

COURSE TITLE	IMMUNO-INFORMATICS
COURSE CODE	01CB0502
COURSE CREDITS	3

Objective:

- 1 To understand the immune system, its components and their functions
- 2 To provide information about the methods used in immunological bioinformatics

Course Outcomes: After completion of this course, student will be able to:

- 1 Apply knowledge of the structure and functions of the immune system, including key components, immune responses, antigens, and antibodies.
- 2 Apply bioinformatics tools and algorithms on immunological data.
- 3 Analyze computer-aided vaccine design and reverse vaccinology approaches for modern immunological applications.
- 4 Analyze immune responses to various pathogens by integrating genomics, proteomics, and bioinformatics strategies
- 5 Evaluate advances in information technology pertaining to immunology.

Pre-requisite of course: Basic knowledge of Bioinformatics.

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
2	1	0	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	Immune System Introduction to Immune System - Adaptive and Innate Immunity. Cells of the Immune System, Soluble Mediators of Immunity, Cell and Antibody mediated immunity. Immune Responses - Inflammation, Immunopathology, Autoimmune diseases, Vaccines	5
2	Antigens and Antibodies Immunoglobulin classes and subclasses, Major Histocompatibility Complex (MHC) its Polymorphism, Causes for Polymorphism, MHC Supertypes. Antigen types – Epitope, Affinity Maturation, Epitope mapping. B-cell and T-cell Epitope Prediction, Recognition of Antigen by B cells. Neutralising Antibody	5

Contents : Unit	Topics	Contact Hours
3	Computational Immunology Computational Immunology - Databases in Immunology, dbMHC-MHC database at NCBI. T-cell epitope databases, B-cell epitope databases, SYFPEITHI MHC-presented epitopes. IMGT Immunoinformatics, IMGT International ImmunoGeneTics Information System. HLA Nomenclature and the IMGT/HLA Sequence Database	6
4	Vaccine Design From immunome to Vaccine – Prediction of immunogenicity, Vaccine design tools. Reverse Vaccinology and Immunoinformatics, Peptides with Antimicrobial Activity or Antibiotic Peptides. Functional Prospecting of Genes and Transcripts, Future of Computational Modelling and Prediction Systems in Clinical Immunology	7
5	Viral Bioinformatics Viral Bioinformatics - Computational Views of Hosts and Pathogens using VIDA. Virus- human protein interaction databases. Virus- NCBI. GISAID database. Virus mint, Virus host database. Viral zone- Expasy	5
Total Hours		28

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	Module1: To compare the immune datasets, present on the databases	1
2	Module1: To identify the peptides used in already designed vaccines such as SARCoV2	1
3	Module2: To compare interactive resources to study immune responses related to inflammation and immunopathology	1
4	Module2: To compare datasets providing information on immunoglobulin classes, subclasses, and antigen types	1
5	Module3: To demonstrate MHC databases and perform epitope mapping using online tools	1
6	Module3: To identify the sequence of protein targeting organism bacteria and virus	1
7	Module3: To compare the list of proteins by checking of the disulfide linkages	1
8	Module3: To predict the allergen activity (Allergenicity) of the peptides	1

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
9	Module4: To predict the epitopes using bioinformatics tools	1
10	Module4: To perform physiochemical analysis using Expasy	1
11	Module4: To perform secondary structure analysis of the peptides	1
12	Module4: To perform tertiary structure analysis of the screened peptides	1
13	Module5: To identify the peptides and justify their antigenicity	1
14	Module5: To design a vaccine using the screened peptides	1
Total Hours		14

Textbook :

- 1 Bioinformatics for Immunomics (Immunomics Reviews), Darren R. Flower, New York: Springer-Verlag, 2010
- 2 Kuby Immunology, J. Thomas, W. H. Freeman, 2007

References:

- 1 Cellular and Molecular Immunology, Cellular and Molecular Immunology, Abul K. Abbas, Andrew H. H. Lichtman, and Shiv Pillai, USA: Elsevier, 2017
- 2 An Introduction to Chemoinformatics, An Introduction to Chemoinformatics, Andrew R. Leach, Valerie J. Gillet, UK: Springer, 2007

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery					
Remember / Knowledge	Understand	Apply	Analyze	Evaluate	Higher order Thinking / Creative
20.00	30.00	20.00	10.00	10.00	10.00

Instructional Method:

- 1 The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.
- 2 The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.

Instructional Method:

- 3 Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

Supplementary Resources:

- 1 <https://stores.biotechnika.org/products/vaccine-design-development-certification-course>
- 2 <https://www.youtube.com/watch?v=iuxd10eBo1U>
- 3 <https://www.cbehx.co.uk/product/vaccine-design/>