M.SC. MEDICAL BIOTECHNOLOGY

Summer training/ Project/ Dissertation

The summer training/ Dissertation project will be based upon research and actual bench work. It will be carried out during summer vacation between April to June for three months after th examination of IVth Semester. the project report will be submitted at the end of June or in July and evauted by External and intrnal examiners. the project work can be done any where in India in any Lab related to Biotechnology. the project work of ach student will be equavalent to one theory paper.

Student Seminar

Each studenbt undet the supervision of a faculty member will deliver a comprehensive seminar which will be evalauted. The topic normally will be from an emerging area of Modern Biology, Bio Medical, Biotechnology or its applications.

Laboratory Practicals I, II

Independent practical may be held under each course. However, for examination puposes two comprehensive 2 days, pratical examination will be held for each semester, covering diferent courses offered during that semster. The student must actually perform the experiments. the exams will be conducted by one external and one internal examiner. The external examiner may however be called on second days.

Internal Assessment :

Internal assessment will be based on assignments during whole semsters in each course.

Invited lectures from eminent researches, indutries and other on recet issues related to biodiversity, ethics, bio- safety inteelictual property rights patent issues and good laboratory and manufaturing practices will be organized.

Scheme of Examination for M.Sc. Medical Biotechnology (Two Year Course) 2009-2010

1st Semester

Sr. No.	Course No.	Subject	Periods			Evaluation Scheme Sessional		
			L	Tu	P	Th	IA	Total
1.	BT-111	Cell biology	4	0	4	80	20	100
2.	BT-112	Biomolecules and metabolism	3	0	4+4	80	20	100
3.	BT-113	Microbiology	3	0	4	80	20	100
4.	BT-114	Bio-statistic	3	0	4	80	20	100
5.	BT-115	Molecular Biology	3	0	4	80	20	100
6.	BT-116	Communidative Skill	2	0	0	25		25
7.	BT-117	Lab Course - I Cell biology, Biomolecule			4x3			50
8.	BT-118	Lab Course-II Microbiology, Molecular Biology, Bio-statistic			4x3			50
	Total				24		Total	625

2nd Semester

Sr. No.	Course No.	Subject	Periods			Evaluation Scheme Sessional		
			L	Tu	P	Th	IA	Total
1.	BT-211	Immunology	4	0	4	80	20	100
2.	BT-212	Bioinformatics	3	0	4+4	80	20	100
3.	BT-213	Enzymology	3	0	4	80	20	100
4.	BT-214	Human Physiology and Developmental Genetics	3	0	4	80	20	100
5.	BT-215	Nano Biotechnology	3	0	4	80	20	100
6.	BT-216	Seminar	2	0	0	25		25
7.	BT-217	Lab Course - I Immunology, Bioinformatics, Nano Biotechnology				4x3		50
8.	BT-218	Lab Course-II Human Physiology, Developmental Genetics, Enzymology			4x3			50
	Total				24		Total	625

Scheme of Examination for M.Sc. Biotechnology (Two Year Course) 2009-2010

3rd Semester

Sr. No.	Course No.	Subject	Periods			Evaluation Scheme Sessional		
			L	Tu	P	Th	IA	Total
1.	BT-311	Medical Microbiology/ Biology of Infections diseases	4		4	80	20	100
2.	BT-312	Animal Cell Culture	4		4	80	20	100
3.	BT-313	Humand genetics and Human Genome	4		4	80	20	100
4.	BT-314	Modelling & Drug Desiginin	4		4+4	80	20	100
5.	BT-315	Genetics Engg.	4		4	80	20	100
6.	BT-316	Seminar	2			25		25
7.	BT-317	Lab Course - I Animal Cell Culture, Human genetics and Human genome, Modeling and Drug Desigining						50
8.	BT-318	Lab Course-II MicroBiology , Gent. Engg.			24			50
								625

4th Semester

Sr. No.	Course No.	Subject	Periods			Evaluation Scheme Sessional		
			L	Tu	P	Th	IA	Total
1.	BT-411	Diagnostic	4		4	80	20	100
2.	BT-412	Somatic and Germ cell Engg.	4		4	80	20	100
3.	BT-413	Stem Cell Biology	4		4	80	20	100
4.	BT-414	Social, Ethical, Legal and Managment issues in Bitechnology	4		4+4	80	20	100
5.	BT-415	Lab Course - I						75
6.	BT-416	Summer Training/ Dissertation./ Project Report	4		4x4 x3	80	20	150
	Total				24			625

The theory practical exams. of 4th semester be completed in all circumstances by March. The project work will be done between April to July for three months. The project work can be domn in any lab/ Industry in India.

** L-Lecture, T- Theory IA - Internal Assessment

M.Sc. Medical Biotechnology

Course Title: Cell Biology **MM. 80 + IA 20**

Course No. **MBT 111** **Time: 3h**

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory

UNIT I

Diversity of cell size and shape.

Cell Theory.

Structure of Prokaryotic and Eukaryotic cells- Isolation and growth of cells.

Microscopic techniques for study of cells.

Sub-cellular fractionation and criteria of functional integrity

UNIT II

Cellular organelles- Plasma membrane, cell wall, their structural organization Mitochondria, Chloroplast; Nucleus and other organelles and their organization.

Transport of nutrients, ions and macromolecules across membrane.

UNIT III

Cellular energy transactions - role of mitochondria and chloroplast

Cell cycle - molecular events and model systems

Cellular responses to environmental signals in plants and animals-mechanisms of signal transduction

UNIT IV

Cell motility - cilia, flagella of eukaryotes and prokaryotes

Biology of cancer

Metabolite pathways and their regulation

Biosynthesis of proteins in Eukaryotic cell, Co- and post-translational modification, intracellular protein traffic.

UNIT V

Cellular basis of differentiation and development-mitosis, gametogenesis and fertilization. Development in Drosophila and Arabidopsis, Spatial and temporal regulation of Gene expression.

Brief introduction to the Life Cycle and Molecular Biology of some important pathogen of AIDS, Malaria, Hepatitis, Tuberculosis, Filaria, Kalazar.

Course Title: Biomolecule and metabolism MM. 80 + IA 20

Course No. MBT 112 Time: 3h

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory

UNIT I

Chemical foundations of Biology –pH, pK, acids, bases, buffers, weak bonds, covalent bonds.

Principles of thermodynamics.Classes of organic compounds and functional groups-atomic and molecular dimensions, space filling and ball and stick models.Macro molecular and supra molecular assemblies.

UNIT II

Amino acids and peptides-classification, chemical reactions and physical properties

Sugars - classification and reactions

Heterocyclic compounds-and secondary metabolites in living systems - nucleotides, pigments, isoprenoids

Separation techniques for different biomolecules

UNIT III

Physical techniques in proteins, nucleic acids and polysaccharides structure analysis (UV, IR, MMR, LASER, MASS, Fluorescence spectroscopy, Differetial calorimetry, X-ray Crystallography, Ultra Centrigugation, Electron crymicrography, Scanning Tunneling microscopy.

UNIT IV

Lipids- classification, structure and functions

Proteins-classification and separation, purification and criteria of homogeneity, end group analysis, hierarchy in structure, Ramachandran map.

Conformational properties of polynucleotides, Polysaccharides - types, secondary and tertiary structural features, theoretical and experimental;

Protein folding - biophysical and cellular aspects.

UNIT V

Water and its properties, enzymes coenzymes, metabolism of carbohydrate, amino acids and lipids, in born errors of metabolism.

Bio-energetics and oxidative phosphorylation. Blood clotting – biochemistry, body fluids – pH and acid base balance and their importance in clinical biochemistry, muscle contraction. Techniques in the study of proteins, carbohydrates and lipids.

Practicals

Titration of amino acids

Colorimetric determination of pK

Model building using space filling/ball and stick models

Reactions of amino acids, sugars and lipids

Isolation, purity determination and quantitation of cholesterol, DNA and mRNA

Quantitation of Proteins and Sugars

Analysis of oils-iodine number, saponification value, acid number

UV, Visible, Fluorescence and IR spectroscopy, Absorption spectra

Separation techniques - Centrifugation, Chromatography (Gel permeation, Ion exchange, TLC etc. and Electrophoresis

Course Title: Molecular Biology **MM. 80 + IA 20**
Course No. MBT 133 **Time: 3h**

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory

UNIT I

The Beginning of Microbiology Discovery of the microbial world by Antony van Leeuwenhoek: Controversy over spontaneous generation, Role of microorganisms in transformation of organic matter and in the causation of diseases, Development of pure culture methods, Enrichment culture methods, developments of microbiology in the twentieth century. Methods in Microbiology Pure culture techniques; Theory and practice of sterilization; Principles of microbial nutrition Construction of culture media; Enrichment culture techniques for isolation of chamoautotrophs, chemoheterotrophs and photosynthetic microorganisms. Microbial Evolution, Systematics and Taxonomy, Evolution of earth and earlier life forms; Primitive organisms and their metabolic strategies and molecular coding; New approaches to bacterial taxonomy classification including ribotypeing Ribosomal RNA sequencing; Characteristics of primary domains Taxonomy, Nomenclature and Bergey's Manual

UNIT II

Microbial Growth The definition of growth, mathematical expression of growth, growth curve, measurement of growth and growth yields; Synchronous growth; Continuous culture; Growth as affected by environmental factors like temperature, acidity, alkalinity, water availability and oxygen; Culture collection and maintenance of cultures

Overview of Basic Metabolism & Microbial Nutrition

Metabolic Diversity among Microorganisms Photosynthesis in microorganisms; Role of Chlorophylls, carotenoids and phycobilins; Calvin cycle; Chemolithotrophy; Hydrogen - iron - nitrite - oxidizing bacteria; Nitrate and sulfate reduction; Methanogenesis and acetogenesis; Fermentations - diversity, syntrophy, role of anoxic decompositions; Nitrogen metabolism;" Nitrogen fixation; Hydrocarbon transformation

UNIT-III

Prokaryotic Diversity Bacteria: Purpl and green bacteria; Cyanobacteria; Homoacetogenic bacteria; Acetic acid bacteria; Budding and appendaged bacteria; Spirilla; Spirochaetes; Gliding and sheathed bacteria; Pseudomonads; Lactic and propionic acid bacteria; Endospore forming rods and cocci: Mycobacteria: Rickettsias, Chlamydies and Mycoplasma. Archaea: Archaea as earliest Life forms: Halophiles; Methanogens; Hyperthermophilic urchaea; Thermoplasma

Eukarya : Algae, Fungi, Slime molds and Protozoa.

UNIT-IV

Viruses: Bacterial, Plant, Animal and Tumor viruses; Discovery, classification and structure of viruses; Lysogeny: DNA viruses: Positive strand Negative strand, and double stranded RNA viruses; Replication: Examples of Herpes, Pox, Adenoviruses, Retroviruses, Viroids and Prions

Prokaryotic Cells: Structure-function Cell walls of eubacteria (peptidoglycan) and related molecules; Outer-membrane of Gram negative bacteria; Cell wall and cell membrane synthesis; Flagella and motility; Cell inclusions like end spores, gas vesicles

Chemotherapy/Antibiotics

Antimicrobial agents; Sulfa drugs; Antibiotics: Pencillins and Cephalosporins; Broad spectrum antibiotics; Antibiotics from prokaryotes; Antifungal antibiotics; Mode of action; Resistance to antibiotics

UNIT-V

Genes, Mutation and. Mutagenesis UV and chemical mutagenesis Types of mutation; Ames test for mutagenesis; Methods of genetic analysis

Bacterial Genetic System Transformation, Conjugation, Transduction, Recombination, Plasmids and Transposons, Bacterial genetics map with reference to E.coli

Viruses and Their Genetic System Phage I and its life cycle: RNA phages RNA viruses; Retroviruses

Genetic systems of Yeast and Neurospora

Extra-Chromosomal Inheritance

Practicals

Preparation of liquid and solid media for growth of microorganisms

Isolation and maintenance .of organisms by plating, streaking and serial dilution methods. Slants and stab cultures. Storage of microorganisms

Isolation of pure cultures from soil and water

Growth; Growth curve; Measurement of bacterial population by turbidometry and serial dilution methods. Effect of temperature, pH and carbon and nitrogen sources on growth.

Microscopic examination of bacteria, yeast and molds and study of organisms by Gram stain, Acid fast stain and staining for spores

Study of mutations by Ames test.

Assay of antibiotics und demonstration of antibiotic resistance

Analysis of water for potability and determination of MPN

Bacterial transformation

Biochemical characterization of selected microbes

Transduction

One step growth curve of coliphage

Isolation of Plasmids

$^{14}C0_2$ fixation by photosynthetic microbes

Course No. MBT 114 **MM. 80 + IA 20**
Course Title: Biostatistics **Time: 3h**

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory

UNIT I

Permutation and Combination, Functions, limits and continuity, Exponential and Logarithmic functions, Vector and Matrices, Algebra of Matrics, Determinants and their simple properties, Rank of matrix, Consistency of system of linear equations and soultion of linear system of equations. Characteristic equation, Eigen values and Eigen vectors.

UNIT II

Differential Calculus, Rules of differentiation, Derivatives of implicit fucntions, parametric differentiation, Higher derivatives Taylor's theorem, Maclaurin's theorem (without proofs), Maxima and minima, Partial differentiation

Integration, Integration by parts, Definite integral, Properties of definite integrals,

Differential Equations :, Separable varaible, homogenous, exact and linear equations of second order.

UNIT III

Concepts in statistics, Types iof Data, presentation ofdata, types of graphics, relative frequency, cummulative frequency, Measuremnt of central tendency, Measures of variation, coefficient of vrariation, measures of Skewness and Kurtosis, Probability and its applications, Laws of Addition and Multiplication, Compound probablity, Baye's Theorem.

UNIT IV

Random Varaibles and Distribution. Binomial, Poisson, Exponential and Normal Distributions and their applications. Samples and Sampling Distribution, Standard Error, significance level, Degrees of freedom, tests of significance, tests for proportion, t an F tests Confidence Intervals.

UNIT V

Contingency tables of X^2 (Chi square) tests of goodness of fit and

homogeneity

Correlation : Simple, Partial and Multiple Correlation, Methoids of averages and least squares, polynomial fitting, Regression Analysis, Analysis of variance for one and two way classification Design of experiments, randomaxization, replication local control, completely randomized and randomized block design.

PRACTICALS

Descriptive statistics : Systematic tabular summarization of data (before analysis), measures of central tendency, measures of dispersion, measures of skeness (using calculators).

Correlations (product-moment coefficient, Spearman's rank coefficient) and regression (linear regression, curve fitting).

Data presentation (tables/ figures) : 1-D and 2-D bar charts, pie diagrams, graphs (using computer software packages).

Statistical distributions : fitting discrete uniform, binomila, Poisson and normal probability distribution to given data

Testing of hypotheses : Tests of significance (mean, standard deviation, correlation coefficient), chi- squard test for goodness of fit, test for independence of attributes, non-parametric tests (run test) using calculators and printed tables and using minitab sampling (drawing random samples using random numbers, tables, chits, computer programmes for random number generation), design of experiments, ANOVA (one-way and two way).

Course Title: Molecular Biology **MM. 80 + IA 20**
Course No. MBT 115 **Time: 3h**

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory

UNIT I

DNA Replication: Prokaryotic and eukaryotic DNA replication, Mechanics of DNA replication, enzymes and accessory proteins involved in DNA replication and DNA repair

Transcription: Prokaryotic transcription, Eukaryotic transcription, RNA polymerase, General and specific transcription factors, Regulatory elements in mechanisms of transcription regulation, Transcriptional and post-transcriptional gene silencing

Modifications in RNA: 5'-Cap formation, Transcription termination, 3'-end processing and .polyadenylation, Splicing, Editing, Nuclear export of mRNA, mRNA stability

UNIT II

Translation: Prokaryotic and eukaryotic translation, the translation machinery, Mechanisms of initiation, elongation and termination, Regulation of translation, co- and post translational modifications of proteins.

Protein Localization: Synthesis of secretory and membrane protein, Import into nucleus, mitochondria, chloroplast and peroxisomes, Receptor mediated endocytosis

Oncogenes and Tumor Suppressor Genes: Viral and cellular oncogenes, tumor suppressor genes from humans, Structure, Function and mechanism of action of pRB and p53 tumor suppressor proteins

UNIT III

Antisense and Ribozyme Technology: Molecular mechanism of antisense molecules, inhibition of splicing, polyadenylation and translation, disruption of RNA structure and capping, Biochemistry of ribozyme; hammer head, hairpin and other ribozymes, strategies for designing

ribozymes, Applications of Antisense and ribozyme technologies

Homologous Recombination: Holliday junction, gene targeting, gene disruption, FLP/FRT and' Cre/Lox recombination, RecA and' other recombinases

Molecular Mapping of Genome: Genetic and physical maps,. physical mapping and map-based cloning, choice of mapping population, Simple sequence repeat loci, Southern and fluorescence in situ hybridization for genome analysis, Chromosome micro dissection and micro cloning.

UNIT IV

Molecular markers in genome analysis: RFLP, RAPD and AFLP analysis, Molecular markers linked to disease resistance genes, Application of RFLP in forensic, disease. prognosis, genetic counseling, Pedigree, varietal etc. Animal trafficking and poaching; Germplasm maintenance, taxonomy and Bio-diversity

Genome Sequencing: Genome sizes., organelle genomes, Genomic libraries, YAC, BAC libraries, Strategies for sequencing genome, Packaging, transfection and recovery of clones, Application of Sequencing sequence information for identification of defective genes

Practicals

Isolation of genomic DNA

Southern blotting

RFLP analysis

Isolation of RNA

Isolation of polyA + RNA

Northern blotting

Preparation of probes

In vitro Transcription

In vitro translation

Metabolic labeling of proteins and immuno precipitation

SEMESTER-I

Course No. MBT 116 **MM. 25**
Course Title: Communication Skills **Time: 30 min.**

NOTE: Seminars

Lectures : prepartion, objectives, concepts, contents, sequence, formal proof, interrelationships, logic, conclusions, time management using audiovisual aids Giving a talk : body language : extempore and prepared talks.

Praparation for interviews, CV/ biodata.

Vocabulary : word power, pronuniations, guessing the meaning of words from the context an body language and using a dictionary

Review of basic grammar Punctuation marks comma, colon, semicolon, full stop, inverted comma.

Avoiding repetitious statments, double positive, double negatives, circular argumants. Dealing with questions : avoiding circumvention and circular arguments, answering after braeking down long question into parts.

MS power pont -based presentations

Analysis of formal presentations in the course 3a in terms ofactual presentations.

SEMESTER-II

Course Title: Immunology **MM. 80 + IA 20**
Course No. MBT 211 **Time: 3h**

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory

Introduction

Phylogeny of Immune System.

Innate and acquired immunity

Clonal nature of immune response

Organization and structure of lymphoid organs

Nature and Biology of antigens and super antigens.

UNIT II

Antibody structure and function

Antigen - antibody interactions

Major histocompatibility complex

BCR & TCR, generation of diversity. Complement system

Cells of the Immune system: Hematopoiesis and differentiation

UNIT III

Lymphocyte trafficking, B-Iymphocytes, T-Iymphocytes, Macrophages, Dendritic cells, Natural killer and Lymphokine -activated killer cells, Eosinophils, Neutrophils and Mast Cells

Regulation of immune response:Antigen processing and presentation, generation of humoral and cell mediated immune responses:Activation of B and T-Lymphocytes

UNIT IV

Cytokines and their role in immune regulation:T-cell regulation, HHC restriction Immunological tolerance

Cell - mediated cytotoxicity; Mechanism of T cell and NK cell mediated lysis, antibody dependent cell mediated cytotoxicity, macrophage mediated cytotoxicity

Hypersensitivity

UNIT V

Autoimmunity

Transplantation

Immunity to infectious agents (interacellular parasites, helminthes & viruses)

Tumor Immunology

AIDS and other Immunodeficiency

Hybridoma Technology and Monoclonal antibodies

Practicals

Blood film preparation and identification of cells

Lymphoid organs and their microscopic organization

Immunization, Collection of Serum

Double diffusion and Immune-electrophoresis

Radial Immuno diffusion

Purification of IgG from serum

Separation of mononuclear cells by Ficol1-Hypaque

Con-A induced proliferation of thymocytes (by MTT method)

Western-blotting

ELISA

Hapten Conjugation and quantitation

Immunodiagnostics (demonstration using commercial kits)

Course Title: Bioinformatics **MM. 80 + IA 20**

Course No. MBT 212 **Time: 3h**

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory

UNIT I

Computers

An overview of computers, microcomputers, VDUs and printer

What is programming? Algorithms. Languages amd packages : Introduction to MS Offfice, MS Access, Front Page and introduction to C. Java and SQL (structured query language) Handling arrays, procedures.

Colour, sound and pgraphics. Use of standard packages.

UNIT II

Introduction to PERL : Sacalar variables, strings and numbers, Assignment statements, Arrays, Hashes, Operators, Input from file, Standard Input, Conditional and logical operators, loops, I/O/ Input from file named in command line, Regular expression, Pattern matching, Aeta symbols,Pattern modifiers, Subroutins.

Applications of PERL in Bioformatics : Storing DNA sequence, DNA to RNA transcription, Finding motifs, Counting nucleotides, Genrating random numbers, simulating DNA mutation generating random DNA, Analyzing DNA.

UNIT III

Biological Sequence Databases : Overview of various primary and seconadry databases that deal with protein and nucleic acid sequences. Databases to be covered in detail are Gen bank, EMBL, DDBJ, Swiss Prot, PIR and MIPS for primary sequences, Various specialized databases like TIGR, Hovergen, TAIR, Palsmo DB, ECDC etc., wil also be discussed. Preliminary ideas of query and analysis of sequence information.

UNIT IV

Sequence Comparison Methods : Method for the comparison of two seuqences viz. Dot matrix plots, Needleman Wusch & Smith Waterman algorithms. Analysis of computational complexities and the relative merits demerits of each method. Theory of scoring matrics and their use for sequence comparison.

UNIT-V

Database Search Algorithms : Methods for searching sequence databases like FASTA and BLAST algorithms.

Statistical analysis and evauation of BLAST results.

Pattern Recognition Methods in Sequence Analysis :

Concept of a sequence pattern, regular expresion based patterns. The use of pattern databases like PROSITE and PRINTS. Concept of position specific weight matrics and their use in sequence analysis. Theory of profiles and their use with special reference to PSIBLAst. Markov chains and Markov models and their use in gene Baum Wech algorithms for training a HMM. Use of profile HMM for protien family classification

Practical : Computational modeling of genomic proteomic, evolutionary tree designing ob databases, network search on genomic and proteomic databases.

Course Title: Enzymology **MM. 80 + IA 20**

Course No. MBT 213 **Time: 3h**

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory

UNIT I

Enzymes : Introduction and scope, Nomenclature, Mechanism of Catalysis

Chemical and Physical properties of enzymes. Information from comparison and sequence.

Staructural Details : Determining the Molecular Weight, Size and Shape by modern technique; De Novo structure prediction from sequence; Solution structure from NMR measurements; Solution of X-ray diffraction pattern, Modelling from acose homolog, Comparing different structures.

UNIT II

Enzymes Kinetics : Single steady state kinetic Altman's methods; Inhibitors and activators; Multi substrate systems; Effect of pH and temperature; Allosteric enzymes, Mnemonial enzyme.

UNIT III

Immobilization of Enzymes : Advantages, Carriers, absorption, covalent coupling, cross linking and emntrapment methods, Micro environmental effects.

Enzyme Reactors : reactors for batch/ continuous enzymes processing, Choice of reacstor type : idealized enzymes reactor systems; Mass Transfer in Enzmes Reactors; Steady state analysis of mass transfer and biochemical reaction in enzymes reactors.

UNIT IV

Bio-process Design : Physical parameters, reactor operational stability; Immobilized cells Types of enzymes preparations and their characterization

Enzyme in food, fodder, textile and tanning industry, medicine, production of biodetergents.

UNIT V

Challenges and futre trends : Enzymes catalysis in organic media; Catalytic antibodies and Non protein biomolecules as catalysts, Biocatalysts from Extreme Thermophllic and Hyperthermophilic Archaea and Bacteria.

PRACTICALS

Electrophoresis of Proteins- native and under denaturing conditions

N-and C- terminal analysis of proteins

Peptie mapping

Sepration techniques (HPLC, GPC, FPLC)

Chemical modification of proteins

Enzymes : purification and kinetic analysis

Hydrodynamic properties measurement and application

Methods for immobililzation of enzymes

Techniques for analysis of Secondary, tertiary and quaternary structures of proteins

Electrophoresisof DNA linear, circular and super coiled

Protein acid hybridization

Determinatioon of Tm of nucleic acid.

Semester-II

Course Title: Human Physiology and Developmental Genetics

Course No. MBT 312 **MM. 80 + IA 20**

Time: 3h

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory

UNIT I

Introduction to brain and neurobioogy.

Slight and perception, hearing and balance, smell, taste, touch, pain, analgesics, Skin, hair. Muscles, movemet, rheumatoid disorders, nervous system, skin, glands.

Heart and blood circulation,blood clotting, microvasuclature.

Lungs, sufactants. Body fluids, fluid balance, parenteral soultions, renal phyisology.

UNIT II

Hormones and homeostatis

Digestive system, reproductive system, nervous system.

Genital system, reproductive biology and contraception.

Diseases of the digestive system, brething, circulation, Mechanisms of rug action.

UNIT III

Structure, chemistry, dynamics and regulation of sperm locomotion,capacitation and egg-surface targeting

Molecular biology, cytology and biochemistry of ovogenesis : Synthesis and storage of maternal transcripts, proteins and cell organells, rDNA amplification in amphibia; transcription on lampbrush chromosomes, ovultion and hormonal control in mammals.

UNIT IV

Molecular and cellular biology of fertilization : acrosome reaction and signal transduction, monopermy and species - specificity.

Egg activation, early cleavages and bastocyst formation in mammals and biochemical and cellular changes during the passage down the oviduct to the uterus.

UNIT V

Implantation and formation of the placenta in mammals

Gastrulation in mammals- formulation of primitive streak, morphognetic movements and neural induction,. Organogenesis and foetal development.

Pattern forming genes and expression in Drosophila and mammalian embryos Development of the mammalian brain- cerebral cell lineages

Lens development fibre differentiataion, programmed morphogenetic histogenetic cell death(apoptosis). Erythropoeisis, myelopoeisis. Ageing.

PRACTICALS

1. Culture in *vitro* of chick embryo by New's technique and neural induction by transplanted Hensen's node.
2. Filter-paper ring culture of chick embryos.
3. Chick embryo limb bud organ culture and observation of cell death in interdigital regions by neutral red staining.
4. Sex- linked inheritance in Drosphila
5. Non-allelic and allelic interaction indrosphila.
6. Linkage study in Drosophila.
7. Allelic and heterozygotic frequencies in human populations.
8. Analysis of quantitatitive traits : frequency distribution, standard deviation and variance.
9. Karyotyping human cells and chromosomal in situ localization of genes.
10. Cell division : mitosis and meiosis.

    Mutants of Drosophila. Sex linked lethals in Drosphila.

Semester-II

Course Title: Nanobiotechnology

Course No. MBT 214 **Time: 3h**

UNIT I

Bionanotechnology - An Overview : What can engineers learn from biology ? From bitechnology to Bionanotechnology. Bionanomachines in actions A Molecular recognition : How molecular recognition underlies cellular communication,material transfer into and within cells, and bitransformation. Information : How information is stored in the cell an how it is read ?

UNIT II

Biophysics : Bioelectromagnetism, bioenergetics, biomechanics, Neuro transport, Biological Rhythyms.

Modren Biomaterials : Proteins, Nucleic acids, Lipids, Polysaccharides.

Biomolecular Design and Biotechnology : Molecular Modelling and Biomolecular structure determination.

UNIT III

Strcutural Principles of Bionanotechnology : Natural Bionano-Macinery, Hierarchical strategy, raw material, Protein folding, self-organization, Molecular recognition flexibility.

UNIT IV

Functional Principles of Bionanotechnology : Information driven nano assembly, Energetics , chemical transformation, regulatio, Biomolecular motors, Biomolecuar motors, Biomolecular sensing, self replication and machine - phase Bionanotechnology.

UNIT V

Bionanotechnology Today and Future : basic capabilities, Nanomedicine today, DNA computers, hybrid materials, artificial life and biosensors.

Semester-II

Course Title: Nano Biotechnology **MM. 80 + IA 20**

Course No. MBT 215 **Time: 3h**

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Semester-III

Course Title: Medical Microbiology and Biology of infections diseases

MM. 80 + IA 20

Course No. MBT 311 **Time: 3h**

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

UNIT I

Bacteria : Representative disease to be studied in detail are - tetanus, diphtheria cholera, tyroid, tuberculsis, leprosy, plague and syphilis. Infetcions caused by anaerobic bacteria, spirochetes,chlamydia, rickettsiae.

Viruses : Reprsentative diseases to be studied in detail are - viral hepatitis, influenza, rabies, polio and AIDS and viral cancers.

Fungi : Diseases to be taken up in follwoing categories : superficial, subcutaneous systemic and opportunistic mycoses.

Protozoa : Diseases to be discussed are- amoebiasis, toxoplasmosis, trichomoniasis & leishmaniasis.

UNIT II

Disease burden : microbial, viral, fungal and parasitic

Investigation of epidemics

Methods of cutting and assaying ; bacteria, viral and parasitic

Classification : fungal, protozoal, helminthlic, bacterial and viral

repication of DNAm RNA _ ve an RNA -ve viruses, retroviruses.

UNIT III

Viral vaccines : convetional : killed/ attenuated; DNA; peptide; recombinant proteins

sterization techniques : biohazard hoods; containment facilities, BSL 2,3,4

UNIT IV

Bacterial and viral vectors

Bilogical warfare agents

Mode of action of antibiotics and antiviral : molecular mechanism of drug resistance (MDR) Anti- viral chemotherapy, Anti fungal chemotherapy.

UNIT V

Hospital -acquired infections (nosocomial), immune compromised states. water and waste management for water- borne disese. Modern approaches for diagnosis of infections disease : Basic concepts of gene probes, ot hybridization and PCR assays.

PRACTICALS

Staining techniques

Haemagglutination test

Commercial kits- based diagnosis

Antibioticsensitivity (bacterial).

Electron microscopy (demo)

Bacterialculture

Agar gel diffusion

ELISA

Preparation of axenic cultures

Course Title: Animal Cell culture **MM. 80 + IA 20**

Course No. MBT 312 **Time: 3h**

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory

UNIT I

Equipments and materials for animal cell culture technology

Primary and established cell line cultures.

Introduction to the balanced salt solutions and simple growth medium, Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium, Role of carbon dioxide.

UNIT II

Role of serum and supplements

Serum & protein free defined media and their application

Measurement of viability and cytotoxicity

Biology and characterization of the cultured cells, measuring parameters of growth

Basic techniques of mammalian cell culture *in vitro* disaggregation of tissue and primary culture maintenance of cell culture cell separation

UNIT III

Scaling-up of animal cell culture, Cell synchronization, Cell cloning and micromanipulation, Cell transformation

UNIT IV

Application of animal cell culture, Stem cell cultures, embryonic stem cells and their applications, Cell culture based vaccines.

UNIT V

Somatic cell genetics, Organ and histolypic cultures, Measurement of cell death, Apoptosis, Three dimensional culture & tissue engineering

Practicals

Preparation of tissue culture medium and membrane filtration

Preparation of single cell suspension from spleen and thymus

Cell counting and cell viability\

Macrophage monolayer from PEC, and measurement of phagocytic activity

Trypsinization of monolayer and sub culturing

Cryopreservation and thawing

Measurement of doubling time

Role of serum in cell culture

Preparation of metaphage chromosomes from cultured cells

Isolation of DNA and demonstration of apoptosis of DNA laddering

MTT assay for cell viability and growth

Cell fusion with PEG

Course Title: Human Genetics and Human Genome MM. 80 + IA 20

Course No. BT 313 Time: 3h

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory:

UNIT I

History and development of human genetics; organization of the human genome. Genes and chromosome- structure, function and inheritance.

Repetitive DNA in human genome - Alu and SINE repeats
Functional organization of centromeres and telomeres, telomerases and centrosomes
Methods for gnetic study in man - pedigree analysis, chromosomal analysis, biochemical analysis

UNIT II

Study cell genetics (somatic cell hybrids, radiation hybrids, monochromosome hybrid panels, gene mapping, hybridoma technology, polyclonal and monoclonal antibodies), molecular genetic analysis. Tissue culture techniques, long- term and shorts- term cultures, lymphoblastoid cell lines; congenital abnomalities; clinical aspects of autosomal and sex chromosomal disorders; inborn errors of metbolism, haemoglobinopathies.

UNIT III

Human genome mapping - genetic mapping, phyiscal mapping- restriction fragment length polymorphism, pulse field gel electrophoresis, yeast artfiiacl chromosomes, bacterial artifital chromososmes, P1 derived artifical chromosomes, expressed sequence tags, sequence tagged sites, microsatellities and microsatellites and single nucleotie polymorphisms.

UNIT IV

Inherited human diseases- single gene diseases, complex traits.
Indentification and isolation genes - positional cloning, functional cloning DNA and cDNA microarrays.

UNIT V

Yeast two-hybrid system.
Statistical methods for genetic analysis of complex traits.
Cancer genetics. Immunogenetics; pre natal diagnosis- chorionic villus sampling amniocentesis Pre-implantation diagnosis.
Genetic counselling. Gene therapy -concept, vectors, gene targeting and tissue - specific expression.
Ethics and human genetics. Introduction to pharmacogenomics and toxicogenomics.

PRACTICALS

Pedigree analysis

Chromosome preparations - PHA stimulated short term blood cultures, air- dried chromosome preparation

G- banding of chromosomes

Karyotype preparation

In situ hybridization- FISH(exapmple wit centromeric and telomeric probes).

Polyacrylamide gel electrophoresis-detection of enzymes (fo examples- G6PD, an X-linked enzymes)

RFLP- radioactive and non-radioactive probes (for example with actin gene).

PCR- PAGE(radioactive/ non radioactive) for microsatellite marker for linkage analysis

PCR- RELP- based genotyping

PCR- SSCP for mutation detection

Single nucleotide polymorphism typing.

Course Title: Modeling and Drug Designing MM. 80 + IA 20

Course No. MBT 314 Time: 3h

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory:

UNIT I

Concept of external and internal coordinates and algorithms and algorithms for their interconversion Different representations of molecular structures and their relative merits and demerits.

UNIT II

Experimental Methods for Molecular Structure Detremination :

Brief account of structure determination by X-ray crystallography and NMR spectroscopy. Validation of experimetally obtained NMR strutures. The Protien Data Bank (PDB) and the Nucleic Acid Data Bank (NDB) The PDB and the mmCIF file formats for the storage and dissemintion of molecular structures.

UNIT III

Conformational Analysis :

Concept of free energy of molecules. Introduction tovarious force fields ad their relative merits and demerits. techniques for Molecuar energy minimization, Monte carlo and Molecular Dynamics simulation.

UNIT IV

Molecular Modelling :

Methods of molecular modelling including homology modeling, threading and ab initio protein structure prediction together with relative merits and demerits. Methods for structure comparison of macromolecules with special references to proteins.

UNIT V

Drug Design :

General ideas of drug designing 2D and 3D QASR, concept of a pharmacophore and pharmacophore based searches of ligand databases. Concepts of COMFA. Methods for simulated docking

Course Title: Genetic engineering **MM. 80 + IA 20**

Course No. MBT 233 **Time: 3h**

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory:

UNIT I

Scope of Genetic Engineering

Milestones in Genetic Engineering

Isolation of enzymes, DNA sequencing, synthesis and mutation, detection and separation cloning, gene expression. Cloning and patenting of life forms. Genetic engineering guidelines

Molecular Tools and Their Applications

Restriction enzymes, modification enzymes, DNA and RNA markers

UNIT II

Nucleic Acid Purification, Yield Analysis

Nucleic Acid Amplification and its Applications

Gene Cloning Vectors

Restriction Mapping of DNA Fragments and Map Construction, Nucleic Acid Sequencing

cDNA Synthesis and Cloning

mRNA enrichment, reverse transcription, DNA primers, linkers, adaptors and their chemical synthesis, Library construction and screening

Alternative Strategies of Gene Cloning

UNIT III

Cloning interacting genes-Two-and three hybrid systems, cloning differentially expressed genes. Nucleic acid microarray arrays

Site-directed Mutagenesis and Protein Engineering

How to Study Gene Regulation? DNA transfection, Northern blot, Primer extension, S1 mapping, RNase protection assay, Reporter assays

Expression strategies for heterologous genes

Vector engineering and codon optimization, host engineering,in vitro transcription and translation, expression in bacteria expression in yeast, expression in insect cells, expression in mammalian cells, expression in plants.

UNIT IV

Processing of recombinant proteins: Purification and refolding, characterization of recombinant proteins, stabilization of proteins.

Phage Display

T-DNA and Transposon Tagging

Role of gene tagging in gene analysis, T-DNA and Transposon Tagging, Identification and isolation of genes through T-DNA or Transposon.

UNIT V

Transgenic and gene knockout technologies

Targeted gene replacement, chromosome engineering.

Gene therapy: Vector engineering strategies of gene delivery, gene replacement/augmentation, gene correction, gene editing, gene regulation and silencing.

Practicals

Bacterial culture and antibiotic selection medias. Prepration of competent cells.

Isolation of plasmid DNA.

Isolation of lambda phage DNA .

Quantitation of nucleic acids.

Agarose gel electrophoresis and restriction mapping of DNA

Construction of restriction map of plasmid DNA.

Cloning in plasmid/phagemid vectors.

Preparation of helper phage and its titration

Preparation of single stranded DNA template

DNA sequencing

Gene expression in E. coli and analysis of gene product

PCR and Reporter Gene assay (Gus/CAT/b-GAL)

Course Title: Diagnostics **MM. 80 + IA 20**

Course No. BT 411 **Time: 3h**

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory:

UNIT I

Quality control, GMP and GLP, records.

Biochemical disorders

Immune diseases

Infections diseases

Parasitic siseases

Genetic disorders chromosomal disordes, single cell disordres and complex traits.

UNIT II

Chromosomal disoorders : autosomal ; sex chromosomal; karyotype analysis.

G-banding, in situ hynridization (FISH and on-FISH), and comparative genomic hybridization (CGH). Cancer cytogenetics; special karotyping.

UNIT III

DNA diagnostics : PCR based diagnostics :ligation reaction, southern blot diagnostics, m arrya vbased diagnostics, DNA sequencing, genetic profiling, single nucleotide polymorphism.

Haemoglobinopathies.

UNIT IV

Neuro developmental disorders

Neuro degenerative disorders.

Dynamic mutations

Biochemical diagnostic : inborn erors of metabolism, haemoglobinopathies, mucopolysaccharidoses, lipidoses and glycogen storage disorders.

UNIT V

Immunodiagnostics : diagnosis of infections diseases, respiratory disease (influenza, etc.) Viral disease- HIV etc. bacterial diaseses, enteric disease, parastic diseases and mycobacterium disease, Phage dispaly, immunoarrays, FACs.

Practicals

Bacterial culture and antibiotic selection medias. Prepration of competent cells.

Isolation of plasmid DNA.

Isolation of lambda phage DNA .

Quantitation of nucleic acids.

Agarose gel electrophoresis and restriction mapping of DNA

Construction of restriction map of plasmid DNA.

Cloning in plasmid/phagemid vectors.

Preparation of helper phage and its titration

Preparation of single stranded DNA template

DNA sequencing

Course No. MBT 412 **MM. 80 + IA 20**

Course Title: Somatic and Germ Cell engineering **Time: 3h**

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.
Theory:

UNIT I

Culture media-pH tempearture, ionic balance essential amino acids, cofactors growth factors and hormones, ultracetrifugation.

UNIT II

Primary cell Culture, secondary cell culture, cell transformation; immortalization and established cell lines.

Cell population growth, inhibition of growth by contact.

Cultures Suspension and semi- soil substances.

UNIT III

Embryo culture, transplanatation and teratogenesis

Teratomas. Stem Cell culture. Organ culture.

UNIT IV

artificialblood. Amniocentesis - karyology and biochemical diagnostics-genetic counselling.Mammalian embryo fusion allopheny.

UNIT V

Transgenesis- gene transfers, knock outs.

Somatic cell fusion somatic cell genetic.

PRACTICALS

Animal cell tissue culture - sterile working techniques.

Chick embryo fibroblast primary cel cultures and mouse chorionic villus cells.

Induced ovulation inmouse, collection of oviducal eggs and in vitro fertilization, culture in vitro of mouse embryos to the blastocyst state.

Transferring aforeign gene (e.g., chicken globin gene) into mouse fertilized eggs and transplanation of transformed mouse blastocysts in foster females .5. Microinhjection or elelctroporation of ES cells cells with foreign DNA (e.g., Chicken globin gene, transplantation into mouse blastocyst and transfer to foster females.

Diagnosing tail DNA of chimeric mouse pups for transferred genes fusing HeLa and Chicken erythrocyte cells in vitro for heterokaryons.

Course No. MBT 413 **MM. 80 + IA 20**

Course Title: Stem Cell Biology and regenerative Medicine **Time: 3h**

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.
Theory:

UNIT I

Introduction to stem cells - Embryonic Stem Cells Adults stem cells, Molecular basis Pluripotemtency and its application, Stem cell niches, Stem cell renewal, Cell cycles regulators in stem cells, epigenetic mechanism of cellular memory, Germ line stem Cells, Stem Cells and cloning, Nuclear cloning and Epigenetic reprogramming Endothelial Progenitor cells.

UNIT II

Basic Biology/ mechanics - Transcription factors -Otx^2 Winged Helix, Goose cord Lim and homeobox gene; growth factors and signal cascades factors signal cadsadesBMP, Nodal, Wnt, Notch and Terenoid signaling during gastrulation.

UNIT III

Tissue and Organ Development - Differentiation in early development, Primordia germ cells in mouse and Human, Bone Marrow Mesenchymal Stem Cells, Hematopoietic Stem Cells : Identification, Chacraterization, Assays and Cell Lineages.

Neurogenesis, Epithelial stem cell, Skeletal muscle stem cell, development of the Cardiovasular system from Embryoi Stem Cells, adult liver cell, Embryonic kidney cell, stem in Kidney Morphogenesis

UNIT IV

Methods- Growth factors and serum free culture, Human pluripotent stem cell culture, feeder free culture, Surface antigen markers, Lineage

marking, Genomic reprogramming, Homologous recombination in humnan stem embryonic cells.

UNIT V

Applications- Neurons Stem Cells and Potential therapies, spinal cord injury, Stargies. Using Cell Therapy to Induce Cardiomyocyte Regeneration in Adults with Strategies Using Cell therapy to Induce cardiomyocyte regeneration in Adults with Haert Disease, Burns and Ulcers, Muscular dystrophy, Orthopedic, Tisue engineering Stem Cell Therpy, Noninvasive Imaging in stem cell Therapies : Current state and Future Perspective of Stem Cell.

Course No. MBT 414 **MM. 80 + IA 20**

Course Title: Social, ethical and legal issue Medical Biotechnology **Time: 3h**

NOTE: In all ten questions will be set, two from each unit. Students are required to attempt any five questions i.e. one from each unit.

Theory:

IPR -patents and copyrigts, Patentabiity of life forms with special refernce to Microorganisms, Pharmaceutical indutsries, Biodiversity, aturally occuring substances . Human genome and IPR in Public- Private partnership

Availabities of Patent facilitating funds, Substantitive Patent Law Treaty (SPLT), Word Patent, European Patent.

UNIT-II

Social- genetic discrimination: insurance and employment, human cloning, foeticide, sex determination. Religious consideration in stem cell therapy

Ethical: somatic and germ line gene therapy, clinical trials, the right to information, ethics committee function.Social and ethical issues Ethics in human stem cell research FDA product and regulatory considerations in stem cell.

UNIT-IV

Biosafety - Definition requirement containment facilities,biohazards, geneticallymodified organisms (GMOs) living modified organisms (LMOs), Biosafety for human health and environment designing and management of laboratory and culture room as per the norm of GLP, GMO and FDA.

UNIT-V

Management- Planning, Organizing, Leading & Controlling; Concepts and characteristics of information ; importance of MIS; Communication - type, channels & barriers; Financial management, planning and *control*

PRACTICAL

Survey and preparation of datasheet social response for use of drug and bio-aids, developed through biotechnology means. Application of statistical methods in data analysis of social response in using drug and healthcare derived from transgenic bacteria, animal and transgenic plants.

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Course No. MBT 134 **MM. 75**

Course Title: Microbiology **Time: 3h**

NOTE: In all ten questions will be set. Students are required to attempt any five questions. The examiner should cover entire syllabus while setting question paper.

Course No. MBT 135 **MM. 75**

Course Title: Computer application, Biomathematics & Biostatistics **Time: 3h**

NOTE: In all ten questions will be set. Students are required to attempt any five questions. The examiner should cover entire syllabus while setting question paper.

Theory

Fundamental of computing; Introduction to operating system: WINDOWS,NT,UNIX,LINUX operating system; comparative advantages of security (hacking, cracking), Installation, portability, and programming of these operating system; computer viruses; use of internet and WWW; searches on MEDLINE, CD, bibliographic database.

Graphics: Visualization technique- Software and Hardware, Interactive graphic; Viewing in the 3D; Raster algorithm; Surface and solid modeling; Rendering; animation; Image processing with stress on Biological system; 3D image reconstruction.

Computer Networking-LAN,WAN,MODEM; Optical Vs; Electronic Networking, Security of the network, Fire-walls, Network goals; Application Network; Networks architecture; Hierarchical networks; Ethernet and TCP/IP family of protocols ; Transport protocol design. Brief description and tabulation of data and its graphical representation

Measures of central tendency and dispersion: mean, median, mode, range,

standard deviation, variance, Idea of two types of errors and level of significance, tests of significance (F&t test); chi-square tests.

Simple lincur regression and correlation

Matrices: Elementary row and column transformations. Linear dependence, Rank of matrix, Consistency of system of linear equations and solution of linear system of equations. Characteristic equation, Cayley-Hamilton theorm, Eiger values and Eigen vectors, Diagonalisation, Complex and unitary matrices.

Differential Calculus I: Leibnitz theorm. Partial differentiation. Euler's theorm, Asymptotes, Curve tracing Change of variables. Expansion of functions of several variables.

Differential Calculus II: Cylindrical and spherical coordinate systems,Jacobians, Approximation of error Extrema of function of several variables, Lagrange's method of multipliers (Simple applications).

Multiple Integrals: Double and triple integral. Change of order, change of variables. Beta and Gamma function, Applications of area, volume, Dirichlet integral and applications.

Vector Calculus: IPoint function. Gradient. Divergence and curel of a vector and their physical interpretation. Lin Surface and Volume integrals, Greens, Stoke's and Gauss divergence theorm.

Practical: Exercises on WINDOWS, LINUX,UNIX and Networking, Internet search and Graphics.

Course No. MBT 136 **MM. 75**

Course Title: Enzymology **Time: 3h**

NOTE: In all ten questions will be set. Students are required to attempt any five questions. The examiner should cover entire syllabus while setting question paper.

Theory

Enzymes: Introduction and scope, Nomenclature, Mechanism of Catalysis, Chemical and Physical properties of enzymes. Information from composition and sequence.

Structural Details: Determining the Molecular Weight, Size and Shape by modern technique; De Novo structure prediction from sequence; Solution structure from NMR measurements; Solution of X-ray diffraction pattern, Modeling from a close homolog, Comparing different structures.

Enzyme Kinetics: Single substrate steady state kinetics; King-Altman's method;

Inhibitors and activators; Multi-substrate systems; Effect of pH and temperature;

Allosteric enzymes.

Immobilization of Enzymes: Advantages, Carriers, adsorption, covalent coupling,

cross-linking and entrapment methods, Micro-environmental effects

Enzyme Reactors: reactors for batch/continuous enzymatic processing, Choice of reactor type; idealized enzyme reactor systems; Mass Transfer in Enzyme Reactors; Steady state analysis of mass transfer and biochemical reaction in enzyme reactors.

Bio-process Design: Physical parameters, reactor operational stability; Immobilized cells.

Types of enzyme preparations and their characterization

Enzymes in food, fodder, textile and tanning industry, medicine, production of biodetergents.

Challenges and future trends: Enzyme catalysis in organic media; Catalytic antibodies and Non-protein biomolecules as catalysts, Biocatalysts from Extreme Thermophilic and Hyperthermophilic Archaea and Bacteria.

Practicals

Electrophoresis of Proteins - native and under denaturing conditions

N- and C- terminal analysis of proteins

Peptide mapping

Separation techniques (HPLC, GPC, FPLC)

Chemical modification of proteins

Enzyme: purification and kinetic analysis

Hydrodynamic properties measurement and applications

Methods for immobilization of enzymes

Techniques for analysis of Secondary, tertiary and quaternary structures of proteins

Electrophoresis of DNA linear, circular and super coiled

Protein-DNA interaction

Nucleic acid hybridization

Determination of Tm of nucleic acid

Course No. MBT 232 **MM. 75**

Course Title: Bioinformatics **Time: 3h**

NOTE: In all ten questions will be set. Students are required to attempt any five questions. The examiner should cover entire syllabus while setting question paper.

Theory

Historical introduction and overview: Discovery of first sequencing DNA molecule, History of sequences analysis program, Alignment of sequence, multiple sequence alignment, Importance of database search, FASTA and BLAST methods, Protein structure prediction and history of genomic sequence.

Collection and storing sequences in the laboratory: Sequencing of DNA, cDNA, Sequence format, and conversion of one sequence to another, multi-sequence format, Using database access program ENTREZ.

Alignment of pairs of sequences: Define sequence alignment its significance and methods of sequence alignment., Dynamic programming, algorithm

for sequence alignment, use of scoring matrices in sequence alignments.

Multiple sequence alignment: Genome sequencing, Methods for multiple sequence alignment, statistical method for aiding alignment, Position specific scoring matrices

Prediction of RNA secondary structure: Basic for RNA structure prediction methods, analysis of folding of RNA, secondary structure of RNA and application in modeling

Phylogenetic prediction: Phylogenetic analysis to sequence alignment, concept of evolutionary tree

Database searching for similar sequences: DNA vs protein search, scoring matrices for similarity searches, FASTA sequence search similarity search, basic local alignment tool BLAST.

Gene prediction: Testing of reliability of an ORF prediction, gene prediction in microbial genomes, gene prediction in eukaryotic , evolutionary method promoter prediction in pro and eu-karyotes.

Protein classification and structure prediction: Alignment of protein structure, modeling on protein structure

Genome analysis: Genome anatomy for pro and eu-karyotic sequences, comparative genomic, functional classification of gene.

Practical: Computational modeling of genomic proteomic, evolutionary tree designing on databases, network search on genomic and proteomic databases.

Course No. MBT 214 **MM. 75**

Course Title: Genomics and Proteomics **Time: 3h**

NOTE: In all ten questions will be set. Students are required to attempt any five questions. The examiner should cover entire syllabus while setting question paper.

Theory

Role of computers in Biology and Medicine, Biological databases: Primary and secondary databases for Proteins, Nucleic acids (DNA/RNA),

Metabolic pathways, Microbial and Cellular data bases, NCBI, EMBL, KEGG, DDBJ, SWISSPROT, PDB, PIR etc.; Tools for DNA sequence analysis, protein sequence analysis; Usage of sequence alignment and searching tools for Gene Identification, Genome Annotation, ORFs, ESTs, Codon biases, Redundancy, Search engines; Conserved motifs, patterns, blocks, domains, Secondary and tertiary Structure prediction tools; FASTA, BLAST, PSI-BLAST, CLUSTALW, Multalign, Dialign, GeneBee, MotifScan, TMPred, GOR, Chou-Fasman, NNPredict, Promoterfinder, NEBcutter, Genscan, ORF Finder, IntronExon finder etc

Using Biological databases; Structure visualization and Building; Protein Sequence Analysis; Genome Analysis; Protein Secondary and Tertiary structure prediction; Homology Modeling; Phylogenetic Analysis Software and Tools: Swiss PDB Viewer, Hyperchem, InsightII, Viewerlite, Rasmol, BLAST, Alibee, Phylip, CLUSTAL, GLIMMER, TCS Biosuite Special topics: Bioinformatics perspectives on human diseases; SNPs; DNA microarrays

Practical

Structure prediction of DNA, RNA and protein through different available software tools on Internet.

Course No. MBT 215 **MM. 75**

Course Title: IPR and Patent **Time: 3h**

NOTE: In all ten questions will be set. Students are required to attempt any five questions. The examiner should cover entire syllabus while setting question paper.

Theory:

Scientific breakthroughs of Biotechnology at national and international level.

Commercial breakthroughs of Biotechnology at national and international level.

Biotechnology and business opportunities.

Concept on IPR, Breakthroughs of IPR at national and international level.

Important facts and figures while updating IPR.

Patentability of life forms with special reference to Microorganisms, Pharmaceutical industries, Biodiversity, Naturally occurring substances.

Human genome and IPR.

Government policies at national and international level in patenting IPR.

Nature of national and international IPR.

Owner ship of Intellectual Property.

IPR related to technology transfer and royalty to inverters.

Issue on IPR in Public-Private partnership.

Availabilities of Patent facilitating funds.

Substantive Patent Law Treaty (SPLT).

Word patent, European Patent.

SEMESTER—III

Course No. MBT 331 **MM. 75**

Course Title: Diagnostics **Time: 3h**

NOTE: In all ten questions will be set. Students are required to attempt any five questions The examiner should cover entire syllabus while setting question paper.

Theory

Quality control, GMP and GLP, records.

Biochemical disorders

Immune disorders

Infectious diseases

Parasitic diseases

Genetic disorders, chromosomal disorders, single cell disorders and complex traits.

Chromosomal disorders : autosomal; sex chromosomal; karyotype analysis.

G-banding, in *situ* hybridization (FISH and on-FISH), and comparative genomic

hybridization (CGH).

Cancer cytogenetics: spectral karyotyping.

DNA diagnostics: PCR based diagnostics; ligation chain reaction, southern blot

diagnostics, array-based diagnostics, DNA sequencing, genetic profiling, single

nucleotide polymorphism.

Haemoglobinopathies.

Neuro developmental disorders.

Neuro degenerative disorders.

Dynamic mutations.

Biochemical diagnostics: inborn errors of metabolism, haemoglobinopathies, mucopolysaccharidoses, lipidoses, and glycogen storage disorders.

Immunodiagnostics: diagnosis of infectious diseases, respiratory diseases (influenza, etc.)

Viral diseases-HIV etc., bacterial diseases, enteric diseases, parasitic diseases and

mycobacterium diseases.

Phage display, immunoarrays, FACs.

Practical:

G-banded chromosomal preparations for detection of autosomes of autosomal/sex chromosomal disorders. (translocation, deletion, Down's syndrome, Klinefelter's syndrome, Turner's syndrome, etc.)

FISH for detections of : translocations, inversions (using appropriate probes) (e.g., chro 9-22 translocation; X-Y translocation)

PCR bases diagnosis (e.g. fragile-X syndrome; SRY in sex chromosomal

anomalies).

Southern blot-based diagnosis (e.g. trinucleoide expansions in fragile-X syndrome, SCA, etc.)

DNA sequencing of representative clones to detect mutation(s)

PCR-SSCP to detect mutations (e.g., sickle cell anemia, thalassemia)

SNP analysis for known SNPs.

PAGE: band detection of enzyme variants.

Immunodiagnostics.

Production of monoclonal antibodies.

Immunogenetics of mice-fusion of myeloma cells.

Course No. MBT 333 **MM. 75**

Course Title: Heterologous protein expression **Time: 3h**

NOTE: In all ten questions will be set. Students are required to attempt any five questions The examiner should cover entire syllabus while setting question paper.

Theory:

Traditional methods involved in heterologous protein expression in pro- and eu-karyotic system.

Heterologous protein expression in non-conventional system (Soluble and non-soluble):

Heterologous protein production in prokaryotes (*Lactococcus lactis and E.coli*) and its delivery system

Heterologous protein production in eukaryotes (Yeast) and its delivery system

Application of Heterologous protein expression for vaccine production, Protein-protein interaction: Homo oligopolymerization, interaction between heterologous protein, protein domains in signal transduction, protein domain involved in transcription regulation, Characterization of protein-protein interaction.

Heterologous protein for therapintic use: Novel therapintic proteins (Actropid, Ambrix, Combax, Elitex, Glucagen, HBVAXPRO, Hexavac, Leukin, Novalog, Angiostatin) in Yeast/ E. coli / filamentous fungi.

Glycosylation of therapintic proteins

Basic concept on commercialization of therapintic protein

Practical:

Analytical ultra centrifugation for heterologous protein isolation, light scattering method for protein quantification, fluorescence spectroscopy for protein –protein interaction, UV-Vis spectroscopy for Protein-protein interaction. isothermal titration, and calorimetric method for protein-protein interaction.

Course No. MBT 334 **MM. 75**

Course Title: Cloning and Stem cells **Time: 3h**

NOTE: In all ten questions will be set. Students are required to attempt any five questions The examiner should cover entire syllabus while setting question paper.

Theory:

Stem Cell Basics: Definitions of stem cell, Key terms, Possibilities of stem cell research

Human Embryonic Stem Cells: Human embryonic development, Where do HESCs come from: preimplantation blastocyst, How to culture HESCs, What types of cells HESCs become, Somatic Cell Nuclear Transfer—alternative source of pluripotent stem cells?

Adult Stem Cells : Differences between adult and embryonic stem cells, What types of cells ASCs can become, Therapies in use today: bone marrow transplants, Adult stem cells as a useful research tool and promising therapy

Stem Cells and Disease: Current stem cell therapies, How we can use stem cells for studying cancer and finding cures to other diseases, Correlation between stem cells and cancer, Breast cancer

Ethics: Controversy surrounding HESC research, Different religious views,

societal implications: women, low-income, Current Ethical Guidelines in America, Ethical views of other countries and how this affects advancement of science

Policy: How idealism influences policy , Bush's stem cell policy ,Current legislation: CA Prop. 71 and HR 810 bill for federal HESC funding, Public misconceptions and how this hinders SCR

Practical:

Demonstration on stem cell culture rector, preparation of media for stem cell culture, demonstration on stem cell culture in shake flask level, demonstration on culture in fermentation methods, Microscopic study of embryo in developing phase.

SEMESTER—IV

Course No. MBT 431 **MM. 75**

Course Title: Hormones and Signal transduction **Time: 3h**

NOTE: In all ten questions will be set. Students are required to attempt any five questions The examiner should cover entire syllabus while setting question paper.

Theory

Hormones – chemistry, mechanism of action and physiological effects. Nutrition and food assimilation, macronutrients and micronutrients, vitamins and trace elements, chemistry and metabolism of purines and pyrimidines. Immunology.

Stability of protein structures: flexibility, reversible folding and unfolding, pH titration, chemical denaturation, thermal denaturation solvent perturbation and chemical modification.

Lipid structure and their organization, phase transitions in lipids, polysaccharides, molecular shapes and the conformation, comparison between different membrane models, diffusions and permeability, carrier transport, ion transport, active and passive transport, ion pumps, water

transport, use of liposomes for membrane models and drug delivery systems.

Endocrines & Reproduction

• Classification of Hormones • Mechanism of Hormone action

• Measurement of hormones in Blood • Endocrine functions of the hypothalamus

• Pituitary • Thyroid • Adrenals • The endocrine pancreas • Pathophysiology of diabetes

• Parathyroid, calcitonin, Vit D & calcium metabolism • Pineal gland • Testosterone & male sex hormones • Spermatogenesis • Hyper & hypogonadism • Menstrual cycle

• Female sex hormones.

Course No. MBT 432 **MM. 75**

Course Title: Metabolic disorders and gene therapy **Time: 3h**

NOTE: In all ten questions will be set. Students are required to attempt any five questions The examiner should cover entire syllabus while setting question paper.

Theory

Nutritional implications and metabolic roles of minerals and vitamins in animal metabolism. The course is designed to instill a basic understanding of vitamin and mineral functions, absorption, metabolism, and excretion. Research

Methodologies used in the study of vitamin and mineral nutrition will also be discussed. Prerequisite.

Metabolic disorders related to nutrition, and application of various dairy feeding guides. Starvation and diabetes mellitus; the sprinter and the marathon runner; dieting and the Atkins diet. Glycogen storage diseases, defects in carbohydrate metabolism - lactose, fructose, galactose and glycerol metabolism. Defects in fatty acid metabolism, carnitine transferase and acyl CoA deficiencies, Jamaican vomiting sickness. Defects in amino acid metabolism, phenylketonuria, alkaptonuria. Defects in the enzymes

of the urea cycle.

The most important skin tumours

· osteoporosis

· diabetes mellitus

· disorders of lipid metabolism

· amyloid diseases

· autoimmune systemic diseases, including chronic rheumatoid

arthritis

Metabolic disorders and its consequences: diabetes, obesity and cardio-vascular disease;

the role of smoking and diet, cancer; and ageing. Metabolically active tissues.Metabolic abnormalities.Recombinant DNA applications. Molecular aspects of growth/regulation of gene expression.

Endocrine/metabolic diseases of all species. Unique metabolic problems of large animals. Pediatrics/geriatrics of companion animals. Oncological diseases of companion/large

animals.

Pathophysiology ,clinical presentation, diagnostic approach, therapeutic options ,and management protocols for metabolic and endocrine based disorders of domestic species.

unusual metabolic pathways,

Mitochondrial metabolic disorder [myopathy]

Biochemical, ultrastructural and clinical studies

Genetic studies - Human mtDNA and mtDNA mutation Correlation of biochemical, genetic and clinical studies

Role of reactive oxygen species. major metabolic pathways, including their control; and structure, biosynthesis, and catabolism of nucleotides.

Human gene therapy.