculovirus and Pichia vector systems; Plant-based vectors: Ti and Ri vectors; Yeast vectors; Shuttle vectors

Unit III

Introduction of foreign DNA into host cells; Construction of libraries; Isolation of mRNA and total RNA; cDNA and genomic libraries; cDNA and genomic cloning; Expression cloning; Jumping and hopping libraries; Southwestern and Far-western cloning; Protein-protein interactive cloning; Yeast two hybrid system; Phage display; Principles in maximizing gene expression

Unit IV

Polymerase chain reaction (PCR); Primer design; Thermostable DNA polymerases; Types of PCR: Multiplex, nested, reverse transcriptase, real time, touchdown, hot start, colony PCR, etc.; Cloning of PCR products; T-vectors; Proof reading enzymes; Applications of PCR Sequencing methods; Enzymatic DNA sequencing; Chemical sequencing of DNA; Automated DNA sequencing; RNA sequencing: Chemical synthesis of oligonucleotides; Introduction of DNA into mammalian cells; Transfection techniques; Gene silencing techniques; Introduction of siRNA; siRNA technology; MicroRNA; Construction of siRNA vectors; Principle and applications of gene silencing; Gene knockouts; Gene therapy; Gene targeting; Transgenics; Possible risks and safety aspects of genetic engineering.

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Suggested Readings / Books

S. No.	Author(s)/ Title/ Publisher	Year of Publication/Reprint
1.	Sambrook, J., Fritsch, E.F., and Maniatis, T., "Molecular cloning: A laboratory Manual", Cold Spring Harbor Laboratory.	2001
2.	Brown, T.A., "Gene Cloning and DNA Analysis", Blackwell Science.	2001
3.	Winnacker, E.L., "From Genes to Clones: An Introduction to Gene Technology", VCH.	1989
4.	Old, R.W. and Primrose S.B., "Principles of Gene Manipulation", Blackwell Scientific Publication.	1999
5	Gupta, P.K., "Biotechnology and Genomics", Rastogi Publications.	2004

IK Gujral Punjab Technical University
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MBT302 Biostatistics

UNIT I

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 II

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.

UNIT III

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 IV

Design of experiments: Least squares, randomization, replication, completely randomized and randomized block design. Theory of errors, errors and residuals, precision, measure of precision.

Suggested Readings / 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

IK Gujral Punjab Technical University
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MBT 303 Genomics and Proteomics

Unit -I

Genome evolution and organization in prokaryotes and eukaryotes. Genome sequencing, basics, strategies and methodology, databases and sequence comparisons.

Unit II

Comparative genomics, functional genomics, expression sequence tags (ESTs), serial analysis of gene expression (SAGE) and targeting induced local lesions in genome (TILLING). Microarrays technology- Principles and applications, transcriptome analysis and SNPs determination.

Unit III

Proteomics- Introduction, proteomics and proteome, protein databases; Tools of proteomics- Analytical protein and peptide separations, high throughput proteome analysis with 2D-IEF, protein digestion techniques, mass spectrometry.

Unit IV

Peptide sequencing analysis by tandem mass spectrometry data, mass-finger printing, protein–protein interactions. Application of genomics and proteomics- mining genome proteomes, protein expression profiles, mapping protein modifications, new directions.

Suggested Readings / Books

S. No.	Author(s)/ Title/ Publisher	Year of Publication/Reprint
1.	Campbell, A. M. and Heyer, L. J., "Discovering Genomics, Proteomics and Bioinformatics", Benjamin Cummings Publication.	2003
2.	Pevsner, J., "Bioinformatics and Functional Genomics", John Wiley & Sons.	2003
3.	Botwell, D. and Sambrook, J., "DNA Microarrays: Molecular Cloning Manual", Cold Spring Harbor Lab. Press.	2002
4.	Hunt, S. P. and Liversey, F. J., "Functional Genomics: A Practical Approach", Oxford University Press.	2001
5.	Pennington, S. and Dunn, P. J., "Proteomics: From Protein Sequence to Function", Springer Verlag.	2001

IK Gujral Punjab Technical University
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MBT 304 IPR, Good Lab Practices and Bioethics

Unit -I

IPR- Introduction, International laws, creation of IP, IP management, Need for IP: National scenario, TRIPS agreements, Knowledge management databases IPR databases- USPTO, WIPO, patent search, How to carry out patent search, novelty search in various databases, Genetically modified organisms-IPR issues patenting of cell lines , microbes, plant varieties. Patent application and filing.

Unit II

Traditional knowledge: concepts of folklore and traditional knowledge, forms of traditional knowledge. Traditional Knowledge Digital Library (TKDL): its purpose, structure and possible risks

Unit III

Good lab practices: - Introduction, maintenance of lab record notebook, biosafety, level of contamination, safety levels, radiation safety, how to handle chemicals, biochemicals, radioisotopes, toxic chemicals safety measures required.

Unit IV

Bioethics- Introduction, international standards, ethical issues in patenting, publishing, how to decide authorship in publications, Issues arising out of Neem, Haldi and basmati cases, conditions and procedure for registration, offences, penalties

Suggested Readings/ Books

S. No.	Author(s)/ Title/ Publisher	Year of Publication/Reprint
1.	Dutfield Graham, “Intellectual Property, Biogenetic Resources and Traditional Knowledge”, Earthscan Publications Ltd, illustrated edition	2004
2.	Klemm, Cottier T., “Rights to Plant Genetic Resources and Traditional Knowledge: Basic Issues and Perspectives”, Cabi Publishing, 1 ed.	2006
3.	“The Geographical Indications of Goods, (Registration and Protection) Act”	1999
4.	Mgbeoji, Ikechi, “Global Biopiracy: Patents, Plants, And Indigenous Knowledge”, Cornell University Press, 1 ed.	2006

IK Gujral Punjab Technical University
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MBT 305 Biotechnology Laboratory III

S. No.	List of Experiments
1.	To study the expression of cloned gene in E. coli using IPTG inducible promoter and analyze on SDS-PAGE
2.	To perform sandwitch Dot-ELISA for antigen detection.
3.	To perform western blot assay in order to make student understand various steps of western blotting technique.
4.	To perform IEF separation of protein on IPG strips and analysis using PD Quest software.
5.	To perform the southern blotting and hybridization experiment in order to make student understand various steps of southern blotting technique.
6.	DNA fingerprinting experiments and its analysis.
7.	Preparation of competent cells and determination of transformation efficiency using plasmid DNA (PUC19)
8.	Crystallization of Proteins by hanging and sitting drop method
9.	X-ray diffraction studies of macromolecules
10.	PCR of DNA and RFLP analysis
11.	Transformation by calcium chloride method
12.	Isolation and production of Industrially important enzymes (Amylase, protease, cellulase and lipase)

Suggested Readings / Books

S. No.	Author(s)/Title/Publisher	Year of Publication/Reprint
1.	Sambrook,J., Russel, D.,"Molecular Cloninga Lab Manual" Vol. I, II and III, 3rd Edition, Cold spring harber lab press.	2001
2.	Walker, J.M. and Rapley, R. "Molecular Biology and Bio Technology" 4th Edition, Panima Publishing Corporation.	2002
3.	Messerschmidt, A. " X-ray Crystallography of Biomacromolecules: A Practical Guide". Wiley-VCH Verlag.	2007
4.	Roberts, G.C.K.,"NMR of Macromolecules : A Practical Approach". Oxford University Press.	2002

IK Gujral Punjab Technical University
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MBT 311 Animal Tissue Culture

Unit I

Introduction to basic principles of animal cell culture, laboratory requirements for setting up cell/tissue culture facility, sterility of cell culture facility.

Unit II

Techniques of cell culture – batch, batch fed and continuous cultures, design of media, cytotoxicity and viability assays, cell separation techniques, flow cytometry and fluorescence associated cell sorting, role of enzymes / isozymes in culture.

Unit III

Characterization of cell lines, cryo-preservation and cell banking, primary, secondary cultures and scale up operations.

Unit IV

In situ hybridization, hybridoma technology, industrial products of animal cell culture.

Suggested Readings/ Books

S. No.	Author(s)/ Title/ Publisher	Year of Publication/Reprint
1.	Freshney, R.I., “Animal Cell Culture – A Practical Approach”, 4th Edn, Wiley-Liss.	2000
2.	Mukhopadhyay, A., “Animal Cell Technology”, 1st Edn, I.K. International Publishing House.	2009

IK Gujral Punjab Technical University
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MBT 312 Food Biotechnology

Unit I

Biotechnology and food ingredients – biogums, fats, oils, fatty acids and oilseed crops, fat substitutes, citric, fumaric and malic acids, bioflavours and biocolors. Biosensors-principle, types and applications in food processing.

Unit II

Protein engineering in food technology– methods, objectives, limitations and applications of protein engineering (glucoseisomerase, lactobacillus β-galactosidase and peptide antibiotic nisin).

Unit III

Nutraceutical: Historical perspective; Definition, nature, nutraceutical compounds and their classification based on chemical/biochemical nature with suitable and relevant descriptions; scope and future prospects.

Functional food overview; Definition, classification; functional food, functional food science, food technology and its impact on functional food development; markers for development of functional foods.

Unit IV

Introduction to gene-diet interactions

Nutrigenomics: Scope and Importance to Human Health and Industry. Transporter gene polymorphisms -interaction with effects of micronutrients in humans. Nutrigenomics approaches to unraveling physiological effects of complex foods.

Suggested Readings/Books

S. No.	Author(s)/ Title/ Publisher	Year of Publication/Reprint
1.	Gutierrez, G. F. & Barbosa-Canovas, G. V. Food Science and Food Biotechnology: CRC Press, Boca raton.	2003
2.	Robert E.C. Wildman; Handbook of Nutraceuticals and Functional Foods, Second Edition; CRC Press	2009
3.	Nutrigenomics and Nutrigenetics in Functional Foods and Personalized Nutrition	2012

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MBT 313 Clinical Research

Unit I

Introduction to Clinical Research, Terminologies and definition in Clinical Research, Origin and History of Clinical Research, Difference between Clinical Research and Clinical Practice

Unit II

Types of Clinical Research, Phases of clinical research, Clinical Trials in India –The National Perspective

Unit III

Post marketing surveillance, Pharmaceutical Industry – Global and Indian Perspective, Clinical Trial market, Career in Clinical Research

Unit IV

International Conference on Harmonization (ICH), Brief history of ICH, Structure of ICH, ICH Harmonization Process, Guidelines for Good Clinical Practice, The Principles of ICH GCP, Institutional Review Board / Independent Ethics Committee, Clinical Trial Protocol and Protocol Amendment(S), Investigator's Brochure, Essential Documents for the conduct of a Clinical Trial

Suggested Readings/Books

S. No.	Author(s)/ Title/ Publisher
1.	D Wang and A Bakhai, Clinical Trials A Practical Guide to Design, Analysis, and Reporting, Remedica.
2.	SK Gupta, Drug Discovery and Clinical Research, Jaypee Brothers, Medical Publishers Pvt. Ltd.
3.	Guidelines: Drugs and Cosmetics Act, EMA, ANVISA www.tga.gov.au/tga-basics www.ich.org www.fda.gov Central Drugs Standard Control Organization: www.cdsco.gov.in