Programme: M.Sc. (Marine Microbiology)

Course Code: MMO 102

Title of the Course: MICROBIAL ECOLOGY OF THE DEEP MARINE ENVIRONMENT

Number of Credits: 4

Effective from Academic Year: 2018-19

Prerequisites	It is assumed that students have a basic knowledge of marine environment- different coastal habitats, pelagic waters and also about some oceanographic processes such as tides, gyres, El Nino Southern Oscillation.	
Objective:	This course develops concepts in microbiology of the various habitats in deep marine environment, their role in the ecology of that environment.	
Content:		
1.	**The deep sea environment** Basic and in-depth conceptualization of deep marine subsurface; dark ocean biosphere/aphotic pelagic ocean habitats beneath the ocean water column, such as marine sediments, oceanic crust, abyssopelagic/abyssal, hadal plains and hydrothermal vents. Types of deep sea habitats and resident microbiota: marine trenches, ridges, deep permafrost sediments, Antarctic Ocean and Southern Ocean deep environments; piezophilic/ barophilic microorganisms in the deep sea.	**(12)**
2.		**(12)**
2.1	**Sampling equipment** Deep sea sampling equipment: submersibles, remotely operated underwater vehicles Techniques for collecting water and sediment samples, corers: gravity, piston and multiple corers (MUC), giant box corer (GBC); drilling techniques, MEBO sea floor drill rig.	
2.2	**Culturing of deep sea microbes** Introduction to anaerobic and pressure culture chambers/systems; techniques for isolation and culturing deep sea microorganisms under *in situ* and simulated deep sea conditions.	
3.	**Hydrothermal vents** Metals at hydrothermal vents, food webs, chemosynthesis, microbial communities – archaea, bacteria; and fungi; diversity of higher organisms including the tube worm *Riftia pachyptila,* sponges, corals.	**(12)**
4.		**(12)**
4.1	**Marine deposits** Sapropel, carbonates, phosphorite, ancient halite, metallic nodules, marine basalts.	

4.2	**Biogeochemical cycling, enzymes and energetic** Nutrient cycling, oxidation of complex organic matter to carbon dioxide via Fe (III) oxide reduction or fermentation; *Nitrosopumilus maritimus*.	
Pedagogy:	lectures/tutorials/assignments/self-study	
References/ Readings	Munn, C. Marine Microbiology: Ecology and Applications, Garland Science, Taylor and Francis Group, N.Y.	
	Jorgensen, B. B., Boetius, A. (2007) Feast and Famine: microbial life in the deep sea bed. Nature Reviews Microbiology, 5: 770-781.	
	Nakagawa, S., Takai, K. (2008) Deep-sea vent chemoautotrophs: diversity, biochemistry and ecological significance. FEMS Microbial Ecology, 68: 1-84.	
	Karl, D. M., The Microbiology of Deep-Sea Hydrothermal Vents, CRC Press.	
Learning Outcomes	1. Explain marine environment and various oceanographic processes, variation in microorganisms in different habitats, different marine deposits. 2. Explain microbial loop, biogeochemical cycling, biological carbon pump and its role in global climate change.	