Module Template for New and Revised Modules[1]

Module Code	EEP55C24
Module Name	**SIMULATIONS FOR GEOPHYSICAL MODELLING**
ECTS Weighting[2]	5 ECTS
Semester taught	Semester 2
Module Coordinator/s	Prof Biswajit Basu
Module Learning Outcomes with reference to the Graduate Attributes and how they are developed in discipline	On successful completion of this module, students should be able to: LO1. Describe the basic thermodynamics and fluid dynamics of geophysical fluids. LO2. Formulate the dynamics of rotating planets and apply the equations for assessing the effect on geophysical flows in oceans. LO3. Critically assess and describe how shallow water wave and geostrophic theory are used for oceanography, numerical climate simulation, coastal and offshore engineering. LO4. Apply special techniques for simulation of non-linear partial differential equations for simulating nonlinear waves such as Rossby waves, gravity waves and internal waves. LO5. Formulate problems related to stratified flows and critically assess flows with stratification. LO6. Solve problems and perform numerical simulations related to turbulence. LO7. Describe various types of instabilities in geophysical flows. LO8. Describe state-of-art models for wind driven gyres. LO9. Formulate and simulate overturning circulation and thermoclines including Antarctic Circumpolar currents. LO10. Formulate and simulate Equatorial undercurrent including El Nino. **Graduate Attributes: levels of attainment** To act responsibly - Introduced To think independently - Enhanced To develop continuously - Attained

[1] An Introduction to Module Design from AISHE provides a great deal of information on designing and re-designing modules.
[2] TEP Glossary

	To communicate effectively - Enhanced
Module Content	• Introduction to Geophysical Fluid Flow – Mass, Momentum, Thermodynamics, Entropy, Energy budget • Equations and dynamics of rotating planet – Rotating frame of reference, Spherical co-ordinates, Geostrophic and Thermal wind balance • Shallow water wave theory – Conservation, Geostrophic adjustment, Variational approach • Geostrophic theory – Stratified flows, Friction, Ekman layers • Nonlinear waves – Rossby waves, Gravity waves • Instabilities – Kelvin-Helmholtz instability, Baroclinic instability • Turbulence – Diffusion, Spectral theory, 2D turbulence, Geostrophic turbulence • Wind-driven gyres – Sverdrup balance, Ocean gyres, Arctic gyres • Overturning circulation – Antarctic Circumpolar current • Equatorial undercurrent – El Nino, Unstable air-sea interaction
Teaching and Learning Methods	The module contains a mixture of tutorials and conventional lab sessions where students will be able to seek assistance on their assignments.

	Assessment Component	Assessment Description	LO Addressed	% of total	Week due

Assessment Details[3] **Please include the following:** • **Assessment Component** • **Assessment description** • **Learning Outcome(s) addressed** • **% of total** • **Assessment due date**	CA	A mixture of algorithm design assignments and in-class tests.	LO 1-10	60%	4,7,10,12
	Final Exam	2 hours Written Exam	LO 1,2,3,5,7,8	40%	Exam week in the Trinity term
Reassessment Requirements	100% repeat 2 hours written exam				
Contact Hours and Indicative Student Workload[3]	**Contact hours:** There will be 22 lecture hours and 11 hour of tutorials (i.e., 3 contact hours per week throughout the semester). **Independent Study (preparation for course and review of materials):** 44 hours **Independent Study (preparation for assessment, incl. completion of assessment):** 48 hours for assignments and summative assessments				
Recommended Reading List	Essentials of atmospheric and oceanic dynamics (2019) by G.K. Vallis. CUP				
Module Pre-requisite					
Module Co-requisite					
Module Website	Via Blackboard				
Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.	No				
Module Approval Date					

[3] TEP Guidelines on Workload and Assessment

Approved by	Prof Naomi Harte
Academic Start Year	September 2025
Academic Year of Date	2025/2026