Syllabus for Medical Biotechnology (2-year Course)

Semester I

Theory

MBT 1-1 : Biochemistry and Cell Biology I (50 L)

Cell: Molecular, structural/functional organization.
Light microscopy, ultrastructure and electron microscopy.
Macromolecules in biology: Properties of water
Chemical bonds
Building blocks of macromolecules: amino acids, purine and pyrimidine bases, fatty acids and sugars, and small molecules of biological importance: vitamins and minerals, proteins, carbohydrates and lipids.
Biochemical structures: proteins, nucleic acids, and lipids.
Secondary structure, tertiary structure.
Ramachandran plot, structure-function correlations, anatomy of biological macromolecules.
Structure and organization of genome: structure of globin, insulin, IgG and r DNA genes, structure and function of chromatin, DNA replication.
Sequencing: nucleic acids and proteins.
Transcription: structure of a transcriptional unit, mRNA and coding sequence.
Transcription and processing of rRNA and mRNA
Capping, polyadenylation and splicing reaction
Regulatory signal elements: promoter, hLh motifs. Transcription factors.
Translation: ribosomes and tRNAs. Mechanism and regulation of protein synthesis
Post Translational modification of proteins, inhibitors of protein synthesis
Cell dynamics, cytoskeleton and cell surface.
Extracellular matrix
Cell-cell interactions and cell-matrix interaction
Cell differentiation
Apoptosis
The transformed cell

MBT 1-2a : Biochemistry and Cell Biology II (25 L)

pH and temperature
Equilibria and energetics
Spectroscopy: UV, visible and fluorescence
Electrophoresis: PAGE, high voltage, electrofocussing, 2-D gels, agarose gel.
Radioactivity.

Instrumentation, nucleids of use in biology, metabolic labelling, measurement of fluxes.
Transport: theory and measurements.
Chromatography: gel permeation, adsorption (ion exchange, affinity), TLC, partition, HPLC, protein purification, centrifugation and subcellular isolation.
IR, NMR, CD, ORD, X-ray diffraction.
Enzymes: classification, catalysis, kinetics, regulation (fine, coarse and metabolic control), reaction mechanisms, immobilization of enzymes, coenzymes and cofactors.
Allosteric proteins
Microscopy, light, phase contrast and fluorescence, morphometry.
Cell division and cell cycle.
Chromosomes.
Fractionation of subcellular organelles.
Metabolic pathways: glycolysis, krebs cycle, pentose phosphate pathways, glycogen metabolism, fatty acids biosynthesis and oxidation, oxydative phosphorylation.
Cell signalling: hormones and growth factors, hormone receptors and signal transduction.
Biomembranes and electrophysiology: action potentials, mepp, single channel conductance, liposome.

MBT 1-2b : Human Physiology (25 L)

Introduction to brain and neurobiology.
Sight and perception, hearing and balance, smell, taste, touch, pain, analgesics.
Skin, hair.
Muscles, movement, rheumatoid disorders.
Heart and blood circulation, blood clotting, microvasculature.
Lungs, surfactants.
Body fluids, fluid balance, parenteral solutions, renal physiology.
Hormones and homeostasis.
Digestive system, reproductive system, nervous system.
Genital system, reproductive biology and contraception.
Diseases of the digestive system, breathing, circulation, nervous system, skin, glands.
Mechanisms of drug action

MBT 1-3 : Quantitative Methods (50 L)

Statistics and computer
Statistical population, sample from population, random sample.
Tabular and graphical presentation
Mean and standard deviation of grouped and ungrouped data
Derivative and its physical significance, basic rules of differentiation (without derivation) maxim and minima, their applications in chemistry, exact and inexact

differentiation with specific emphasis on thermodynamic properties, partial differentiation
Curve sketching
Basic rules for integration (without derivations), definite and indefinite integrals, geometric meaning of integration, applications in biology and chemistry.
Separable variable, homogeneous, exact and linear equations, equations of second order, applications of differential equations in chemistry.
Interpolation and polynomial fitting
Probability, relative frequency, probability distribution.
Binomial, poisson and normal distribution.
Test of significance, test for proportion, means and standard deviations, F-and t-test and chi-square tests for goodness of fit.
Theory of errors, errors and residuals, precision, measure of precision, probable error of function, rejection of observation.
Methods of averages and least squares
Correlation and linear regression, associated test of significance
Analysis of variance for one and two-way classification
Design of experiments, randomisation, replication, local control, completely randomised and randomised block design.
Nonparametric tests

Computers

An overview of computers, microcomputers, VDUs and printer.
What is programming? Algorithms.
Languages and packages: Introduction to MS Office, MS Access, Front Page and introduction to C, Java and SQL (structured querry language)
Handling arrays, procedures.
Colour, sound and graphics.
Use of standard packages.

MBT 1-1P Biochemistry and Cell Biology Practicals (30x 3 h)

Introduction to measurements: balances and pipetting. Preparation of solutions of given normality and its standardization.
pH meter: buffering capacity of a buffer, indicators. To determine the pKa value and hence the Dissociation constant of a given acid by using pH meter. Determination of the amount of a-amino nitrogen by the formol titration method
Colorimetry: To determine dissociation constant of a given indicator, Colorimetrically and to prepare buffer solutions in the pH range of 2.2 to 8.0
Spectrophotometry: Double-beam and recording spectrophotometry, derivatives and difference spectra: Indicators, cytochromes, hemoglobin. To find out the absorption spectrum of a Given chrom ophore and/or oxidized and reduced forms (sodium nitrite and borohydrate).
a) Hemoglobin and methemoglobin
b) NAD and NADH c) Spectrophotometer absorption spectrum, activity of the fraction or

260/280 ratio.
Estimation of protein: Lowry, Biuret and Bradford methods, standard curves, linear regression and assessment of ranges and reliability.
Enzyme assays (LDH, b-galactosidase, acid phosphatase, arginase, succinic dehydrogenase) time, temperature, protein concentration, cofactors. LDH : Km and Vmax, various kinetic plots.
Radioactivity: To determine the half-life, average life and decay constant of a radioactive isotope.
Protein purification: Ammonium sulfhate, acetone, TCA precipitation., dialysis concentration thin layer chromatography: lipids, mixture of dyes.
Liposome preparation, sonication, light scatter, Uni and multilamellar vesicles, turbidity/light scatter and size of vesicles.
Microscopy: a) simple, compound, phase contrast b) Micrometry: Calibration of stage and ocular micrometer and measurement of the given biological sample.
c) Haemocytometer d) Electron microscopy: Demonstration and good photographs for interpretation e) photography and videotaping: (motility, morphometry)
Cell motility and flagellar staining
Blood cells: a) RBC: Osmotic fragility b) WBC: Differential counting.
Subcellular fractionation: a) mitochondria, nuclei, etc., b) Centrifugation: Differential and density gradient (sucrose, percoll, CsCI).
Embryo development: Permanent mounts and experimental: a) Chick: Developmental stages and gastrulation (permanent slides and fresh preparation)
Programmed cell death during embryonic development
Cytology and histology of major organs and endocrine glands (permanent slides and fresh preparation)

MBT 1-3P : Quantitative Methods Practicals (20 x 3 h)

Statistics and computer
Descriptive statistics: Systematic tabular summarization of data (before analysis), measures of central tendency, measures of dispersion, measures of skewness (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 co - mputer software packages).
Statistical distributions: fitting discrete uniform, binomial, Poisson and normal probability distributions to given data
Testing of hypotheses: Tests of significance (mean, standard deviation, correlation coefficient), chi-squared 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).
Ratio and proportion
Factorial notation, permutation and combination.
System of algebraic equations (verification of consistency and finding solutions)
Round-off error and how to minimize it while evaluating algebraic expression (can be included in computer course)
Functions and their graphs
Concept of limit of function
Computing area under a curve of regular/arbitrary shape
Overview of computers, microcomputers, VDU and printer.
What is programming? Algorithms
Languages and packages: Introduction to MS Office, MS Access, Front Page and introduction to C, Java and SQL

Semester II

Theory

MBT 2-1 : Molecular Biology (50 L)

The central dogma: Law of DNA-, chromosome-and gene constancy.
Evidence that DNA is the genetic material
Structure of DNA, RNA and polypeptide.
The concept of template surfaces: Physical properties of DNA: Cot curve, kinetic and sequence complexity, Tm, buoyant density (centrifugation), satellite DNA, gel electrophoresis.
DNA replication- models
DNA- dependent and RNA-dependent DNA polymerases-mode of action
DNA amplification and polytenization
DNA damage, repair and recombination.
DNA modification enzymes-methylation, demethylases, DNAses, gyrases, topoisomerase, restriction endonucleases.
RNA transcription-phage, E.coli and eukaryotes (RNA polymerase-structure and mode of action.
Structure of chromatin-nucleosomes, solenoids, scaffolds, histone modification, transcription, condensation and decondensation.
Nucleo-cytoplasmic transport of ribonucleoproteins
Structure of tRNA, rRNA, pre-mRNA and mRNA-processing; exon, intron.
Structure of genes-promoters, enhancers, TATA box, transcription initiation and termination sites, consensus sequences.
Structure of ribosomes
Genetic code, translation, polypeptide folding and modifications.

Secretion

MBT 2-2 : Genetics and Developmental Biology (50 L)

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 organelles. rDNA amplification in amphibia; transcription on lampbrush chromosomes, ovulation and hormonal control in mammals.
Molecular and cellular biology of fertilization: acrosome reaction and signal transduction, monospermy and species-specificity.
Egg activation, early cleavages and blastocyst formation in mammals and biochemical and cellular changes during the passage down the oviduct to the uterus.
Implantation and formation of the placenta in mammals
Gastrulation in mammals-formation of primitive streak, morphogenetic movements and neural induction.
Organogenesis and foetal development
Pattern forming genes and expression in Drosophila and mammalian embryos
Development of the mammalian brain-cerebral cortex-cell lineages
Lens development-fibre differentiation, programmed morphogenetic histogenetic cell death (apoptosis).
Erythropoeisis, myelopoeisis.
Ageing
Recapitulation of Mendelian principles
Concept of a gene, multiple alleles, gene interactions Dominance
Chromosomal basis of inheritance: Consequences of chromosomal organization; segregation, linkage, linkage groups, recombination maps in diploids.
Inheritance of quantitative traits, genetic basis and influence of environment.
Principles of population genetics: Hardy-Weinberg law and its application for autosomal genes
Organization and mutational analysis of *lac* and arabinose operons
Mobile genetic elements: Trasposons
Molecular basis of spontaneous and induced mutations

MBT 2-3 : Medical Microbiology/Biology of Infectious Diseases (50 L)

Disease burden : microbial, viral, fungal and parasitic.
Investigation of epidemics
Methods of culturing and assaying: bacterial, viral and parasitic.
Classification: fungal, protozoal, helminthic, bacterial and viral
Replication of DNA, RNA^{+ve} and RNA^{-ve} viruses, retroviruses
Viral vaccines: conventional: killed/attenuated; DNA; peptide; recombinant proteins.

Sterilization techniques: biohazard hoods; containment facilities, BSL 2,3,4.
Bacterial and viral vectors
Biological warfare agents
Mode of action of antibiotics and antivirals: molecular mechanism of drug resistance (MDR)
Hospital-acquired infections (nosocomial), immune compromised states.
Water and waste management for water-borne diseases.

MBT 2-1P : Molecular Biology Practicals (20x3 h)

Isolation of nuclei and analysis of chromatin- i) determination of mononucleosomal size ii) chromatin gel electrophoresis
Endonuclease digestion of nuclei and analysis of DNA fragments by agarose gel electrophoresis
Thermal melting of DNA
DNA: a) isolation of DNA (nuclear and Mt) b) Agarose gel electrophoresis c) detection of DNA modifications: i) restriction endonuclease digestions and separation of fragments by gel chromatography and density gradient centrifugation ii) Base composition analysis of DNA.
To find out the capacity and nature of the given ion-exchange resin (ion exchange chromatography).
Gel filtration chromatography.
DEAE cellulose chromatography of DNA.
2-D gel electrophoresis of proteins and isoelectrofocusing.

MBT 2-2P : Developmental Biology and Genetics Practicals (15x3 h)

Developmental Biology

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 Drosophila.
5. Non-allelic and allelic interaction in Drosophila.
6. Linkage study in Drosophila.
7. Allelic and heterozygotic frequencies in human populations.
8. Analysis of quantitative traits: frequency distribution, standard deviation and variance.
9. Karyotyping human cells and chromosomal in situ localization of genes.

Genetics

Cell division : mitosis and meiosis.
Mutants of Drosophila. Sex liked lethals in Drosophila

Mono and dihybrid crosses in drosophila-Mendel's laws of genetics.
Sex likage in Drosophila.
Dominant lethals in Drosophila.
Sister chromatid exchange in CHO cell line : control and EMS-treated.
Use of Drosophila as a model system in genetics: morphology, life history, mutants, culture, sexing pupae for setting up crosses, etc.
Study of autosomal gene heritance.
Study of sex-linked gene inheritance.
Estimating gene frequencies in human population, estimation of heterozygotes frequencies.
Isolation/identification of auxotroph mutants in bacteria.
Recombination in bacteria.
Pedegree analysis, analysis of human karyotes, chromosomal aberrations.
Micronucleus test for detecting genotoxins.
Study of sister chromatid exchange for genotoxicity study.
AME's test for screening genotoxins.

MBT 2-3P : Medical Microbiology Practicals (15x3 h)

Staining techniques.
Haemagglutination test.
Commercial kits-based diagnosis.
Antibiotic sensitivity (bacterial).
Electron microscopy (demo)
Bacterial culture
Agar gel diffusion
ELISA
Preparation of axenic cultures

Semester III

Theory

MBT 3-1 : Genetic Engineering, Genomics and Proteomics (50 L)

General introduction to the concepts of genetic engineering
Use of various enzymes in recombinant DNA work
Vectors in gene cloning-plasmids, bacteria phages, shuttle vectors, Ti plasmid, expression vectors, shotgun cloning and cDNA cloning techniques.
Selection of recombinant DNA clones.
Construction of genomic and cDNA libraries.
Identification and characterization of insert DNA fragments. Restriction mapping.
Chromosome walking and chromosomal localization of genes.
RFLP and other uses of cloned sequences.
Cloning of microbial genes e.g., strepto---

PCR-based analysis, YACS, microcloning, RFLP, DNA fingerprinting.
Site-directed mutagenesis and molecular chimeras
Use of genetic engineering in environmental management, biodegradation, biosafety.
Data bases in gene and genome analysis-data mining, inventories, sequence homology search.
Proteomics-2D analysis of cell protein, analysis and sequencing individual spots by Mass spectrometry (Malditoff) and protein microarrays.

MBT 3-2 : Human Genetics and Human Genome (50 L)

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 genetic study in man – pedigree analysis, chromosomal analysis, biochemical analysis.
Somatic 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 abnormalities; clinical aspects of autosomal and sex chromosomal disorders; inborn errors of metabolism, haemoglobinopathies.
Human genome mapping – genetic mapping, physical mapping-restriction fragment length polymorphism, pulse field gel electrophoresis, yeast artificial chromosomes, bacterial artificial chromosomes, P1 derived artificial chromosomes, expressed sequence tags, sequence-tagged sites, microsatellites and single nucleotide polymorphisms.
Inherited human diseases-single gene diseases, complex traits.
Identification and isolation of disease genes – positional cloning, functional cloning, DNA and cDNA microarrays.
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.

MBT 3.3 : Immunology, Vaccines and Transplantation Technology (50L)

Overview: concept of self and nonself, antigens, antibodies; immune response, evolution of immune response, immunological tolerance, hypersensitivity, humoral

and cell-mediated immunity, active and passive immunization.
Antibody-Immunoglobulin: classes and subclasses, structure-function relationship, isotypes, idiotypes and allotypes.
Immunobiology: development of the immune system, development of the lymphoid tissue, cellular basis of immunity, T cell receptor.
Antigen-antibody reaction, complement fixatior, agglutination, immuno-electrophoresis, immunofluorescence, enzyme-linked immunosorbant assay (ELISA), radioimmunoassay (RIA).
Immunogenetics: blood groups and transplantation antigens, HLA and disease association. Immune deficiencies and disorders, immunological diseases including AIDS, antigen processing and MHC.
Allergy, immunoprophylaxis; vaccines, monoclonal antibodies.
Theories of antibody synthesis and generation of antibody diversity-molecular basis.
Immunity to infections by viruses, bacteria, fungi and parasites and immunity to tumors autoimmune diseases: aetiology, pathogenesis and treatment.

Practicals

MBT 3-1P : Genetic Engineering, Genomics and Proteomics Practicals (25 x 3 h)

Isolation of plasmid DNA-i) minipreparation ii) large-scale isolation
In *vitro* DNA ligation, transformation of *E.coli.*
Techniques: a) DNA blotting technique b) DNA hybridization.
Isolation of cytoplasmic RNA.
Electrophoresis of RNA on denaturing gels.
Northern blotting technique.
Separation of poly A+RNA on oligo-dT column.
cDNA synthesis and cloning.
RNA hybridization-dot and northern blots.
In *situ* detection of RNA in embryos/tissue.
In vitro translation.
Seqencing and computer analysis.
PCR/RFLP technique.

MBT 3-2P : Human Genetics Practicals (10 x 3 h)

Pedigree analysis
Chromosome preparations-PHA-stimulated short-term blood cultures, air-dried chromosome preparations.
G-banding of chromosomes.
Karyotype preparation.
In situ hybridization-FISH (example with centromeric and telomeric probes).
Polyacrylamide gel electrophoresis-detection of enzyme (for example-G6PD, an X-linked

enzyme)
RFLP-radioactive and non-radioactive probes (for example with actin gene).
PCR-PAGE (radioactive/non-radioactive) for microsatellite marker for linkage analysis.
PCR-RFLP-based genotyping.
PCR-SSCP for mutation detection.
Single nucleotide polymorphism typing.

MBT 3-3P : Immunology, Vaccines and Transplantation Technology Praticals (15 x 3 h)

Interferon induction in cells-isolation and assay.
Development of monoclonal antibodies by hybridoma technology.
Production of polyclonal antibodies and testing-immunodiffusion,
immunoelectrophoresis, crossed antigen-antibody electrophoresis, radioimmunoassay,
immunoblotting,
immunofluorescence, agglutination, rosette-formation, complement-fixation.
Antigen-induced T cell proliferation.
Generation of cytotoxic T lymphocytes.

Semester IV

MBT 4-1a : Somatic and Germline Engineering (25L)

Culture media-pH, temperature, ionic balance, essential amino acids, serum,
cofactors, growth factors and hormones, ultracentrifugation.
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-solid substrates.
Embryo culture, transplantation and teratogenesis.
Teratomas.
Stem cell culture.
Organ culture.
Artificial blood.
Amniocentesis-karyology and biochemical diagnostics-genetic counselling.
Mammalian embryo fusion-allopheny.
Transgenesis-gene transfers, knock-outs.
Somatic cell fusion and somatic cell genetics.

MBT 4-1b : Social, Ethical and Legal Issues in Medical Biotechnology (25 L)

IPR : patents and copyrights.
Social- genetic discrimination: insurance and employment, human cloning, foeticide,
sex determination.

Ethical: somatic and germ line gene therapy, clinical trials, the right to information, ethics committee function.
Biosafety containment facilities, biohazards, genetically modified organisms (GMOs), living modified organisms (LMOs)

MBT 4-2 : Diagnostics (50 L)

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.

MBT 4-3a : Seminar (25 L)

MBT 4-3c : Communication Skills (25 L)

Lectures: preparation, objective/s, concepts, contents, sequence, formal proof, interrelationships, logic, conclusions, time management, using audiovisual aids.
Giving a talk: body language: extempore and prepared talks.
Preparing for interviews, CV/biodata.
Vocabulary: word power, pronunciations, guessing the meaning of words from the context and body language and using a dictionary
Review of basic grammar
Punctuation marks: comma, colon, semicolon, full stop, inverted comma.

Avoiding repetitious statements, double positives, double negatives, circular arguments.
Dealing with questions: avoiding circumvention and circular arguments; answering after breaking down long questions into parts.
MS power point-based presentations.
Analysis of formal presentations in the course 3a in terms of actual presentations.

MBT 4-3d : Other Optional Courses as Required (25 L)

Epidemiological courses that require handling of statistical packages of data bases and field studies, quality control in diagnostics, BMDP and similar package-based quantitative method package would be useful depending on the local expertise.

Practicals

MBT 4-1aP : Somatic and Germline Engineering Practicals (9 x 3 h)

1. Animal cell tissue culture – sterile working techniques.
2. Chick embryo fibroblast primary cell cultures and mouse chorionic villus cells.
3. Induced ovulation in mouse, collection of oviducal eggs and in vitro fertilization, culture in *vitro* of mouse embryos to the blastocyst state.
4. Transferring a foreign gene (e.g., chicken globin gene) into mouse fertilized eggs and transplantation of transformed mouse blastocysts in foster females.
5. Microinjection or electroporation of ES cells with foreign DNA (e.g., chicken globin gene, transplantation into mouse blastocyst and transfer to foster females.
6. Diagnosing tail DNA of chimeric mouse pups for transferred genes fusing HeLa and chicken erythrocyte cells in vitro for heterokaryons.

MBT 4-2P : Diagnostics (16 x 3 h)

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

Selection of hybrid-use of MoAb in diagnostics of TB.
Avidin biotin technique in immunocytochemical staining.
Immunofluorescence technique.
Immunoblot analysis of antigens and allergens.
ELISA for detection of *Salmonella* in food, antibodies to AIDS viruses.

MBT 4-3b : Project (25 x 3 h)