Programme: M.Sc. (Marine Microbiology)

Course Code: MMO 116

Title of the Course: TECHNIQUES IN MICROBIAL OCEANOGRAPHY [T]

Number of Credits: 3

Effective from Academic Year: 2018-19

Prerequisites	It assumed that students have basic knowledge about marine environment and basic knowledge about analytical techniques and instrumentation. Basic knowledge about microbiology.	
Objective:	This course develops concept of different analytical techniques and instrumentation in oceanography. Also, different sampling strategies in oceanography to study microbes in ocean.	
Content:		
1.	**Spatial estimates and ocean-biogeochemistry based on Remote sensing measurements of**:	**(15)**
	Chl a, C-DOM, Total; suspended matter, detection of phytoplankton bloom forming groups from scattering and reflectance, primary and new-productivity, photosynthetically available radiation (PAR), Sea-surface temperature, salinity, aerosol optical thickness and types, UV-index of radiations, Cloud-cover, wind-speed and direction, Ocean-currents, ocean-atmosphere heat-exchange, ice-cover, ozone layer etc.	
2.		**(13)**
2.1	**Water-column profiling:** Conductivity-Temperature-Depth (CTD), Sea-bird CTD rosette, Depth – Pressure transducer, turbidity, pH, salinity – Conductivity sensor, oxygen and nutrient. **Water-current / circulation:** Acoustic doppler current profiler (ADCP). **Determination of Euphotic Zone:** Secchi-disk, PAR (Photosynthetically available radiation) sensor. **Bioptical measurements:** Radiometry, Absorption and fluorescence of dissolved organic matter (C-DOM) using spectrophotometry, particulate absorption (filter-pad technique).	
2.2	**Sampling strategies and gears:** **Sampling strategies incorporating time, space and replicates.** **Water sampling:** at discrete depths**,** Niskin sampler mounted on CTD rosette; hand-held plankton net, Bongo-paired zooplankton net. **Sediment sampling:** Grab samplers (van-veen), Box-corers, Gravity corer, Hydraulically damped gravity corer.	
2.3	**Physico-chemical parameters:** pH**,** dissolved oxygen**,** polarographic sensor, Winkler's titration**,** dissolved inorganic nutrients (Nitrate, Nitrite, phosphate, silicate, Ammonia)**,** spectrophotometry**,** CHNS analyzer**,** Total Inorganic Carbon**,** Coulometry**,** dissolved organic carbon**,** high temperature	

	combustion method using DOC analyzer**,** particulate organic carbon/ nitrogen**,** high combustion elemental analyzer**,** Chlorophyll *a*, sediment traps (Moored arrays/drifting traps), ^{234}Thorium based POC export estimates.	
3.		**(08)**
3.1	**Metabolism and Diversity:** Respiration measurements of plankton size fractions, and Respiratory quotient to estimate carbon-flux; labeled substrate uptake and growth kinetics of microbial consortia/isolates to study flux of C, N, P; physiological profiling (CLPP) using BIOLOG plates; Fluorometric assessment of enzymic activity using 4-Methylumbelliferyl (MUF) substrate analogues; scanning confocal-laser microscopy for study of bio-films, changes in redox-potentials in fluorescent stained micro-zones.	
Pedagogy:	Lectures/tutorials/assignments/self-study	
References/ Readings	Grasshoff, K., Ehrhardt, M. and Kremling, K., Methods of Seawater Analysis, Verlag Chem., Weinheim.	
	Jeffrey, S.W and Vesk, M., Introduction to Marine Phytoplankton and Their Pigment Signatures. In: Phytoplankton Pigments in Oceanography. UNESCO Publishing, Paris.	
	Parsons, T. R., Maita, Y and Lalli, C. M., Manual of Chemical and Biological Methods for Seawater Analysis, Pergamon Press.	
	Strickland, J. D. H. and Parsons, T. R., A Manual of Seawater Analysis, Queen's Printer and Controller of Stationery, Ottawa.	
Learning Outcomes	Development of skilled persons for to handle instruments used in oceanography and analytical techniques. Knowledge about how to study microbes in ocean using different techniques and instrumentations.	