Semester	JAN 2022
Open to semester	6,8,22
Course code	**EC3224/EC6224**
Course title	**Geophysical Fluid Dynamics**
Credits	4 /4
Course Coordinator & participating faculty (if any)	Suhas Ettammal
Nature of Course	Lectures and Tutorials
Pre-requisites	Nil
Objectives (goals, type of students for whom useful, outcome etc)	The main goal of the course is to understand the dynamical processes in the atmosphere and Ocean and their mathematical-physical formulation. GFD is a prerequisite for all advanced courses in Earth and Climate science (Geophysics, Advanced fluid dynamics, climate modeling, tropical meteorology etc). Though GFD mainly addresses the atmospheric-Oceanic fluid system, the tools and techniques developed would be useful for studying other fluid systems (e.g. dynamics of the mantle and lithosphere, astrophysical fluid dynamics). Lectures + Tutorials (mainly fluid tank laboratory experiments. It helps students better understand the GFD concepts and gain physical insights)
Course contents (details of topics /sections with no. of lectures for each)	Physical properties of fluids Continuum hypothesis Framework for describing fluid motion Lagrangian and Eulerian frameworks Fundamental forces acting on fluids Conservation laws Momentum, mass, and energy Equation of state Rotating and non-rotating frames of references Apparent forces: centrifugal and Coriolis forces Naiver-Stokes equations in a rotating spherical coordinate Simplifications and approximations of the governing equations (Naiver-Stokes equation) Traditional approximation Boussinesq-Anelastic approximations f and Beta-plane approximations

	Scale analysis Physical properties of fluids Continuum hypothesis Framework for describing fluid motion Lagrangian and Eulerian frameworks Fundamental forces acting on fluids Conservation laws Momentum, mass, and energy Equation of state Rotating and non-rotating frames of references Apparent forces: centrifugal and Coriolis forces Naiver-Stokes equations in a rotating spherical coordinate Simplifications and approximations of the governing equations (Naiver-Stokes equation) Traditional approximation Boussinesq-Anelastic approximations f and Beta-plane approximations Scale analysis Hydrostatic approximation Geostrophic approximation Gradient wind approximation Cyclostrophic approximation Thermal wind balance Vertical coordinates Height, Pressure, Theta (entropy) coordinates Vorticity and Circulation Kelvin circulation theorem, physical interpretation of vorticity equation and their applications, potential vorticity. Effect of friction on fluid Effect of friction on large-scale flow, Ekman layer and pumping, Western boundary intensification.
Evaluation /assessment	End-Sem Examination-40% Mid-Sem Examination-40% Others-20%
Suggested readings (with full list of authors, publisher, year, edn etc.)	Atmosphere, Ocean, and Climate Dynamics, John Marshall and Alan Plumb. Atmospheric and Oceanic Fluid Dynamics, Geoffrey Vallis. An introduction to Dynamic Meteorology, J. R. Holton and G. J. Hakim. Physics of the Atmosphere and Climate, Murray L Salby.