Programme: M.Sc. (Microbiology)

Course Code: MIO 104

Title of the Course: MARINE MICROBIOLOGY [T]

Number of Credits: 3

Effective from Academic Year: 2018-19

Prerequisites	Basic understanding of the unique properties of water, features of marine environments and microorganisms.	
Objective:	This course focuses on the various characteristics of marine environments including the physico-chemical variables, climate events, microbial habitats, the different marine microorganisms found in seawater and their metabolic diversity, detection and enumeration methods.	
Content:		
1.		**(12)**
1.1	Introduction to oceanography: the world's oceans and seas, properties of seawater, physico-chemical factors in the marine environment such as temperature, density, nutrients, salinity, dissolved gases, waves, tides, oceanic currents, Ekman transport and upwelling; oceanic phenomena such as Coriolis effect, eddies, gyres, El Nino Southern Oscillation (ENSO).	
1.2	Marine microbial habitats: estuaries, mangroves, salt marshes, beach, coastal ecosystems and coral reefs.	
2.	**Marine microbes – bacteria, fungi, phytoplankton, zooplankton, viruses: their growth, physiology and contribution to ocean processes**	**(12)**
2.1	Modes of microbial growth: viable but non-culturable (VBNC) microorganisms, biofilms, microbial mats, epibiosis.	
2.2	Physiology of marine microbes: metabolic diversity, microbial loop; marine snow; fermentation, aerobic respiration, anaerobic respiration (denitrification, sulphate reduction, methanogenesis); nitrification, annamox, sulphur oxidation, methanotrophy; carbon dioxide fixation in autotrophs; the role of microorganisms in biogeochemical cycling: carbon, nitrogen, phosphorous, sulphur, iron.	
3.	**Methods in marine microbiology**	**(12)**
3.1	Sampling equipment: water samplers such as Niskin sampler, Hydro-Bios sampler, Rosette samplers; sediment samplers such as van Veen grabs and corers.	
3.2	Analysis of primary productivity: the radiocarbon method	
3.3	Analysis of bacterial productivity: the thymidine uptake method	
3.4	Measurement of respiration rates: light-dark bottle method	
3.5	Tools to study marine microbial diversity: flow cytometry, molecular approaches such as metagenomics and community fingerprinting.	

Pedagogy:	Lectures/tutorials/assignments/self-study	
References/ Readings	Belkin, S. and Colwell, R. R., Ocean & Health: Pathogens in the Marine Environment, Springer.	
	Grasshoff, K., Ehrhardt, M. and Kremling, K., Methods of Seawater Analysis, Verlag Chem., Weinheim.	
	Hunter-Cevera, J., Karl, D. and Buckley, M., Marine Microbial Diversity: the Key to Earth's Habitability, American Academy of Microbiology.	
	Meller, C. B., Wheeler, P. A., Biological Oceanography, Wiley-Blackwell Publishers.	
	Mitchell, R. and Kirchman, D. L., Microbial Ecology of the Oceans, Wiley- Blackwell Publishers.	
	Munn, C., Marine Microbiology: Ecology and Applications, Garland Science, Taylor and Francis, N.Y.	
	Nybakken, J. W. and Bertness, M. D., Marine Biology: an Ecological Approach, Benjamin Cummings, San Francisco.	
	Parsons, T. R., Maita, Y. and Lalli, C. M., Manual of Chemical and Biological Methods for Seawater Analysis, Pergamon Press, New York.	
	Strickland, J. D. H. and Parsons, T. R., A Manual of Seawater Analysis, Queen's Printer and Controller of Stationery, Ottawa.	
	Sournia, A., UNESCO Monographs on Oceanographic Methodology, Vol. 6, Phytoplankton Manual, UNESCO Publishing, Paris.	
	Tomas, C. R., Identifying Marine Phytoplankton, Academic Press, San Diego, CA.	
Learning Outcomes	1. Explain the concept of marine environments and the factors governing them. 2. Apply the principles of marine microbiology to understand the biological phenomena occurring in marine environments.	