Semester	JAN 2022
Open to semester	8
Course code	**EC4224**
Course title	**Climate Modelling**
Credits	4 /
Course Coordinator & participating faculty (if any)	Neena Joseph Mani*, Guest Faculty Dr. Vinu K. Valsala, IITM Pune
Nature of Course	Lectures and Tutorials
Pre-requisites	Geophysical Fluid Dynamics
Objectives (goals, type of students for whom useful, outcome etc)	This is an advanced course which deals with the computational approaches used in climate modelling and weather prediction. The student will get introduced to a hierarchy of climate models and will gain hands on training in carrying out experiments using these models. The course is open for VIII semester students, who have opted for the basic Climate Science courses and have an aptitude for numerical computation.
Course contents (details of topics /sections with no. of lectures for each)	Hierarchy of Numerical Models: Barotropic Model, Equivalent Barotropic Model, Two level Baroclinic Model, Shallow Water Equation Model, Primitive Equation Model, Spectral Model Parametrizations in climate models; Fundamental representation of Radiation, Boundary layer, Cloud and convective processes Numerical Weather Prediction as an Initial Value Problem, Filtering Problem, Finite Difference Techniques, Explicit, Implicit, and semi-implicit Schemes. Spectral Technique, CFL conditions and stability analysis, Staggered grid, Nonlinear Instability and Aliasing, Data assimilation and Model initialization, ensemble methods Components of an earth system model -- Atmosphere, Ocean, Land, Biosphere, Sea and Land ice. Interactions between different components, energy, mass and momentum fluxes.

	Hierarchy of Coupled models-Coupling strategies-spin up problems Introduction to a full complexity climate model (CESM/WRF) -- configuration, compiling and execution on an HPC machine Computation exercises in Python: plotting climate model output.
Evaluation /assessment	End-Sem Examination-35% Mid-Sem Examination-35% Others-30%
Suggested readings (with full list of authors, publisher, year, edn etc.)	1. Fundamentals of Atmospheric Modeling, Mark Z. Jacobson, Cambridge University Press, 2005, Second Edition. 2. A Climate Modelling Primer, McGuffie and A Henderson Sellers, Wiley-Blackwell, Fourth Edition. 3. Numerical Prediction and Dynamic Meteorology, G.J.Haltiner & Williams, John Wiley & Sons, 1983, Second Edition. 4. Numerical Modelling of Oceans and Oceanic Processes, L.H. Kantha & C. A. Clayson, Academic Press, 2000 5. Numerical Weather and Climate Prediction. Thomas T. Warner, Cambridge, 2011. 6. Inverse modeling of the Ocean and Atmosphere by A. F. Bennet, Cambridge, 2002. 7. Small scale processes in Geophysical Fluid Flows, L. H. Kantha and C.A. Clayson, Academic Press, 2000 8. Ocean Modeling for Beginners, J. Kampf, Springer, 2009