Gyanmanjari Innovative University

Syllabus
Gyanmanjari Science College
Semester-3 (B.Sc.)

Subject: Immunology- BSC1EM13310

Type of course: Major

Prerequisite: Basic understanding of biology, including cell structure, human physiology, and fundamental biochemistry concepts, along with basic laboratory skills.

Rationale: This course provides foundational knowledge of the immune system and develops practical skills in diagnostic techniques, enabling students to understand immune responses and appiy them in clinical and laboratory settings.

Teaching and Examination Scheme

Teaching Scheme			Credits	Examination Marks		Total Marks
CI	T	P	C	SEE	CCE	
2	0	4	4	100	100	200

Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; SEE - Semester End Evaluation; LWA - Lab Work Assessment; V – Viva voce; CCE-Continuous and Comprehensive Evaluation; ALA- Active Learning Activities.

Course Content:

Sr. No	Course Content	Hrs.	% Weightage
1	**Overview of immune system** • Historical perspective of immunology • Early studies revealed humoral and cellular components of the immune system, Principles of immune system, Early theories attempted to explain the specificity of the antibody–antigen interaction and its properties • Types of immunity: 1) Innate immunity 2) Adaptive immunity **Practical** 1. Group wise students will collect the blood samples in EDTA containing tubes and they will separate the blood components by centrifugation. ➢ To visualize and study the different components of blood (Top: Plasma (straw-colored), Middle: Buffy coat (thin whitish layer) and Bottom: RBCs (red layer) using centrifugation technique. 2. Students will separate the blood serum from the blood for the diagnosis of following disease: ➢ To diagnose normal, hyperglycemic, and hypoglycemic conditions from the blood serum by estimating the concentration of glucose using the Glucose Oxidase–Peroxidase (GOD–POD) method. 3. Explain the significance of Alkaline Phosphatase (ALP) estimation in the diagnosis of liver and bone disorders. Determine whether the (ALP) activity is normal or abnormal. Interpret the result and identify the most likely clinical condition associated with this elevated ALP level. 4. Explain the clinical significance of total serum protein estimation in assessing nutritional status, liver function, and kidney disorders. Determine whether the serum total protein level is normal or abnormal.	**T:P 6:12**	**20**

Evaluation method

Sr. No	Evaluation Methods	SEE	CCE
1	**Historical perspective and its theories:** Students will be given a list of immune-related symptoms and examples. They will classify each one into cellular and hormonal components of the immune system. Prepare the assignment and upload on the GMIU web portal.		10
2	**Clinical Case study problems:** Students will be given different patient case scenarios with specific health problems for the determination of Glucose, Alkaline Phosphatase (ALP), serum total protein, will perform the problems specific test, and interpret the results.	15	
	Symptom Sorting Challenge: Innate vs Adaptive Sorting Challenge- Students will be given a list of immune components such as skin, T cells, B cells, fever, antibodies, mucus, phagocytes, and memory cells. They will classify each component into Innate Immunity or Adaptive Immunity by sorting them correctly. Innate Immunity or Adaptive Immunity based on whether it is a rapid, non-specific response or a specific, memory-based response	5	
3	Journal		5
4	**Blood Blueprint - Components Breakdown**: Students will write about the different components of blood, including plasma, red blood cells, white blood cells, and platelets. They will describe the structure and function of each component and explain their role in		5

		maintaining body functions and upload on the GMIU web portal.			
		Total	20	20	
2	**Antigens and Antibodies** • Antigen: Definition and types • Structure and Properties of Antigen • Antibody (Immunoglobulins): Definition, Basic structure (basic Y-shape), Antigenic Determinants on Immunoglobulins. • Antibody Classes and Biological activities: IgG immunoglobulin, IgA immunoglobulin, IgM immunoglobulin, IgD immunoglobulin, IgE immunoglobulin. • Antigen–antibody reactions: a. Agglutination b. Precipitation **Practical:** 5. Slide Agglutination Test: To detect the presence of specific antigens or antibodies in a sample by observing visible agglutination (clumping) reaction on a slide. 6. Tube Agglutination Test: To detect and measure specific antigen–antibody reactions in serum by observing agglutination in test tubes. 7. Ring Precipitation Test: To detect the presence of a specific antigen or antibody by observing a visible precipitation ring formed at the junction of antigen and antibody solutions. 8. Ouchterlony Double Diffusion Test: To study the antigen–antibody reaction by double diffusion in agar gel and to observe the formation of precipitin lines. 9. COVID detection diagnostic test: To detect the presence of SARS-CoV-2 infection using diagnostic methods such as RT-PCR, Rapid Antigen Test (RAT), or antibody-based assays by identifying viral genetic material, antigens, or antibodies in patient samples. **Evaluation method** Sr. No | Evaluation Methods | SEE | CCE 1 | **Antigen–Antibody Explorer - PPT Builder Challenge**: Individual students will prepare a short PowerPoint presentation explaining the concept of | | 5	**T:P 6:12**	**20**

		antigen and antibody with its structure showing importance in immunity. PDF to be uploaded on GMIU web portal.					
	2	**Flashcard to Function: Antibody Architect Challenge**: Students will be given variable flashcards containing different functions of antibodies. They must identify the correct antibody based on its function, then draw its basic structure (labeling key parts), and finally write a short note about its role in the immune system.	5				
	3	**Identify the Antigen-Antibody specific Test**: Students will be given different situations based on antigen antibody reactions. They must first identify and understand the given situation and then select the appropriate immunological test (Slide Agglutination Test, Tube Agglutination Test, Ring Precipitation Test Slide Precipitation Test, Ouchterlony Double Diffusion Test, COVID detection diagnostic test, will perform it and interpret the results.	15				
	4	Journal		5			
	5	**Antibody Showdown-Compare & Conquer Table**: Students will create a comparative table of different types of antibodies, comparing their functions, structure, and roles in the immune system and upload them on the GMIU web portal.		10			
		Total	20	20			

3	**Cells of Immune System** • Classification and functions of immune cells: 1. Lymphocytes: a. B lymphocytes: development and functions b. T lymphocytes: helper, cytotoxic, and regulatory T cells c. Natural Killer (NK) cells and their role in innate immunity 2. Antigen-Presenting Cells (APCs): a. Dendritic cells b. Macrophages c. B cells as APCs 3. Phagocytic Cells: a. Neutrophils b. Monocytes and macrophages c. Mechanism of phagocytosis 4. Other Immune Cells: a. Eosinophils b. Basophils c. Mast cells **Practical:** 10. **Dengue NS1 (Non-Structural Protein 1) Rapid Diagnostic Test**: To detect the presence of Dengue Non-structural protein 1 (NS1) antigen in blood samples for early diagnosis of dengue infection using an immunochromatographic rapid test kit. 11. **Beta HCG Pregnancy Test**: To detect the presence of human chorionic gonadotropin (β-hCG) hormone in urine or serum samples for confirmation of pregnancy. 12. **Syphilis Rapid Test**: To detect antibodies against *Treponema pallidum* in blood samples using a rapid immunochromatographic assay for the diagnosis of syphilis infection. 13. **Rapid Diagnostic Test** (RDT)-HCV: To detect antibodies against Hepatitis C Virus (HCV) in blood, serum, or plasma samples using a rapid immunochromatographic test method. 14. **Rapid Diagnostic Kit-Malaria**: To detect malaria parasite antigens in blood samples using a rapid immunochromatographic assay for the diagnosis of malaria infection. **Evaluation method**	**T:P 6:12**	**20**

Sr. No	Evaluation Methods	SEE	CCE
1	**Immune Cell Matrix: Compare & Conquers**: Students will create a comparison table for immune		10

		cells including B cells, T cells, macrophages, dendritic cells, and NK cells. They will design the table on their own and fill in columns such as type of immunity, function, and special features for each cell. and uploaded on the GMIU portal.					
	2	**Cell Function Battle Cards-Match & Master Immunity**: Students will be given a set of immune cell functions such as phagocytosis, antibody production, antigen presentation, direct killing of infected cells, and activation of adaptive immunity. They must match each function with the correct immune cell and then classify the cells into Innate Immunity or Adaptive Immunity.	5				
	3	**Diagnose & Decide**: Lab Test Challenge: Students will identify the correct test such as NS1 antigen, Beta HCG Pregnancy Test, Syphilis Rapid Test, Rapid Diagnostic Test-HCV, Malaria diagnostic test based on the given symptoms. They will perform the practical, write the procedure, explain the principle, and interpret the results of the selected tests.	15				
	4	Journal		5			
	5	**From Bone to Battle: B & T Cell Flow Map**: Students will draw a flow diagram showing the origin and development of B cells and T cells starting from hematopoietic stem cells and uploaded on GMIU portal.		5			
		Total	20	20			
4	**Organs of Immune System** • **Classification and Functions of lymphoid organs:**					**T:P 6:12**	**20**

1. **Primary Lymphoid Organs**
   a) Bone Marrow: Structure and location, Hematopoiesis and blood cell formation, Development and maturation of B lymphocytes, Role in immune cell production.
   b) Thymus: Anatomy and histological structure, T lymphocyte maturation and differentiation, Positive and negative selection of T cells, Thymic hormones and immune regulation.
2. **Secondary Lymphoid Organs:**
   a) Spleen: Structure with red pulp and white pulp, Filtration of blood and removal of aged cells, Immune responses to blood-borne antigens, Role in lymphocyte activation.
   b) Lymph Nodes: Structure and compartments, Lymph circulation, Antigen capture and presentation, Lymphocyte activation and proliferation.
   c) Mucosa-Associated Lymphoid Tissue (MALT): Definition and characteristics, Gut-Associated Lymphoid Tissue (GALT), Role in mucosal immunity and IgA production.

Practical:

15. **Estimation of urea by diacetyl monoxime (DAM) method**: To estimate the concentration of urea in biological fluids (blood/serum) using the diacetyl monoxime (DAM) method.
16. **WIDAL Test**: To detect antibodies against Salmonella typhi in blood serum for diagnosis of typhoid fever.
17. **Determination of total cholesterol and HDL**: To estimate the levels of total cholesterol and high-density lipoprotein (HDL) cholesterol in serum samples using biochemical methods for the assessment of lipid profile and cardiovascular health status.
18. **CRP Test (C-Reactive Protein Test):** To detect C reactive protein in serum as an indicator of inflammation and infection.
19. **Estimation of serum bilirubin**: To determine the concentration of bilirubin in serum samples using biochemical methods for the assessment of liver function and diagnosis of jaundice or hepatic disorders.

Evaluation method:

Sr. No	Evaluation Methods	SEE	CCE
1	**Compare & Conquer - Immune Organs Projects**: Students will prepare a short project comparing the functions of primary and secondary		5

		lymphoid organs. They will clearly highlight the differences with examples and explain how each type contributes to the immune system and Upload on GMIU portal.					
	2	**Diagnostic Mastery Lab**: In this activity, students may be given any one test using serum (DAM, WIDAL, cholesterol, CRP and bilirubin) and students are required to write its principle, related symptoms, diagnosis, and also perform it.	15				
	3	**Lab Detective-**The Diagnosis Hunt projects: Students act as medical detectives who solve patient cases using lab test clues like WIDAL, CRP, urea, and cholesterol reports. By analyzing symptoms and results together, they identify the most probable disease and develop strong clinical reasoning skills.	5				
	4	Journal		5			
	5	**Draw & Defend: Immune Organs Challenge**: Students will draw any one primary or secondary lymphoid organ, label its parts, and write 2–3 functions of that organ. and upload it on the GMIU portal.		10			
		Total	20	20			
5	**Immune Disorders** • Definition, Types and functions of Immune disorders: a. Autoimmune Diseases includes Rheumatoid arthritis and Type 1 diabetes b. Immunodeficiency Disorders such as Human Immunodeficiency Virus-Acquired Immunodeficiency Syndrome (HIV-AIDS) c. Allergic Disorders (Food allergy, Hay fever)					**T:P 6:12**	**20**

d. Transplant Rejection (Kidney rejection, Heart rejection)

Practical:

20. To determine the disease through physical examination of urine - volume, color, appearance, odor, specific gravity, pH, and foam for the preliminary evaluation of physiological and pathological conditions.
21. Detection of blood/hemoglobin in urine: To detect the presence of blood or hemoglobin in urine samples using chemical or strip-based methods for the diagnosis of hematuria and related urinary tract disorders.
22. Detection of bile salts in urine: To detect the presence of bile salts in urine samples using Hay's sulphur test for the assessment of liver and biliary tract disorders.
23. Detection of ketone bodies using Rothera's test: To detect the presence of ketone bodies in urine samples using Rothera's reaction for the diagnosis of ketosis and diabetic ketoacidosis.
24. Detection of glucose in urine using Benedict's test
25. To detect the presence of protein (albumin) in urine using heat test or sulfosalicylic acid test.

Evaluation method

Sr. No	Evaluation Methods	SEE	CCE
1.	**Immune Insight Posters:** Students will work in groups to create a visual poster explaining an immune-related disorder, including its cause, mechanism, and real-life impact and Upload on GMIU portal		5
2.	**Case to Test: Decode the Diagnosis**: Students will be given unknown clinical case scenarios and will identify which laboratory test is most appropriate for diagnosis. They will justify and perform the selected test and interpret the expected findings to arrive at the final clinical diagnosis.	15	

	3.	**Triple Analysis of Urine- Spot the Disorder**: Each student will randomly pick a urine test category (physical, chemical, or microscopic) and perform the procedure. They will explain the principle and clinical significance of their findings.	5			
	4.	Journal		5		
	5.	**The Immune System Showdown** – Students act out real immune system scenarios by playing roles like WBCs, antibodies, pathogens, and allergens to understand how the body responds to different threats and Upload on GMIU portal.		10		
		Total	20	20		
					90	**100%**

Distribution of Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage %	20%	30%	20%	10%	20%	00

RUBRICS:

UNIT 1: Introduction of Immune system

Understanding of Immune System Concepts (Definition, Scope, Functions): 5 marks
Classification & Comparison of Immunity Types (Innate vs Adaptive): 5 marks
Identification of Immune Components & Experimental Accuracy: 5 marks
Result Interpretation & Application of Immune Responses: 5 marks

UNIT 2: Antigens and Antibodies

Understanding of Antigen Concepts (Definition, Types, Properties): 5 marks
Antibody Structure & Immunoglobulin Classification: 5 marks
Experimental Accuracy & Identification of Antigen–Antibody Reactions: 5 marks
Result Interpretation & Application of Immunological Reactions: 5 marks

UNIT 3: Immune cells

Understanding of Immune Cell Concepts & Functions: 5 marks
Classification & Comparative Understanding of Immune Cells: 5 marks
Identification & Experimental Accuracy: 5 marks
Result Interpretation & Application in Immune Response: 5 marks

UNIT 4: Cells and Organs of Immune System

Understanding of Immune Organs & Their Functions: 5 marks
Classification & Comparative Understanding of Lymphoid Organs: 5 marks
Identification & Experimental/Diagrammatic Accuracy: 5 marks
Result Interpretation & Application in Immune Function: 5 marks

UNIT 5: Immune Disorders

Understanding of Immune Disorders & Causes: 5 marks
Classification & Comparative Understanding of Immune Disorders: 5 marks
Identification & Experimental/Clinical Accuracy: 5 marks
Result Interpretation & Application in Health & Disease Management: 5 marks

Seminar: Evaluation based on
Quality and Design of PPT – 3 marks
Depth of Content Knowledge and Accuracy – 4 marks
Presentation Skills and Audience Interaction – 3 marks

Course Outcome

	After learning this course, the students must be able to:
CO1	Explain the principles and components of the immune system, antigen–antibody interactions, and immune dysfunctions in protecting the body against pathogens.
CO2	Apply the concepts of antigens, antibodies, and antigen–antibody reactions in immunological diagnosis.
CO3	Analyze the structure and functions of immune cells in innate and adaptive immunity.

CO4	Evaluate the roles of primary and secondary lymphoid organs in immune responses.
CO5	Evaluate the causes, mechanisms, and diagnosis of major immune disorders.

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Instructional Method:

The course delivery method will depend upon the requirement of content and needs of students. The teacher, in addition to conventional teaching methods by black board, may also use any tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

From the content 10% topics are suggested for flipped mode instruction.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory.

The internal evaluation will be done on the basis of the Active Learning Assignment.

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

Reference Books:

1. Punt, J., Stranford, S. A., Jones, P. P., & Owen, J. A. *Kuby Immunology* (8th ed.). W. H. Freeman & Company.
2. Kindt, T. J., Goldsby, R. A., Osborne, B. A., & Kuby, J. *Kuby Immunology* (7th ed.). W. H. Freeman & Company.
3. Abbas, A. K., Lichtman, A. H., & Pillai, S. *Cellular and Molecular Immunology* (10th ed.). Elsevier.
4. Murphy, K., & Weaver, C. *Janeway's Immunobiology* (9th ed.). Garland Science.
5. Delves, P. J., Martin, S. J., Burton, D. R., & Roitt, I. M. *Roitt's Essential Immunology* (13th ed.). Wiley-Blackwell.
6. Male, D., Brostoff, J., Roth, D. B., & Roitt, I. *Immunology* (8th ed.). Elsevier.
7. Abbas, A. K., & Lichtman, A. H. *Basic Immunology: Functions and Disorders of the Immune System* (6th ed.). Elsevier.