UNIVERSITY OF
EXETER

MODULE TITLE	Computability and Complexity	CREDIT VALUE	15
MODULE CODE	ECM3422	MODULE CONVENER	Dr Khulood Alyahya (Coordinator)

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

Number of Students Taking Module (anticipated)	40

DESCRIPTION - summary of the module content

It is popularly supposed that there is no limit to the power of computers to perform any task, so long as it is sufficiently well defined, and to do so quickly and efficiently. In fact this is not so, and it can be proved mathematically that there are well-defined computational tasks which cannot, in principle, be performed by computers as we know them; and other tasks which, while they can be performed, cannot be completed in a feasible amount of time. This module will introduce you to the Turing Machine model of computation which underpins the fundamental theories of computability (concerned with what can be computed at all) and complexity (concerned with how efficiently things which can be computed can be computed). These theories will be introduced in a precise and formal way, and the main results and theorems will be stated and proven.

Pre-requisites: ECM1414, ECM2418

AIMS - intentions of the module

To introduce the Mathematical basis and practical implications of the classical theory of computability and complexity and to consider the extent to which this is still relevant to modern developments in computing.

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 explain what is meant by a general model of computation and work with some specific examples of such models;
2 describe the mathematical basis of the theory of computability and complexity;
3 appreciate the relationship between the theory of computation and complexity and practical computing.
Discipline Specific Skills and Knowledge:
4 appreciate the power of abstraction to support a general understanding of some subject matter;
5 appreciate the role of theoretical understanding in underpinning disciplined and responsible practice.
Personal and Key Transferable / Employment Skills and Knowledge:
6 approach problems analytically at an appropriate level of abstraction.

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

- Turing machines, and the universal Turing machine;

- recursive and recursively enumerable languages;

- undecidability of the halting problem for Turing machines; variants of the halting problem; other undecidable languages;

- the Church-Turing thesis;
- properties of languages and Rice's theorem;

- time complexity;

- Complexity classes P and NP, and the P vs NP problem;
- NP-complete problems;
- Cook's theorem;
- Space complexity classes and their relationships with the other complexity classes seen in the module.

LEARNING AND TEACHING

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

Scheduled Learning & Teaching Activities	46.00	Guided Independent Study	104.00	Placement / Study Abroad	

DETAILS OF LEARNING ACTIVITIES AND TEACHING METHODS

Category	Hours of study time	Description
Scheduled learning and teaching	22	Lectures
Scheduled learning and teaching	24	Tutorials
Guided Independent Study	24	Coursework
Guided Independent Study	80	Independent study

ASSESSMENT

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

None.

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
Written exam – closed book	80	2 hours - Summer Exam Period	1, 2, 3, 4, 5, 6	None
Coursework assignment	20	20 hours	1, 2, 4, 5, 6	Written

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-reassessment

Original Form of Assessment	Form of Re-assessment	ILOs Re-assessed	Time Scale for Re-reassessment
Written Exam	Written Exam (2 hours)	All	August Ref/Def period
Coursework Assignment	Coursework Assignment	1, 2, 4, 5, 6	August Ref/Def period

RE-ASSESSMENT NOTES

Reassessment will be by coursework and/or written exam in the failed or deferred element only. For referred candidates, the module mark will be capped at 40%. For deferred candidates, the module mark will be uncapped.

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

ELE-https://vle.exeter.ac.uk
Reading list for this module:

Type	Author	Title	Edition	Publisher	Year	ISBN	Search
Set	Hopcroft, J. E.; Motwani, R. and Ullman, J. D.	Introduction to Automata Theory, Languages, and Computation	3	Addison-Wesley	2007	978-0321476173	[Library]

CREDIT VALUE	15	ECTS VALUE	7.5

PRE-REQUISITE MODULES	ECM1414, ECM2418
CO-REQUISITE MODULES	

NQF LEVEL (FHEQ)	3 (NQF level 6)	AVAILABLE AS DISTANCE LEARNING	No
ORIGIN DATE	Thursday 06 July 2017	LAST REVISION DATE	Monday 11 April 2022

KEY WORDS SEARCH	Turing machine; computability; computational complexity.