

Semester IV**Title of the Course: MARINE MICROBIAL INTERACTIONS [T]****Course Code: MIC-607****Number of Credits: 3, Theory****Contact hours: 45****Effective from Academic Year: 2022-2023**

Prerequisites	Students must have a background about the basic concepts of Marine Microbiology, including properties of seawater, marine microorganisms.	
Objective:	<ul style="list-style-type: none"> Students will learn advances in marine microbiology with special emphasis on the intricate associations between microorganisms and marine organisms, diseases of microbial origin in fish and invertebrates, and other beneficial and harmful aspects like bioremediation and HABs respectively. 	
Content:		
1.	Symbiotic associations	(15)
1.1	Symbiosis of microalgae with animals, Symbiosis of chemoautotrophic prokaryotes with marine animals; Light organ symbiosis in fish and invertebrates; Microbial symbionts of sponges-significance and advantages; Symbiosis and mixotrophy in protists; Metabolic consortia and mutualism between prokaryotes.	
1.2	Ecological significance and advantages of various symbiotic associations - Bacterial, Algal, Sponges, Protists, Planktons. Applications of symbiotic associations.	
2.	Microbial diseases of fish and invertebrates	(15)
	Diseases of fish, bivalve mollusks, crustaceans, corals in fresh water/ sea water/ aqua culture: Bacterial – vibriosis, pasteurellosis, furunculosis, marine, bacterial kidney disease, mycobacteriosis, streptococcosis, black band disease, white plague, white pox, Juvenile Oyster Disease (JOD), bacterial shell disease, Coral Bleaching and methods of restoration; Symptoms and diagnosis; Control of the disease Viral – Infectious salmon anemia (ISA) virus, viral hemorrhagic septicemia virus (VHSV), lymphocystis virus, birnaviruses, viral nervous necrosis. Symptoms and possible diagnosis; Control of the disease Protistan – <i>Paramoeba perurans</i> , <i>Kudoa sp.</i> , <i>Loma salmonae</i> , <i>Hematodinium</i> Symptoms, Diagnostic methods, Control of disease.	
	Human diseases- toxic dinoflagellates and diatoms Red tides, shell fish poisoning, ciguatera fish poisoning	
3.	Marine microbes - Beneficial and harmful aspects	(15)
	Beneficial aspects: Biodegradation and bioremediation of marine pollutants such as oil, persistent organics and plastics. Environmental monitoring using indicator microorganisms. Microbial enzymes and polymers; biomedical and health products.	

	<p>Harmful aspects: Harmful Algal Blooms (HABs)- effect on biota. Biodeterioration, biofouling, bio-invasion – ballast waters. Environmental monitoring – Microbiology of fish and sea food products, microbial enzymes, Secondary products from fish waste, application of microbial enzymes</p>	
Pedagogy:	Lectures/tutorials/assignments	
References/ Readings	Grasshoff, K., Ehrhardt, M. and Kremling, K., Methods of Seawater Analysis, Verlag Chem., Weinheim. (1999)	
	Gatesoupe, F. J., The use of probiotics in aquaculture, Aquaculture, 180: 147-165. (1999)	
	Maier, R., Pepper, I. and Gerba, C., Environmental Microbiology, Academic Press. (2008)	
	Munn, C., Marine Microbiology: Ecology and Applications, Garland Science, Taylor and Francis, N.Y. (2003)	
	Nybakken, J. W. and Bertness, M. D., Marine Biology: an Ecological Approach, Benjamin Cummings, San Francisco, N.Y. (2005)	
	Parsons, T. R., Maita, Y. and Lalli, C. M., Manual of Chemical and Biological Methods for Seawater Analysis, Pergamon Press, New York. (1984)	
	Sharma, P. D., Environmental Microbiology, Alpha Science. (2005)	
	Sindermann, C. J., Principal Diseases of Marine Fish and Shellfish: Diseases of Marine Fish, Vol. 1, Gulf Professional Publishing. (1970)	
	Strickland, J. D. H. and Parsons, T. R., A Manual of Seawater Analysis, Queen's Printer and Controller of Stationery, Ottawa. (1972)	
	Toranzo, A. E., Magarinos, B. and Romalde, J. L., A review of the main bacterial fish diseases in mariculture systems, Aquaculture, 246(1): 37-61. (2005)	
	Intergovernmental Oceanographic Commission, Protocols for the Joint Global Ocean Flux Study (JGOFS) Core Measurements. DOI: https://doi.org/10.25607/OBP-1409 Intergovernmental Oceanographic Commission Manuals and Guides : 29 -JGOFS Report; 19 (1994)	
Course Outcomes	<ul style="list-style-type: none"> • Different kinds of interactions of microbes and marine organisms • Ecological significance of microbial associations • Understanding the various microbial diseases of marine organisms • Bioprospecting and applications of microbial associations. 	