GUJARAT TECHNOLOGICAL UNIVERSITY

Syllabus for M.Sc. in Industrial Biotechnology, Semester - 2
Subject Name: Immunotechnology

Subject Code: 1320104 **W.E.F 2021-22**

1. Learning Outcomes

Learning Outcome Component	Learning Outcome (Learner will be able to)
Theoretical and practical understanding of Immunotechnology	● Distinguish between innate immunity and acquired immunity. ● Understand the structure and functions of the molecules, cells and organs involved on immunity.
Intellectual abilities	● Determine the strategies that viruses and tumor cells interfere with to decrease the presentation of viral peptides on MHC class I molecules at the surface of infected cells and the consequences of such a situation on NK cells and cytotoxic T lymphocytes.
Effective Communication	● Communicate concepts and ideas effectively.
Professional & Ethical Behaviour	● Transparency, honesty and ethical reasoning in handling molecular and cellular elements of the immune system.

LO – PO Mapping: Correlation Levels:
1 = Slight (Low); 2 = Moderate (Medium); 3 = Substantial (High), "-"= no correlation

Sub Code: 1320104	PO1	PO2	PO3	PO4	PO5	PO6	PO7
LO1:Theoretical and practical understanding of Immunotechnology	3	2	3	2	2	3	1
LO2: Intellectual abilities	3	3	3	2	2	3	2
LO3: Effective communication	2	3	2	2	3	3	2
LO4: Professional & Ethical Behaviour	2	2	3	2	3	2	3

2. Course Duration: The course duration is 45 sessions of 60 minutes each.

3. Course Contents:

Module No:	Module Content	No. of Sessions	70 Marks (External Evaluation)
1	**Lymphocyte maturation and cell-mediated immune response** Components of innate and acquired immunity; Important organs and cells of immune responses, complement and inflammatory responses; pathogen recognition receptors (PRR) and pathogen associated molecular pattern (PAMP); innate immune response; mucosal immunity; antigens - immunogens, haptens; Major histocompatibility	11	20

	complex (MHC) genes, Role of MHC in infectious diseases and disease susceptibility, HLA typing; Immunoglobulins-basic structure, classes & subclasses of immunoglobulins, antigenic determinants; multigene organization of immunoglobulin genes; B-cell receptor; Immunoglobulin superfamily; principles of cell signaling; basis of self & non-self discrimination; kinetics of immune response, memory; B cell maturation, activation and differentiation; generation of antibody diversity; T-cell maturation, activation and differentiation and T-cell receptors; functional T Cell subsets; cell-mediated immune responses, ADCC; cytokines-properties, receptors and therapeutic uses; antigen processing and presentation- endogenous antigens, exogenous antigens, non-peptide bacterial antigens and super-antigens; cell-cell co-operation.		
2	**Antigen-antibody interactions** Precipitation, agglutination and complement mediated immune reactions; advanced immunological techniques - RIA, ELISA, Western blotting, T cell epitope prediction and ELISPOT assay, immunofluorescence, flow cytometry and immunoelectron microscopy; surface plasmon resonance, biosensor assays for assessing ligand–receptor interaction, CMI techniques-lymphoproliferation assay, mixed lymphocyte reaction, cell cytotoxicity assays, apoptosis, microarrays, transgenic mice, gene knockouts, Hybridoma and monoclonal antibodies, Applications of monoclonal antibodies; HLA-tetramer complex, Application of HLA-tetramer complex in analyzing antigen/peptide –specific T cell responses using flow cytometer.	12	15
3	**Vaccinology** Active and passive immunization; live, killed, attenuated, subunit vaccines; vaccine technology-role and properties of adjuvants, recombinant	10	15

	DNA and protein based vaccines, reverse vaccinology; peptide vaccines, conjugate vaccines; antibody genes and antibody engineering- chimeric, hybrid monoclonal antibodies; catalytic antibodies and generation of immunoglobulin gene libraries, idiotypic vaccines and marker vaccines, viral-like particles (VLPs), dendritic cell based vaccines, vaccine against cancer, T cell based vaccine, edible vaccine and therapeutic vaccine ; Success stories in vaccinology *e.g.* Hepatitis, Polio, Small pox, DPT.		
4	**Clinical Immunology** Immunity to infection: bacteria, viral, fungal and parasitic infections (Tuberculosis, HIV/AIDS, Schistosomiasis, Kala Azar, Chickungunya, Dengue); hypersensitivity reactions– Type I-IV; autoimmunity; types of autoimmune diseases; mechanism and role of CD4+ T cells; MHC and TCR in autoimmunity; transplantation – immunological basis of graft rejection; clinical transplantation and immunosuppressive therapy; tumor immunology – tumor antigens; immune response to tumors and tumor evasion of the immune system, cancer immunotherapy; immunodeficiency-primary immunodeficiencies, acquired or secondary immunodeficiencies, anaphylactic shock; immunosenescence: a challenge for an aging population; Immune exhaustion in the setting of chronic infections and malignancies; chronic Inflammation (Inflammaging) and immune activation; mucosal immunity and Gut Associated Lymphoid Tissue (GALT) in various gastrointestinal (GI) infections; complement deficiencies and human health; role of regulatory B cells (Bregs) in human disease. Monoclonal antibodies and their therapeutic role in reversing T cell functionality, Fab, F(ab)2 fragments; single-chain variable fragment (scFv), A trifunctional antibody; Bi-specific T-cell engagers	12	20

	(BiTEs) as artificial bispecific monoclonal antibodies for the use as anti-cancer drug.		

4. Pedagogy:

- ICT enabled Classroom teaching
- Practical / live assignment
- Interactive classroom discussions

5. Evaluation:
Students shall be evaluated on the following components:

A	**Mid-Semester Examination**	**(Internal assessment-30 Marks)**
B	**End-Semester Examination**	**(External assessment-70 Marks)**

6. Reference Books:

No	Author	Name of the Book	Publisher	Year of Publication / Edition
1	Kindt, T. J., Goldsby, R. A., Osborne, B. A., & Kuby, J.	Kuby Immunology	W.H. Freeman	Latest Edition
2	Brostoff, J., Seaddin, J. K., Male, D., & Roitt, I. M.	Clinical Immunology	Gower Medical Pub	Latest Edition
3	Murphy, K., Travers, P., Walport, M., & Janeway, C.	Janeway's Immunobiology	Garland Science	Latest Edition
4	Paul, W. E.	Fundamental Immunology	Raven Press.	Latest Edition

Note: Wherever the standard books are not available for the topic appropriate print and online resources, journals and books published by different authors may be prescribed.

7. List of Journals/Periodicals/Magazines/Newspapers / Web resources, etc

- https://www.nature.com/ni/
- https://www.cell.com/trends/immunology/home

Course Outcomes:
On completion of this course, Student should be able to:

- Evaluate the usefulness of immunology in different pharmaceutical companies.
- Identify the proper research lab working in the area of their own interests.

- Apply their knowledge and design immunological experiments to demonstrate innate, humoral or cytotoxic T lymphocyte responses and figure out the kind of immune responses in the setting of infection (viral or bacterial) by looking at cytokine profile.