Techniques of introducing genes in Prokaryotes and eukaryotes: transformation, calcium phosphate method, DEAE- Dextran method, protoplast fusion/somatic cell hybridization. Liposome mediated transfer, microinjection, electroporation and gene gun.

UNIT III (13 hrs)

Identifying the right clones: Direct screening: Insertional inactivation of marker gene, visual screening, plaque phenotype. Indirect screening: Immunological techniques, Hybrid arrest translation, Hybrid select translation. Screening using probes: Construction of gene probes, hybridization and labeling. Nucleic acid hybridization – Southern blotting, colony hybridization, dot blot; Chromosome walking and chromosome jumping. DNA sequencing: Maxim and Gilbert's method, Sanger and Coulson's method, Messing's shot gun method, Automated sequencers; Analysis of genetic variation: Single nucleotide polymorphism, conserved and variable domains, RFLP, AFLP, EST, STS, SCAR, SSCP. DNA finger printing. Genome sequencing: overview, strategies (e.g. Human genome project), Next Gen Sequencing.

UNIT IV (13 hrs)

Mapping of DNA: Restriction mapping, DNA footprinting, mapping by somatic cell hybridization. Use of transposons in gene mapping. Analysis of gene expression: Analysis of transcription by Northern blot, RNase protection assay, Primer extension assay, *in-situ* hybridization, Fluorescent In-situ Hybridization (FISH) Technique, Comparative genomic hybridization. Comparing transcriptomes: Differential screening, subtractive hybridization, array based methods; Implication of Genetic engineering. Methods of studying promoter, reporter genes, locating the promoter, regulatory elements and DNA-binding proteins. Translational analysis: Screening expression libraries with antibodies – Western Blot, 2D-electrophoresis. Manipulating gene expression: Transcriptional fusions, translational fusions, *In-vitro* mutagenesis: Oligonucleotide directed mutagenesis, deletions, Insertional mutagenesis, direct single base mutagenesis. General guidelines for recombinant DNA research activity. Containment facilities and biosafety practices; Rules for import and export of biological materials.

References

1) From Genes to Clones, Winnacker E.L., Panima Educational Book agency, 1987,
2) Genes VII, Lewin, Oxford University Press, 2000
3) Principles of Gene Manipulation. Primrose S.B., &Twyman R.M. Blackwell scientific Pub. 2006.
4) Recombinant DNA Technology. Watson J.D. et al., Scientific American Book Series, 2006
5) Genetics: a molecular approach. Brown TA., Stanley Thornes Publ. 1999
6) An introduction to genetic engineering. Nicoll DST., Cambridge Univ Press., 2012
7) Principles of Genome Analysis and Genomics. Primrose SB., Twyman RM., Blackwell Publ. 2002

IMMUNOTECHNOLOGY (HARD CORE COURSE) Hours: 52

Course outcome

After successful completion of the course, students will be able to:

CO 1. Understand the structure, components and functioning of the immune system, including toxins and toxin resistance

CO 2. Understand the molecules related to immune system such as immunoglobulins, antigens and the genes associated with diversity and specificity, tissue histocompatibility

CO 3. Differentiate reactions and concepts and various techniques associated with immunoglobulins such as in diagnostics and research, vaccine development etc.
CO 4. Use the knowledge regarding advances in the field for application in therapeutics

UNIT I (13 hrs)
History and scope of immunology. Types of immunity – humoral and cell-mediated. Innate and adaptive immunity. Specificity and memory. Primary and secondary lymphoid organs; Cells involved in immune response-T-cells, B-cells. Clonal selection theory. Lymphocyte activation, clonal proliferation, differentiation.

UNIT II (13 hrs)
Antigens and haptens, determinants; types of immunoglobulins: structure, distribution and function. Antigen-antibody reactions – Antigen equilibrium, dialysis, precipitation reactions, immunodiffusion. Affinity and Avidity. Antibody diversity - V, D, J, gene segments and DNA rearrangements, molecular biology of antibody synthesis. Production, purification and characterization of monoclonal antibodies. Polyclonal antibodies versus monoclonal antibodies. ELISA, RIA, Fluorescent techniques, Fluorescent activated cell sorter (FACS).

UNIT III (13hrs)
Effector mechanisms in immunity-macrophage activation. Lymphokines – Interleukins and their role in immune regulation. Toxin and Toxin resistance. Complement system. Human and mouse MHC, Transplantation immunology. HLA in human health and disease HLA tissue typing. Immune-suppression in transplantation. Immunization and antibody response.

UNIT IV (13hrs)
Hypersensitivity reactions, treatment approaches. Immunological tolerance. Autoimmune diseases. Thyrotoxicosis, Systemic Lupus Erythematosus, Antinuclear antibodies. Tumor immunology – tumor antigens, immuno-surveillance, immunological escape. Immune deficiency diseases – AIDS; X-linked gammaglobinemia. Concepts in vaccine development. Types of vaccines. Immunotherapeutic approaches to disease treatment-immunotoxins, Lymphokine-activated killer cells. T-cell cloning and their applications.

References

1. Cellular and Molecular Immunology. Abbas, A.K. et al., Elsevier Saunders Co., 2015
2. Essential Immunology. Riott, I.M., Blackwell Scientific Publications, 1994
3. Handbook of Experiments in Immunology, Vol. 1 & 2, Weir D.M., Wiley, 1997
4. Kuby Immunology. Kindt T.J. et at., W.H. Freeman & Co. 2007
5. Immunology. Riott, I.M., BrostoffJ., Male, D. Mosby Pub., 2001
6. Immunobiology. Janeway C.A. and Travers, P. Churchill Livingstone Pub., 1996
7. Practical Immunology. Hudson L. and Hay F.C., Blackwell Scientific Pub., 1989

BIOANALYTICAL TECHNIQUES (SOFT CORE COURSE) Hours: 40

Course outcome
After successful completion of the course, students will be able to:
CO 1. Apply the principle, instrumentation of bio analytical techniques such as chromatography and electrophoresis for the separation of different biomolecules
CO 2. Learn the principle and application of different spectroscopic methods for the structural analysis of biomolecules.