GUJARAT TECHNOLOGICAL UNIVERSITY
Integrated Master of Science (Biotechnology)
Semester: 8
Subject Name: Immunology & Marine Pathogenesis
Subject Code: 1380413

Prerequisite:
Basic knowledge of cell biology, microbiology, and biochemistry is required. Understanding immune system components, host-pathogen interactions, and marine microbiology will help students explore disease mechanisms, immune responses, and pathogen control strategies in marine organisms.

Rationale:
This course focuses on immune mechanisms and disease pathogenesis in marine organisms, covering host defense systems, pathogen interactions, and disease management. It equips students with knowledge of marine immunology, diagnostic techniques, and biotechnological applications for disease prevention, aquaculture health management, and marine conservation.

Course Scheme:

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
				Theory		**Practical**		
L	**T**	**PR**	**C**	ESE (E)	PA(M)	ESE (V)	PA (I)	
4	0	0	4	70	30	0	0	100

Course Content:

Unit No.	Content	No. of Hours	Weightage (%)
1	**Fundamentals of Immunology** Introduction to Immunology – Innate and adaptive immunity; Cells and organs of the immune system – Lymphoid organs, immune cell types; Antigens, immunogens, and antigenicity; Mechanisms of immune response – Complement system, cytokines, and signaling pathways; Immune memory and vaccination principles.	12	20
2	**Marine Immunology & Defense Mechanisms** Immune adaptations in marine organisms; Non-specific defense mechanisms – Mucosal immunity, phagocytosis, and antimicrobial peptides; Adaptive immunity in fish and invertebrates – Immunoglobulins, T-cell responses; Influence of environmental factors on marine immune responses; Immunopathology in marine species.	12	20
3	**Marine Pathogens & Disease Mechanisms** Bacterial pathogens of marine organisms – Vibrio, Aeromonas, Pseudomonas; Viral diseases in marine life – Iridoviruses, Nodaviruses, and Rhabdoviruses; Fungal and parasitic infections in marine species; Molecular mechanisms of pathogenesis – Toxins, adhesion factors, and immune evasion strategies; Emerging infectious diseases in marine environments.	12	20

4	**Diagnostic & Therapeutic Approaches in Marine Disease Management** Molecular and immunological diagnostic tools – PCR, ELISA, Immunohistochemistry; Role of probiotics, immunostimulants, and vaccines in marine disease control; Antibiotic resistance and its impact on marine ecosystems; Quarantine, biosecurity, and disease prevention strategies in aquaculture; Case studies on marine disease outbreaks and management strategies.	12	20
5	**Biotechnological Applications & Future Trends in Marine Immunology** Genetic engineering and immunomodulation in aquaculture; Marine bioactive compounds with immunological significance; Role of CRISPR and other genome-editing tools in disease resistance; Climate change and its effect on marine pathogen dynamics; Sustainable approaches for marine health management.	12	20
	Total Hours:	60	100

Textbook:

1. Janeway, C. A., Travers, P., Walport, M., & Shlomchik, M. (2001). Immunobiology: The Immune System in Health and Disease. Garland Science.
2. Abbas, A. K., Lichtman, A. H., & Pillai, S. (2021). Cellular and Molecular Immunology. Elsevier.
3. Iwama, G., Nakanishi, T. (1996). The Fish Immune System: Organism, Pathogen, and Environment. Academic Press.
4. Press, C. M., & Reite, O. B. (2001). Fish Immunology. Karger Publishers.
5. Ellis, A. E. (1988). Fish Vaccination. Academic Press.

Reference Books:

1. Austin, B., & Austin, D. A. (2016). Bacterial Fish Pathogens: Disease of Farmed and Wild Fish. Springer.
2. Woo, P. T. K., & Bruno, D. W. (2011). Fish Diseases and Disorders. CABI Publishing.
3. Jeney, G. (2017). Fish Diseases: Prevention and Control Strategies. Academic Press.
4. Rohde, K. (2005). Marine Parasitology. CSIRO Publishing.
5. Subramanian, S. (2017). Aquatic Animal Immunology: Pathogen Detection and Disease Diagnosis. CRC Press.

Course Outcomes:

No.	Course Outcomes	RBT Level*
1	Describe the components and functions of the immune system in marine organisms.	RM, UN
2	Explain host-pathogen interactions and immune responses in marine disease conditions.	UN, AP
3	Analyze the mechanisms of marine pathogen infection, immune evasion, and disease progression.	AN, EL

4	Evaluate diagnostic tools, immunological assays, and pathogen detection techniques in marine health management.	EL, CR
5	Apply immunological principles to develop disease control strategies, vaccines, and biotechnological applications in aquaculture.	AP, CR

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

Suggested Course Practical List:

1. Determination of antibody titer using double immunodiffusion
2. Assesment of similarity between antigens using Ouchterlony's double diffusion test
3. Estimation of antigen concentration using radial immunodiffusion
4. Quantitative precipitation assay
5. DOT ELISA
6. Latex agglutination
7. Immunoelectrophoresis
8. Rocket immunoelectrophoresis
9. Sampling of fish and shellfish for disease diagnosis
10. Identification of bacteria- staining techniques and biochemical techniques
11. Observation of cellular components of fish blood and shrimp hemolymph
12. Isolation and characterization of fungi from fish & slide culture of fungi
13. SDS-PAGE analysis of fish proteins
14. Fish/shrimp cell culture.
15. Identification of fish pathogens using various techniques.

List of Laboratory/Learning Resources Required

1. Equipment & Instruments
   - PCR machine for molecular diagnostics.
   - ELISA reader for antigen-antibody interactions.
   - Immunoelectrophoresis apparatus.
   - SDS-PAGE and Western blot equipment.
   - Light and fluorescence microscopes.
   - Centrifuge for sample processing.
   - Haemocytometer for blood cell analysis.
   - Water quality assessment kits (pH meter, DO meter).
2. Glassware & Consumables
   - Microcentrifuge tubes, pipettes, and glass slides.
   - Culture plates, Petri dishes, and staining reagents.
   - Antibodies, antigen kits, and biochemical reagents.
   - Nutrient media for bacterial and fungal isolation.
   - Fish/shrimp cell culture media and supplements.
3. Field & Learning Resources
   - Field visits to marine aquaculture farms for disease diagnosis.
   - Reference samples of diseased and healthy marine organisms.
   - Access to published case studies on marine pathogen outbreaks.

- Digital resources and software for molecular analysis.
- Edward J. Noga, (2010). Fish Disease: Diagnosis and treatment, Wiley Blackwell.
- R.lan Froshney, Culture of Animal Cells, (3rd edition), Wiley-Liss.
- Thanwal. R., (2014)A Handbook of Diseases, Astha Publisers & Distributors.
- Bullock, G.L.,(2014) Diseases of Fisheried . Narendra Publishing House.
- Inglis, V.,(2013) Bacterial Diseases of Fish , Wiley Publications

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