SEMESTER III

Programme: M. Sc. (Marine Sciences)
Course Code: MSO 361 Title of the Course: Geophysical Fluid Dynamics
Number of Credits: 04
Effective from AY: June, 2018-19

Prerequisites for the course:	Students undergoing course with Physical Oceanography specialization. However, it is flexible to those having interest to learn basics of fluid dynamics.	
Objective:	This course is introduced to impart students an insight into different scales of motion in fluids (which includes both atmosphere and ocean) and how to understand them by applying basic theorems and laws of fluid dynamics.	
Content:	Basic concepts: fluid continuum, fluid properties, ideal fluid, types of flows; Scales of motions; Importance of rotation and stratification; Distinction between Atmosphere and Oceans;, statics: pressure surface and body forces on a fluid element; fundamental equation of fluid statics: application to compressible and incompressible fluids, hydrostatic equation along the vertical, application to the atmosphere, Units of measurement – Newtonian and non – Newtonian fluids – Coriolis, rotating frame of reference, Kinematics.	12 hours
	Kinematics: Lagrangian and Eulerian methods of description of fluid flow-Lagrangian and Eulerian method- stream lines, streak lines and trajectories, steady and non-steady flow, decomposition of the field of motion in the vicinity of a point, translation, rotation, divergence and deformation, Principles of Prandtl’s mixing length theory, Momentum budget, salt and moisture budget, Summary of governing equations, Boussinesq approximation, typical flow patterns, stream function, divergence and vorticity in different co-ordinate systems, material, local and convective derivatives.	12 hours
	Dynamics - I: equation of continuity and its applications, non-viscous incompressible flow, Eulerian equations of motion, inertial and rotational frames of reference, Coriolis force, irrotational flow, velocity potential, integration of the equations of motion, Bernoulli's theorem and its applications.	12 hours
	Dynamics – II: Circulation and vorticity, Stoke's theorem, Kelvin's theorem, Helmholtz theorem, barotropic and baroclinic fluids, absolute and relative circulation; V. Bjerknes circulation theorem and its interpretation, potential vorticity-conservation, Eddy coefficients, Important dimensionless number, Turbulent diffusion; Combination of advection and diffusion, Geostrophic flow and vorticity dynamics, laminar flow of viscous incompressible fluids; Turbulence in stratified flows; Reynold's number and dynamic similarity of flows, physical significance of Reynold's number, low and high Reynold's number.	12 hours
Pedagogy:	Since the above course is theory component which includes basic theory and derivations, total syllabus is taught in the class. However to get a feeling of the application to natural ecosystem, assignments are given to students thus developing the art of presentation and generating a thought process in the students.	
References/ Readings	1. Hydraulics and fluid mechanics, 1985 – Modi, P.N. and Seth., Standard Book House, Delhi. 2. Foundation of fluid mechanics, 1969 – Yuan, S. W., Prentice Hall, New Delhi. 3. An introduction to fluid mechanics, 1967 – Batchelor, G.K., Cambridge Univ. Press, UK. 4. Hydrodynamics, 1975 – Lamb, H., Cambridge Univ. Press, U.K. 5. Introduction to fluid mechanics, 1976 – Rathy, R.K., Oxford and IBH Publ. Co., New Delhi. 6. The physics of marine atmosphere, 1965 – Roll, H.U., Academic Press, London. 7. Atmosphere – Ocean Dynamics, 1982 - Gill, Adrian E, International Geophysics, 30 Academic press, New York.	
Learning Outcomes	Apply the knowledge gained to solve real life problems confronting the environment.	