MODULE TITLE	**Theory of Weather and Climate**	**CREDIT VALUE**	**15**
MODULE CODE	**MTH3001**	**MODULE CONVENER**	**Dr Tim Jupp (Coordinator)**

DURATION: TERM	**1**	**2**	**3**
DURATION: WEEKS	**0**	**11**	**0**

Number of Students Taking Module (anticipated)	**61**

DESCRIPTION - summary of the module content

This module is designed to give you an overview of the key physical processes determining the behaviour of the Earth's ocean and atmosphere, exploring both some of the major processes involved and the fundamental theory behind them. An informative subtitle might be climate physics for the mathematically literate. The module builds upon basic principles and key equations (such as hydrostatic balance, ideal gas law, adiabatic fluid motion etc) to bring to life an application of the content from MTH3007 - Fluid Dynamics. Topics covered will include radiative energy transfer, the structure, motion and thermodynamics of the atmosphere, the surface energy balance, and the main components of the general circulation (Hadley cells, Walker cells, jet streams etc.). The emphasis, where possible, will be on simple analytical models (such as shallow water equations and Ekman layers) for commonly observed phenomena and on the development of physical intuition. The material is developed further in modules such as MTHM019 Fluid Dynamics of Atmospheres and Oceans.

Prerequisite module: MTH3007 or equivalent

AIMS - intentions of the module

By the end of this module, you will have an understanding of the basic physics of the Earth's weather and climate, and will comprehend the structure and principal circulations of the atmosphere and the ocean.

INTENDED LEARNING OUTCOMES (ILOs) (see assessment section below for how ILOs will be assessed)

On successful completion of this module, ***you should be able to***:
Module Specific Skills and Knowledge:
1 Appreciate how mathematics can be used to understand the physics of weather and climate;
2 Comprehend the physics responsible for the general circulation;
3 Understand in detail radiation, dynamics and atmospheric thermodynamics;
4 Demonstrate a familiarity with the terminology and physical mechanisms of common meteorological phenomena;
Discipline Specific Skills and Knowledge:
5 Understand the role of mathematical modelling in real-life situations;
6 Recognise how many aspects of applied mathematics learned in earlier modules have practical issues;
7 Develop expertise in using analytical and numerical techniques to explore mathematical models;
8 Formulate simple models;
9 Study adeptly the resulting equations and draw conclusions about likely behaviours;
Personal and Key Transferable / Employment Skills and Knowledge:
10 Display enhanced numerical and computational skills via the suite of practical exercises that accompany the formal lecture work;
11 Show enhanced literature searching and library skills in order to investigate various phenomena discussed;
12 Demonstrate enhanced time management and organisational abilities.

SYLLABUS PLAN - summary of the structure and academic content of the module

- Motivation: the observed state of the atmosphere

- Planetary scale energy balance (for planets with and without atmospheres)

- Surface energy balance

- Vertical structure and thermodynamics (dry and moist) of the atmosphere

- Rotating fluid dynamics: (Geostrophic flow, the thermal wind, Ekman transport, Potential vorticity and quasi-geostrophic potential vorticity)

- Waves (Plane waves. Shallow water theory. Inertial, Kelvin, Rossby and buoyancy waves)

- Instability (barotropic via Rayleigh and Fjortoft theorems, baroclinic via the Eady model)

- Wind-driven circulation in the ocean (Ekman spirals, Ekman pumping)

- Recap of how the theory above explains surface pressure maps, the jet stream, frontogenesis, Hadley and Walker cells etc.

LEARNING AND TEACHING

LEARNING ACTIVITIES AND TEACHING METHODS (given in hours of study time)

Scheduled Learning & Teaching Activities	33.00	**Guided Independent Study**	117.00	**Placement / Study Abroad**	0.00

DETAILS OF LEARNING ACTIVITIES AND TEACHING METHODS

Category	Hours of study time	Description
Scheduled Learning and Teaching Activities	33	Lectures
Guided Independent Study	117	Assessment preparation, wider reading

ASSESSMENT

FORMATIVE ASSESSMENT - for feedback and development purposes; does not count towards module grade

Form of Assessment	Size of Assessment (e.g. duration/length)	ILOs Assessed	Feedback Method
Two Coursework Sheets	15 hours	All	Feedback sheet and oral feedback during lecturer office hour

SUMMATIVE ASSESSMENT (% of credit)

Coursework	20	**Written Exams**	80	**Practical Exams**	0

DETAILS OF SUMMATIVE ASSESSMENT

Form of Assessment	% of Credit	Size of Assessment (e.g. duration/length)	ILOs Assessed	Feedback Method
Coursework 1 – based on questions submitted for assessment	10	15 hours	All	Annotated script and written/verbal feedback
Coursework 2 - based on questions submitted for assessment	10	15 hours	All	Annotated script and written/verbal feedback
Written Exam - Closed Book	80	2 hours (Summer)	All	Written/verbal on request, SRS

DETAILS OF RE-ASSESSMENT (where required by referral or deferral)

Original Form of Assessment	Form of Re-assessment	ILOs Re-assessed	Time Scale for Re-assessment
Written Exam*	Written Exam (2 hours)(80%)	All	August Ref/Def Period
Coursework 1*	Coursework 1 (10%)	All	August Ref/Def Period
Coursework 2*	Coursework 2 (10%)	All	August Ref/Def Period

* Please refer to reassessment notes for details on deferral vs. Referral reassessment

RE-ASSESSMENT NOTES

Deferrals: Reassessment will be by coursework and/or written exam in the deferred element only. For deferred candidates, the module mark will be uncapped.

Referrals: Reassessment will be by a single written exam worth 100% of the module only. As it is a referral, the mark will be capped at 40%.

RESOURCES

INDICATIVE LEARNING RESOURCES - The following list is offered as an indication of the type & level of information that you are expected to consult. Further guidance will be provided by the Module Convener

Basic reading:
ELE: http://vle.exeter.ac.uk/

Reading list for this module:

Type	Author	Title	Edition	Publisher	Year	ISBN	Search
Set	Holton, J.R.	An Introduction to Dynamic Meteorology	4th	Academic Press	2012	978-0123848666	[Library]
Set	Houghton, J.T.	The Physics of Atmospheres	3rd	Cambridge University Press	2002	978-0521011228	[Library]
Set	Peixoto, J.P. and Oort, A.H.	Physics of Climate		American Institute of Physics	1997	978-0883187128	[Library]
Set	Marshall, J. and Plumb, R.A.	An Introduction to Dynamic Meteorology		Academic Press	2004		[Library]
Set	Dunlop, S.	A Dictionary of Weather	New Edition	Oxford University Press	2005	978-0198610496	[Library]
Set	Ambaum, M.H.P.	Thermal Physics of the Atmosphere	1st	Wiley-Blackwell	2010	978-047074151	[Library]

CREDIT VALUE	15	**ECTS VALUE**	7.5
PRE-REQUISITE MODULES	MTH3007		
CO-REQUISITE MODULES			
NQF LEVEL (FHEQ)	6	**AVAILABLE AS DISTANCE LEARNING**	No
ORIGIN DATE	Tuesday 10 July 2018	**LAST REVISION DATE**	Thursday 26 January 2023
KEY WORDS SEARCH	None Defined		