

Course contents - MSc in Cellular & Molecular Immunology **IBMBB, University of Colombo**

CORE CURRICULUM

Semester 1

Unit 1: Overview of the Immune System (30 h)

- Introduction to the immune system: Innate and adaptive immunity, General properties of the immune responses.
- Cells, tissues and organs of the immune system: Hematopoiesis, Cells of the immune system; Lymphocytes, Antigen presenting cells; dendritic cells & mononuclear phagocytes and granulocytes
- Anatomy and functions of primary, secondary & tertiary lymphoid tissues: Bone marrow, Thymus, Lymph nodes and lymphatic system, spleen, Cutaneous immune system and mucosal immune system
- Pathways and mechanisms of lymphocyte recirculation and homing: Recirculation of naïve T lymphocytes and B lymphocytes, Cell adhesion molecules & Migration of lymphocytes to sites of inflammation
- Evolution of immunity

Unit: Molecular Immunology (60 h)

- Molecules of the immune system:
 - Acute phase proteins: C-reactive protein, serum amyloid A, fibrinogen, mannose-binding protein and complement components
 - Cytokines: Properties of cytokines, cytokine receptors, cytokine antagonists, secretion, cytokine network, cytokine-related diseases & therapeutic uses
 - The complement system: Functions of complement, components, regulation of complement system, biological sequences and deficiencies
- Antigens: Immunogenicity vs antigenicity, Factors that influence immunogenicity, haptens and pattern recognition receptors
- Immunoglobulins: Structure & function, Organization and expression of immunoglobulin genes, Monoclonal antibodies, Antibody cloning and engineering
- The Major Histocompatibility Complex: The general organization and inheritance, MHC molecules and genes, Genomic map of MHC genes and MHC and disease susceptibility
- T-cell Receptors and accessory membrane molecules, Antigen processing and presentation

Unit 3: The Immune Response (40 h)

- Innate immunity: Innate immune response, features and components of the innate immune system; barriers; anatomic, physiologic, phagocytic & inflammatory, circulating effector cells, circulating effector proteins and cytokines
- Inflammatory response, mediators of inflammation, Role of innate immunity in local and systemic defense against microbes and Role of innate immunity in stimulating adaptive immune responses
- Adaptive immunity
 - T-cell maturation, activation and differentiation; B-cell generation, activation and differentiation, Regulation of B-cell development & immune effector functions and Immunological tolerance of lymphocytes

- Effector mechanisms of Cell-Mediated immunity
- Effector mechanisms of Humoral immunity
- Collaboration between innate & adaptive immunity and Regulation of the immune effector response

Unit 4: Antigen-Antibody interactions: Principles and Applications (80 h)

And Immunological techniques

- Antibody affinity and avidity, Cross reactivity, Immunoassays & immunodiagnosis
- Antigen-Antibody interactions: Precipitation reactions, Agglutination reactions, Radioimmunoassay, ELISA, Western blotting, Immunoprecipitation, Immunofluorescence
- Identification of cell populations: Flow cytometry & fluorescence, Immunohistochemistry, Immunoelectronmicroscopy
- Isolation of cell populations: Fluorescent activated cell sorting (FACS), density-dependent centrifugations, panning
- Functional assays: Complement activity, phagocytic assay, lymphocyte proliferation, cytotoxicity, Assays for antibody and cytokine production

Semester 2.

Unit 5: Immunopathology (Immunedisorders) (40 h)

- Autoimmune diseases: Spectrum of autoimmune diseases, Organ-specific and systemic autoimmune diseases, genetic factors and pathogenesis, animal models, aetiology, mechanisms of induction of autoimmunity and therapeutic approaches
- Immunodeficiencies: Primary immunodeficiencies: Lymphoid immunodeficiencies, immuno-deficiency of myeloid lineage, defects in complement proteins, experimental models of immunodeficiencies, AIDS and other acquired or secondary immunodeficiencies
- Hypersensitivity: IgE-mediated (Type I) hypersensitivity, Antibody-mediated (Type II) hypersensitivity, Immune complex-mediated (Type III) hypersensitivity and Type IV or delayed-type hypersensitivity (DTH)

Unit 6: Immunity in Defense and Disease (60 h)

- Immune mechanisms induced by microbes:
 - Immunity to extracellular and intracellular bacteria; mechanisms of immunity related to bacterial surface structures, First and second line defenses, antigen specific protective mechanisms
 - Immunity to viruses; innate immune responses, host defense involving B and T cells, strategies for evading immune defenses, immunopathology
 - Immunity to fungi
- Immunity to parasites (protozoans & nematodes); Features of parasitic infections, effector mechanisms, role of T cells in development of immunity, escape mechanisms, immunopathological consequences, Emerging infectious diseases
- Immunity to tumours; tumor antigens, immune response to tumors, evasion of immune response by tumors, immunotherapy for tumors

Unit 7: Immunomodulation (65 h)

- Immunotherapy
- Vaccinology: Principles of vaccinology; active and passive immunization, Designing vaccines for active immunization: whole-organism vaccines, different types of antigens used as vaccines, purified macromolecules, recombinant vector vaccines, DNA vaccines and multivalent subunit vaccines
- Safety and effectiveness of vaccines; vaccines of the future
- Immunization programmes, Combination vaccines and Regulatory mechanisms in Sri Lanka
- Global vaccine initiative and Elimination programmes in Sri Lanka

OPTIONAL UNITS

Optional Unit 1: Recombinant DNA Technology (30 h)

- Structure of DNA, Structure of genes, Extraction of DNA, DNA manipulation enzymes and their applications, Restriction Endonucleases and their applications, DNA sequencing and Polymerase Chain Reaction (PCR)
- DNA cloning: Construction of genomic DNA libraries; Construction of cDNA libraries: isolation of mRNA, synthesis of cDNA and cloning of cDNA; screening of libraries; cloning DNA fragments into plasmid vectors; Genetic transformation and gene expression in prokaryotic & eukaryotic cells

Optional Unit 2: Cancer Immunology (30 h)

- Cancer: origin and terminology & malignant transformation of cells, Tumors of the immune system, Immune response to tumors, Tumor evasion of the immune system, Tumor antigens & markers, Oncogenes and cancer genetics, Cancer immunotherapy, Cancer Epidemiology, Therapies available in Sri Lanka, Current diagnostics & Research needs

Special topics

- Philosophy of Science
- Research Methodology & Biostatistics
- Introduction to Information Technology and Bioinformatics
- Ethical, Legal and Social Implications of Science