Needs: Local : Pink, National : Orange, Regional: light blue, International : green

Colour Coding
Global GREEN
Regional BLUE
National ORANGE
Local (State) PINK

Annexure-1

SYLLABUS OF THE COURSE

M. Sc. Medical Biotechnology 1st Year

Semester I

MBT-101: Biochemistry

1. Carbohydrates: Classification, characteristics and functions carbohydrates; Structure and properties of mono, oligo and polysaccharides; Complex carbohydrates: Types, structure and general function; Chemistry of amino sugars, blood sugar compounds, sugar nucleotides.
2. Fatty acids: General formula, nomenclature and chemical properties; Lipid classification: simple, complex; General structure and functions of major lipid subclasses - acyl glycerols, phosphoglycerides, sphingolipids, waxes, terpenes, steroids and prostaglandins & free fatty acids; Circulating lipids - chylomicrons. LDL, HDL and VLDL
3. Vitamins: Structure, properties, deficiency, symptoms and functions including biochemical reactions.
4. Amino acids: Chemical structure and general properties; Protein classification, size, shape, sequence of proteins; Primary, secondary, tertiary and quaternary structure of proteins
5. Nucleic Acids: Structure of purines, pyrimidines, nucleosides and nucleotides; Physical & biochemical properties of DNA; Types of DNA: A, B and Z DNA, their structure and significance; Primary, secondary, and tertiary structures of RNA
6. Carbohydrate Metabolism: Glycolysis, Tricarboxylic acid cycle, Gluconeogenesis, Glycogenolysis, glycogen synthesis and their regulation.
7. Lipid Metabolism: fatty acid oxidation, beta - oxidation of saturated fatty acids, oxidation of unsaturated and odd carbon fatty acids, regulation of fatty Acid oxidation, alpha & omega oxidation of fatty acids, ketogenesis, biosynthesis of saturated fatty acids, elongation and desaturation of fatty acids, biosynthesis of triacylglycerols.
8. Protein Metabolism: Essential & nonessential amino acids, degradation & biosynthesis of amino acids, urea cycle: reactions, regulation and its linkage with the citric acid cycle, nitrogen cycle, regulation of amino acid bio synthesis.
9. Nucleic Acid Metabolism: De-novo biosynthesis of purine and pyrimidines, regulation of purine & pyrimidine biosynthesis, salvage pathway, formation of deoxyribonucleotides, catabolism of purines & pyrimidines.

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10. Enzymes: Classification and nomenclature of enzymes, Mechanism of enzyme action, Lock and key and induced fit hypothesis, factors influencing Enzyme activity, Expression of enzyme activity, unit of activity, measurement of activity, Specific activity. Kinetics of enzyme, Km value determination – methods.

Recommended Readings:

- Biochemistry by D. Voet and J.G. Voet, John Wiley & Sons, USA
- Biochemistry by L. Stryer, W.H. Freeman and Company, New York
- Lehninger Principles of Biochemistry by D.L. Nelson and M.M. Cox, Macmillan worth Publisher, New York, USA.

MBT-102: Genetics & Immunology

1. Mendelian Genetics: Types of genetic diseases; Role of genetics in medicine; Human pedigrees; Patterns of single gene inheritance - autosomal recessive; autosomal dominant; X linked inheritance; Multiple alleles; Co dominance; Sex influenced expression; Hemoglobinopathies - Genetic disorders of hemoglobin and their diseases.

2. Non-Mendelian Inheritance: Mitochondrial inheritance; genomic imprinting; Lyon hypothesis; isodisomy. Complex inheritance – genetic and environmental variation; Heritability; Twin studies; Behavioral traits; Analysis of quantitative and qualitative traits

3. Cytogenetics: Structural and numerical chromosomal abnormalities – deletion; duplication; translocation; Sex determination; Role of the Y chromosome; Genetic recombination; Disorders of sex chromosomes and autosomes; Molecular cytogenetics

4. Developmental Genetics: Genes in early development; Maternal effect genes; Pattern formation genes; Homeotic genes; and Signaling and adhesion molecules. Single gene disorders of immune system

5. Population Genetics and Evolution: Phenotype; genotype; gene frequency; Hardy-Weinberg law; Factors distinguishing Hardy-Weinberg equilibrium; Mutation selection; Migration; Gene flow; Genetic drift. Human genetic diversity.

6. Human Immune System: Cells and organs of immune system- lymphocytes, null cells, mononuclear cells, granulocytes, dendritic cells, primary lymphoid and secondary lymphoid organs, and lymphatic system. Types of immunity- Innate, Acquired, Passive and Active. Factors affecting Immune System.

Antigens and Antibodies: Immunogenicity and antigenicity. Factors affecting immunogenicity. Antigenic epitopes, adjuvants, haptens, super antigens. Antibodies basic structure, Immunoglobulin domains, antigenic determinant on immunoglobulin isotype, allotype, idiotype. Immunoglobulin classes and sub classes. Antigen-antibody

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interactions: Affinity and avidity, cross-reactivity, precipitation, agglutination and agglutination inhibition reactions.

8. MHC: structure and organization- immune response, disease susceptibility, T-cell and B-cell receptors. Antigen processing and presentation. Effector responses- Humoral and Cell- mediated response. NK cell mediated cytotoxicity, Antibody dependent cell mediated cytotoxicity, macrophage mediated cytotoxicity. Regulation of immune response. Activation of B and T lymphocytes.

9. Hypersensitivity: types diagnosis and treatment approaches, Autoimmunity and Autoimmune diseases – Organ specific: thyroid and Systemic: SLE Diagnosis and treatment approaches.

10. Clinical Immunology: Immunity to Bacteria, viral, fungal and parasitic infections (with examples from each group); Hypersensitivity – Type I-IV; Autoimmunity; Types of autoimmune diseases; Mechanism and role of CD4+ T cells; MHC and TCR in autoimmunity; Treatment of autoimmune diseases; Transplantation – Immunological basis of graft rejection; Clinical transplantation and immunosuppressive therapy; Tumor immunology – Tumor antigens; Immune response to tumors and tumor evasion of the immune system, Cancer immunotherapy; Immunodeficiency-Primary immunodeficiencies, Acquired or secondary immunodeficiencies..

11. Vaccinology: Active and passive immunization; Live, killed, attenuated, subunit vaccines; Vaccine technology. Role and properties of adjuvants, recombinant DNA and protein-based vaccines, plant-based vaccines, reverse vaccinology; Peptide vaccines, conjugate vaccines; Antibody genes and antibody engineering- chimeric and hybrid monoclonal antibodies; Catalytic antibodies and generation of immunoglobulin gene libraries.

Recommended Readings:

- Strachan T and Read A P, Human molecular genetics, 3rd Edition Wiley Bios
- Mange E J and Mange A. P., Human genetics, 2nd Edition, Sinauer Associates publications
- Kuby- Immunology (Freeman)
- Fundamentals of Immunology – William Paul
- Immunology – Roitt and others

MBT-103: Molecular Biology

1. DNA Structure; Replication; Repair & Recombination; Replication initiation, elongation and termination in prokaryotes and eukaryotes; Enzymes and accessory proteins; Fidelity; Replication of single stranded circular DNA; Gene stability and DNA repair- enzymes; Photoreactivation; Nucleotide excision repair; Mismatch correction; SOS repair; Recombination: Homologous and non-homologous; Site specific recombination; Chi sequences in prokaryotes.

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2. Prokaryotic & Eukaryotic Transcription Prokaryotic Transcription; Transcription unit; Promoters- Constitutive and Inducible; Operators; Regulatory elements; Initiation; Attenuation; Termination-Rho-dependent and independent; Anti-termination; Transcriptional regulation-Positive and negative; Operon concept-lac, trp, ara, his, and gal operons; Transcript processing; Processing of tRNA and rRNA Eucaryotic transcription and regulation; RNA polymerase structure and assembly; RNA polymerasel, II, III; Eukaryotic promoters and enhancers; General Transcription factors; TATA binding proteins(TBP) and TBP associated factors (TAF); Activators and repressors.

3. Post Transcriptional Modifications Processing of hnRNA, tRNA, rRNA; 5'-Cap formation; 3'-end processing and polyadenylation; Splicing;RNA editing; Nuclear export of mRNA; mRNA stability; Catalytic RNA.

4. Translation & Transport Translation machinery; Ribosomes; Composition and assembly; Universal genetic code; Degeneracy of codons;Termination codons; Isoaccepting tRNA; Wobble hypothesis; Mechanism of initiation, elongation andtermination; Co- and post-translational modifications; Genetic code in mitochondria.

5. Introduction to epigenetics; types of epigenetic modifications, techniques in epigenetics; role of epigenetics in development and disease. factors influencing epigenetic mechanisms.

6. Mutations; Oncogenes and Tumor suppressor genes: Types of mutations, molecular mechanism of mutations. Nonsense, missense and point mutations; Intragenic and Intergenic suppression; Frameshift mutations; Physical, chemical and biological mutagens; Viral and cellular oncogenes; Tumor suppressor genes from humans; Structure, function and mechanism of action of pRB and p53 tumor suppressor proteins; Activation of oncogenes and dominant negative effect; Suppression of tumor suppressor genes; Oncogenes as transcriptional activators.

Recommended Readings:

- Benjamin Lewin, Gene IX, 9th Edition, Jones and Barlett Publishers.
- J.D. Watson, N.H. Hopkins, J.W Roberts, J. A. Seitz & A.M. Weiner; Molecular Biology of the Gene, 6th Edition, Benjamin Cummings Publishing Company Inc.
- Alberts et al; Molecular Biology of the Cell, 4th edition, Garland.

MBT-104: Basic Human Biology

1. Human Embryology and Development: Human Reproductive Cycle, Pregnancy, Implantation, Placenta, Embryonic Developmental Stages, Germ Layers, Somitogenesis, Neuralation, Birth, Common Developmental Anomalies

2. Blood and Lymph: Composition and functions of blood including their disorders. Blood grouping and its significance, mechanism of coagulation, bleeding and

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clotting disorders. Formation of lymph and its composition. Reticule-endothelial system and its functions.

3. Cardiovascular system: Anatomy and physiology of heart, blood circulation - systemic, hepatic, pulmonary, fetal and circle of Willis, cardiac cycle, heart rate, blood pressure and its regulation, ECG and heart sounds.

4. Digestive system: Gross anatomy of the Gastrointestinal system and its physiology with special reference to liver, pancreas and stomach. Digestion, absorption, movements of intestine.

5. Respiratory system: Anatomy of respiratory tract, mechanism of respiration, lung volumes, transport of oxygen and carbon dioxide.

6. Urinary system: Structure and functions of kidney and urinary tract. Physiology of urine formation and acid-base balance.

7. Endocrine system: Basic anatomy and physiology of pituitary, thyroid, parathyroid, adrenal and pancreatic hormones and disorders of these glands.

8. Central nervous system: Structure and functions of brain and spinal cord. Functions of cerebrum, cerebellum, vital centers of medulla oblongata, cerebral ventricles, cranial nerves and their functions. Reflex arc, cerebrospinal fluid and its functions, meninges.

Recommended Readings:

- R.M.H Mcminn et al: Concise Handbook of Human Anatomy, Book Power.
- Orban's Oral Histology & Embryology - S.N.Bhaskar
- Human Physiology by C.C. Chatterjee.
- Samson Wright's Applied Physiology by Cyril A. Keek, Eric Neil and Norman
- Development Biology, Gilbert S.F. (Sinauer Associates, USA)
- Principles of Development, Wolpert L and Tickle C, Publisher: Oxford University

MMBT-105- Practical on Biochemistry& Molecular Biology

The practical would be caried out as designed by the subject teachers

MMBT-106- Student Seminar /Assignments

Presentation and Assignments on topic relevant to semester III course content by student

Colour Coding

Global	GREEN
Regional	BLUE
National	ORANGE
Local (State)	PINK

SEMESTER II

MBT-201: Cell & Stem Cell Biology

1. Cells: Basic structure and function of cells, diversity of cell size, shape, number, and internal organization. Prokaryotic cells and eukaryotic cells- structure and organization.
2. Structure and functions of Cellular organelles: plasma membrane, mitochondria, endoplasmic reticulum, chromosomes, nucleus, Golgi apparatus, lysosomes, microbodies, peroxisomes. Cytoskeleton. Cell motility- cilia and flagella– organization and functions.
3. Cellular Transport: Transport of nutrients, ions and macromolecules across across biomembranes, facilitated transport, group translocation, active transport. Transport of molecules into and out of the nucleus, transport of proteins into mitochondria and chloroplasts, transport from the ER through golgi apparatus to lysosomes.
4. Cell-Cell Interactions and signaling: General principles of cell-to-cell communication, cell adhesion and role of different adhesion molecules, extracellular matrix. Signaling via G- Protein- linked cell surface receptors and via enzyme- linked cell surface receptors, two components signaling.
5. Cell growth and cell division, molecular events and model systems. Regulation of cell cycle- cell cycle checkpoints.
6. Stem Cells: Classification and sources of stem cells: Types of stem cells: embryonic, fetal and adult stem cells. Toti-, pluri-, and multi-potent stem cells. Hematopoietic and non-hematopoietic stem cells. Tissue specific stem cells. Induced pluripotent cells, cancer stem cells.
7. Biology of Stem Cells: Stem cell self-renewal, differentiation, pluripotency, stem cell niches, phenotypic markers. Cell cycle regulation. Blood cell formation from Bone marrow stem cell, embryonic stem cell and therapeutic cloning. Formation of different non-hematopoietic cells and tissues by stem cells.
8. Stem Cell Technology: Isolation and characterization of stem cells from different sources. In vitro expansion of stem cells under normoxic, hypoxic, static and suspension culture systems. Genetic manipulation of stem cells using viral and non-viral methods.
9. Therapeutic applications of stem cells in medicine. Hematopoietic stem cell transplantation, regenerative medicine, inflammatory and immunologic diseases.
10. Pre-clinical models of Stem Cell Therapy: Development of rodent and non-human primate animal models of various diseases. Production of transgenic animals. Animal cloning.

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11. GMP/GLP guidelines for production of clinical grade stem cells; ICMR-DBT guidelines for stem cell research and therapy.

Recommended Readings

- Cell: A Molecular approach: Cooper, G. M.
- Cell Biology. Sadava D. E.
- Cell and Molecular Biology. Kish V. M. and Kleinsmith L.J.
- Development Biology, Gilbert S.F. (Sinauer Associates,USA)
- Principles of Development, Wolpert L and Tickle C, Publisher: Oxford University Press, US
- Essentials of Stem Cell Biology, 2ndedition. Robert Lanza, et al. Elsevier Academic Press, USA
- Stem cells and the future of regenerative medicine,1stedition, National research council and Institute of medicine, National Academic press, Washington DC

MBT-202: Microbiology & Pathology

1. Introduction to Microbiology: Discovery of microbial world, Microbial Staining-Grams, Differential, Motility determination, role of microbes in transformation of organic matter; Sterilization and Disinfection.; Culture media and Culture techniques; Biology of Mycoplasma; Host Pathogen Interactions.

2. Bacteriology: Common Bacteria Encountered in Cell Culture Contamination - Distinguishing features of each, Mode of Spread, Laboratory Diagnosis

3. Mycology – General characters of Fungi, Cultivation of Fungi, Cultural characters, Microscopic Morphology, Importance of Fungi in industry and Food production. Fungi as human pathogen

4. Virology: Discovery and structure, Baltimore classification, Replication – Lytic and Lysogenic Cycles, Cultivation of Viruses. Detection and Enumeration of Viruses – Viral assay.

5. Antimicrobial Agents, Antibiotics, chemotherapeutic agents, major classes and mechanism of action, minimal inhibitory concentration (MIC), Microbial Drug resistance.

6. Introduction to Pathology: General pathology – cell injury, causes; Reversible Injury-Types, morphology, swelling, hyaline, fatty change; Irreversible Injury-Types of necrosis, apoptosis, calcification, dystrophic; Metastasis; Concepts of disease

7. Cardiovascular Diseases: atherosclerosis, Ischemic Heart Disease, Myocardial Infarction, Hypertension, Congestive Cardiac Failure, peripheral vascular diseases.

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8. Respiratory Diseases: COPD, Pneumonia, Tuberculosis, Asthma
9. Neurological Diseases: Cerebrovascular Accident, Coma, Polio, Parkinsonism, Myasthenia Gravis, Spinal Cord Injury, Multiple Sclerosis, Cerebral Palsy
10. Bone and Joint Diseases: Arthritis, Osteomyelitis, Autoimmune Disease, Spondylosis, Osteomalacia, Tenosynovitis Muscle – Muscular Dystrophy, Polio, Myopathies.
11. Cancer: Hematological and solid cancers

Recommended Readings

- Pelczar, M.J.Chan, ECS & Krieg - Text Book of Microbiology.
- Fundamentals of Microbiology – Alcamo E.
- Prescott, L.M., Harley J. P & D.A.Klein – Microbiology
- Cappuccino, J.G. – Laboratory Mannual in Microbiology.
- Robbins. Basic Pathology, Saunders.
- Parakrama Chandrasoma. Concise Pathology. McGraw-Hill Publishing,

MBT-203: Bioanalytical & Research Techniques

1. Basic Techniques: Buffers; Methods of cell disintegration; Enzyme assays and controls; Detergents and membrane proteins; Dialysis, Ultrafiltration and other membrane techniques.
2. Microscopic Techniques: light and phase contrast microscopy, fluorescence microscopy, confocal microscopy, transmission electron microscopy, scanning electron microscopy.
3. Spectroscopy Techniques: UV, Visible and Raman Spectroscopy; Theory and application of Circular Dichroism; Fluorescence; MS, NMR and Plasma Emission spectroscopy
4. Chromatography Techniques: TLC and Paper chromatography; Chromatographic methods for macromolecule separation - Gel permeation, Ion exchange, Hydrophobic, Reverse-phase and Affinity chromatography; HPLC and FPLC; Criteria of protein purity
5. Centrifugation: Basic principles; Mathematics & theory (RCF, Sedimentation coefficient etc); Micro-centrifuge, High speed & Ultracentrifuges; Differential & density gradient centrifugation.
6. Radioactivity: Radioactive & stable isotopes; Pattern and rate of radioactive decay; Units of radioactivity; Measurement of radioactivity; Geiger-Muller counter; Solid & Liquid scintillation counters; Brief idea of radiation dosimetry; Cerenkov radiation; Autoradiography; Measurement of stable isotopes; Falling drop method; Applications

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of isotopes; Radiotracer techniques; Distribution studies; Isotope dilution technique; Metabolic studies; Clinical application; Radioimmunoassay.

7. Southern blotting, Northern blotting, DNA Fingerprinting, DNA denaturation/hybridization: cot/rot curves, electrophoresis.

8. Advanced Imaging Techniques: Animal Imaging, Animal echocardiography. Live cell imaging, Single cell imaging, cell tracking and live cell Imaging

Recommended Readings:

- Freifelder D., Physical Biochemistry, Application to Biochemistry and Molecular Biology, 2nd Edition, W.H. Freeman & Company, San Fransisco.
- Keith Wilson and John Walker, Principles and Techniques of Practical Biochemistry, 5th Edition, Cambridge University Press,
- D. Holme & H. Peck, Analytical Biochemistry, 3rdEdition, Longman.
- R. Scopes, Protein Purification - Principles & Practices, 3rdEdition, Springer Verlag,
- Selected readings from Methods in Enzymology, Academic Press.

MBT-204: Computation, Bioinformatics & Biostatistics

1. Computers: Classification of computers. Fundamentals of computing. Generation of Computers and information storages devices. Types of Hardware and Software. Components of Computer. Operating systems of computer.

2. Networking: Network structure and architecture, Hierarchical networks, Ethernet and TCP/IP family of protocols, transport protocol design Types of network, Topologies of network, Router, Switch, Data Communication, Concept of Wireless networking, LAN, WAN, MAN, Security of the network, Firewalls, Network Applications Information Technology: Concepts of client Server Architecture, Concept of search Engine, Database search engines. Introduction to Internet. Introduction to Word, Power point and Excel

3. Basic Bioinformatics: Historical perspectives. Introduction to data mining, internet and bioinformatics, applications of data mining to bioinformatics problems and applications of bioinformatics.

4. Sequence Alignments - Pair wise sequence alignments – Global and Local, Methods of alignment, Algorithms for sequence comparisons – Smith Waterman, Needlman and Wunsch, Dynamic Programming, Scoring matrices and gap penalties. Multiple sequence alignments – scoring multiple sequence alignments, methods for multiple sequence alignments.

5. Tools for sequence alignment – web based and local – BLAST, Clustal W, BLOCKS. Phylogenetic prediction and analysis –methods, gene prediction. Biological databases and their interfaces-Types of databases, nucleotide database- Genebank,

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EMBL, PDBJ, Genes, Entrez. Protein sequence databases – Swiss Prot/ TrEMBL; Sequence motif/domain databases – Pfam, PROSITE; Protein sequence databases - PDB, CATH, SCOP.

6. Protein classification and structure prediction - Conserved domains, motifs, structure function relationships, viewing protein structure; Protein sequence alignments, use of sequence pattern for structure prediction, prediction of secondary structures – tools, tertiary structure prediction by homology modeling.

7. Applications of Bioinformatics - Phylogenetic analysis, Comparative genomics – functional genomics, Drug design discovery, Gene expression analyses.

8. Biostatistics, concept of variables in biological systems, collection, classification, tabulation, graphical and diagrammatic representation of numerical data, Measure of central tendency: Mean median and mode, and their relationship, Measure of dispersion: quantitative deviations, mean deviation, standard deviation, coefficient of variations. Correlation and regression, linear and quadratic regressions, Concept of Standard errors. Hypothesis testing (null & alternative hypothesis).

9. Probability, concept of random experiment, various definition of probability, addition theorem of probability, random variables (discrete and continues). Probability distributions: Binomial, Normal, Chi-squares. Estimation of parameters: method of moments, maximum likelihood Testing of hypotheses: (a) parametric tests: t-test, z-test, chi-squares test, ANOVA (b) non-parametric tests: Mann-Whitney, Kruskal Wallis, Kolmogorov-Smirnov.

Recommended Readings:

- Bioinformatics. Bishop Martin
- Bioinformatics: Sequence and Genome Analysis by David W. Mount, *University of Arizona, Tucson*
- Discovering Genomics, Proteomics, & Bioinformatics, Second Edition by A. Malcolm Campbell, *Davidson College;* Laurie J. Heyer, *Davidson College;* With a Foreword by Francis S. Collins
- Biostatistics :P.N.Arora ,P.K.Malha
- Introductory statistics for Biology: *Mahajan,*

MMBT-205- Practical on Cell & Stem Cell Biology& Bioanalytical Techniques.

The practical would be caried out as designed by the subject teachers.

MMBT-206- Student Seminar /Assignment

Presentation and Assignments on topic relevant to semester III course content by student

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SEMESTER III

MBT-301: Genetic Engineering

1. Basics Concepts: Principles of genetic engineering., Scope of genetic engineering, DNA Structure and properties; Restriction Enzymes; DNA ligase, Klenow enzyme, T4 DNA polymerase, Polynucleotide kinase, Alkaline phosphatase; Cohesive and blunt end ligation; Linkers; Adaptors; Homopolymeric tailing; Labeling of DNA: Nick translation, Random priming, Radioactive and non-radioactiveprobes, DNA-Protein Interactions-Electromobility shift assay; DNaseI footprinting; Methyl interference assay.

2. Cloning Vectors: Plasmids; Bacteriophages; M13 mp vectors; PUC19 and Bluescript vectors, Phagemids; Lambda vectors;Insertion and Replacement vectors; EMBL; Cosmids; Artificial chromosome vectors (YACs; BACs); AnimalVirus derived vectors-SV-40; vaccinia/bacculo & retroviral vectors; Expression vectors; pMal; GST; pETbased 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 vectors system, Yeast vectors, Shuttle vectors

3. Cloning Methodologies: Insertion of Foreign DNA into Host Cells; Transformation; Construction of libraries; Isolation of mRNA and total RNA; cDNA and genomic libraries; cDNA and genomic cloning; Expression cloning; Protein-protein interactive cloning and Yeast two hybrid system; Phage display; Principles in maximizing gene expression

4. PCR and its Applications: Primer design; Fidelity of thermostable enzymes; DNA polymerases; Types of PCR – multiplex, nested, reverse transcriptase, real time PCR, touchdown PCR, hot start PCR, colony PCR, cloning of PCR products; Tvectors; Proof reading enzymes; PCR in gene recombination; Deletion; addition; Site specific mutagenesis; PCR in molecular diagnostics; Viral and bacterial detection; PCR based mutagenesis, Mutation detection: SSCP, RFLP), MCC (Mismatch Chemical Cleavage, ASA (Allele-Specific Amplification), PTT (Protein Truncation Test)

5. 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 to siRNA; siRNA technology; Micro RNA; Construction of siRNA vectors; Principle and application of gene silencing; Cas9 Technology, Gene Therapy; Creation of knockout mice; Disease model; Somatic and germ-line therapy- in vivo and ex-vivo; Suicide gene therapy; Gene replacement; Gene targeting.

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Recommended Readings:

- Advances in Biochemical Engineering/Biotechnology, Volume 73 (Metabolic Engineering) by J. Nielsen, Springer-Verlag, USA.

- From Genes to Genomes: Concepts and Applications of DNA Technology by J.W. Dale, M. von Schantz and N. Plant, John-Wiley & Sons Ltd., USA.
- Genomes 3 by T.A. Brown, Garland Science, USA
- Metabolic Engineering by S.Y. Lee and E.P. Popoutsakis, Marcel Dekker, Taylor & Francis Group, USA.
- Molecular Biology of Gene by J.D. Watson, T.A. Baker, S.P. Bell, A. Gann, M. Levine and R. Losick, The Benjamin Cummings Publishing Company Inc., USA.
- Molecular Biotechnology: Principles and Applications of Recombinant DNA by B.R. Glick and J.J. Pasternak, ASM Press, USA.
- Molecular Cloning by M.R. Green and J. Sambrook, Cold Spring Harbor Press, USA.
- Principles of Gene Manipulation and Genomics by S.B. Primrose and R. Twymann, Wiley-Blackwell Publishers,

MBT-302: Diagnostics & Therapeutics of Human Diseases

1. Biochemical disorders; Immune, Genetic and Neurological disorders; Molecular techniques for analysis of these disorders; Assays for the Diagnosis of inherited diseases; Bioinformatic tools for molecular diagnosis.

2. Antibody based diagnosis; Monoclonal antibodies as diagnostic reagents; Production of monoclonal antibodies with potential for diagnosis; Diagnosis of bacterial, viral and parasitic diseases by using; ELISA and Western blot.

3. Nanodiagnostics & Nanomedicine: Basic nanotechnology, Nanomaterials synthesis, Characterizations of nanoparticles, Biomolecules nanoparticle interaction. Application of nanotechnology in diagnostics and therapeutics.

4. Gene therapy; Intracellular barriers to gene delivery; Overview of inherited and acquired diseases for gene therapy; Retro and adeno virus mediated gene transfer; Liposome and nanoparticles mediated gene delivery.

5. Tissue engineering; Role of scaffolds; Role of growth factors; Role of adult and embryonic stem cells; Clinical applications.

6. Recombinant therapy; Clinical applications of recombinant technology; Erythropoietin; Insulin analogs and its role in diabetes; Recombinant human growth hormone; Streptokinase and urokinase in thrombosis; Recombinant coagulation factors.

7. Gene silencing technology; Antisense therapy; siRNA; Transgenics and their uses; Cloning; Ethical issues

8. Immunotherapy; Monoclonal antibodies and their role in cancer; Cell based immunotherapy in cancer, Vaccines: types, recombinant vaccines and clinical applications.

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6. Proteomics and drug discovery: High throughput screening for drug discovery; Identification of drug targets; Pharmacogenomics and pharmacogenetics and drug development; Toxicogenomic; Metagenomics.

Recommended Readings:

- Brown TA, Genomes, 3rd Edition, Garland Science.
- Campbell AM & Heyer LJ, Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition, Benjamin Cummings.
- Primrose S & Twyman R, Principles of Gene Manipulation and Genomics, 7th Edition, Blackwell.
- Glick BR & Pasternak JJ, Molecular Biotechnology, 3rd Edition, ASM Press.
- Ed. C. Cantor and C.L. Smith, Genomics: The Science and Technology behind the Human Genome Project, Wiley-Interscience.
- G. Gibson, S. V. muse, A Primer of Genome Science, Sinauer Associates Inc. Publishers.
- H. Rehm, Protein Biochemistry and Proteomics, 4th Edition, Academic Press.
- E. de Hoffman and V. Stroobant, Mass Spectrometry, 2nd Edition, Wiley

MBT-304: Research Methodology, Biosafety, Ethics, Intellectual Property Rights

1. Research Methodology: Meaning, objective & types of research, how to select a research topic? Motivation in research, Research Methodologies Survey, Philosophical, Descriptive and Experimental Methods, Importance of knowing how research is done, Criteria of good research.

2. Defining Research Problem and Hypothesis: Identification of Research Problem and Selection design, Formulation of Research Problem, Necessities & techniques in defining the problem, designing the research plan, concepts, types and basic principles of experimental design, , Selection of appropriate methodology.

3. Data collection &Sampling: Methods of data collection: Observation method, Interview method, Questionnaire method for the collection of primary data, Collection of secondary data, selection of appropriate method for data collection, Case study method. Guidelines for developing questionnaire

4. Importance of literature review, Writing research papers and grants, Paper presentation in scientific conference.

5. Biosafety and risk assessment issues; Regulatory framework; National biosafety policies and law, WTO and other international agreements related to biosafety, Cross border movement of germplasm; Risk management issues - containment.

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6. General principles for the laboratory and environmental biosafety; Health aspects; toxicology, allergenicity, antibiotic resistance, etc; Impact on environment: gene flow in natural and artificial ecologies.

7. Ecological aspects of GMOs and impact on biodiversity; Monitoring strategies and methods for detecting transgenics; Radiation safety and nonradio isotopic procedure; Benefits of transgenics to human health, society and the environment.

8. Bioethics: Concepts; Ethical Terms; Principles & Theories; Relevance to Biotechnology; Ethics and the Law Issues:. Genetic Engineering, Stem Cells, Cloning, Medical techniques; Research concerns - Animal Rights, Ethics of Human Cloning, Reproduction and Stem Cell Research.

9. Intellectual property rights (IPR): Intellectual properties, copyrights, trademarks, trade secrets, patents, geographical indications, etc; Requirement of a patentable novelty; Issues related to IPR protection of software and database; IPR protection of life forms. Obtaining patent; Invention step and prior art and state of art procedure; Detailed information on patenting biological products and biodiversity. trade related aspects of Intellectual Property Rights and Budapest treaty; Indian patent act and amendments, patent filing; Implications of intellectual property rights on the commercialization of biotechnology products.

Recommended Links

- http://www.w3.org/IPR/
- http://www.wipo.int/portal/index.html.en
- http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html
- www.patentoffice.nic.in
- www.iprlawindia.org
- http://www.cbd.int/biosafety/background

MMBT-305- Practical on Genetic Engineering & Genomics.

The practicals would be caried out as designed by the subject teachers

MMBT-306- Student Seminar /Assignments

Presentation and Assignments on topic relevant to semester III course content by student

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SEMESTER IV

MMBT-401: DISSERTATION

As partial requirement for the Award of M.Sc. Degree in Medical Biotechnology, a project culminating in the submission of a dissertation must be carried out by students in their final semester. The project-dissertation is a component that provides the students with the opportunity to design undertake or conduct an independent piece of research under the guidance of a supervisor. The 'Dissertation' is a comprehensive description of the aims, objectives of the project, a review of the literature on the subject matter, the investigation/planning and methodology, the results and findings, and concrete recommendations and conclusions. Every student will submit a comprehensive report of the project work in the form of thesis, duly certified by the supervisor. The project will be presented by the student and evaluated by expert at the end of the semester. The students shall be required to present themselves for a comprehensive viva-voce examination before completion of the course.

- A 'Project' is an investigative undertaking, a structured, organized experiential learning including design work, field work or other placement learning.
- The dissertation is a major document that reflects the skills of the student to investigate critically a topic/problem, the ability to gather and analyze information, and to present and discuss the results/investigation concisely and clearly.
- Be a self-motivated and personally responsible for your action and learning
- Apply standard and advance techniques to solve a range of identified problems
- Be proficient in the recording, storage, management and reporting data

Paper	Subject Title
MBT-401	Dissertation (Presentation of Research Project, Thesis work, Thesis Writing & Viva)

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