

MODULE TITLE	High Performance Computing	CREDIT VALUE	15
MODULE CODE	ECMM461	MODULE CONVENER	Dr Man Luo (Coordinator)
DURATION: TERM	1 2	2	3
DURATION: WEEKS	1	1	
Number of Students Taking	Module (anticipated) 10	D	

## **DESCRIPTION - summary of the module content**

The demand for ever-increasing computational power drives the development and exploitation of high-performance computing that underpins leading edge research in computationally intensive engineering technologies fields. This module is designed to equip you with a solid foundation and useful skills in high-performance and distributed computing. In this module, you will learn about current high-performance computer architectures and how the computer architecture influences the performance of algorithms and programs. You will also develop skills in parallel algorithm design and parallel programming, and will gain experience of using a high-performance computing system.

Students should have some familiarity with basic C programming and the basics of differential equations and linear algebra.

## AIMS - intentions of the module

This module aims to provide you with a thorough grounding in parallel programming and the architectures used in high-performance computing. After presenting the fundamental ideas and basic concepts of high-performance computing, the module outlines the architectures, components and parallel programming of high-performance computers. The module will introduce you to recent developments and future trends in architecture and algorithms in high-performance 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. Demonstrate an in-depth understanding of the fundamental ideas and issues of high-performance computing.
- 2. Demonstrate knowledge of high-performance computer architectures and how to make effective use of these architectures.
- 3. demonstrate skills in parallel processing algorithm design and the practical implementation of such algorithms;
- 4. demonstrate knowledge of how to quantitatively assess the performance of parallel programs;
- 5. demonstrate an understanding of numerical effects and the influence of floating point number representation in high-performance computing applications.

#### **Discipline Specific Skills and Knowledge**

- 6. understand how computer architectures can influence the performance of algorithms and programs.
- 7. interpret an informal requirement specification;
- 8. systematically analyse information and make appropriate design choices.

#### Personal and Key Transferable / Employment Skills and Knowledge

9. Relate reading materials to lecture content and analyse a problem. 10. Use technical manuals and books to interpret technical errors.

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

- motivation of and introduction to high-performance computing;

- parallel computer architecture: shared-memory and distributed-memory architectures, multi-core processors, Graphics Processing Unit (GPUs);
- interconnection networks in high performance computers: topologies, latency and bandwidth;
- parallel processing algorithm and programming design: domain decomposition, halo exchange, manager-worker, task-based parallelism;
- parallel programming methods: Message Passing Interface (MPI), OpenMP;
- parallel performance: speed-up, efficiency, parallel overheads and scaling;
- floating point arithmetic: floating point model, range, accuracy, exceptions.

# LEARNING AND TEACHING

LEARNING ACTIVITIES AND TEACHING METHODS (given in hours of study time)								
Scheduled Learning & Teaching Activities	32.00 Guided Independent	t Study	118.00	Placement / Study Abroad	0.00			
DETAILS OF LEARNING ACTIVITIES AND TEACHING METHODS								
Category	Hours of study time	Description						
Scheduled learning and teaching	22	Lectures						
Scheduled learning and teaching	10	Workshops						
Guided independent study	80	Coursework (in	dividual-a	ssessed work)				
Guided independent study	38	Guided indepe	ndent stud	dy				

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		

Form of Assessment	Size of Assessment (e.g. duration/length)	ILOs Assessed	Feedback Method
Weekly online quizzes	10 quizzes comprising 5-7 questions	1, 2, 3, 4, 5, 6	Oral feedback

SUMMATIVE ASSESSMENT (% of credit)						
Coursework	100	Written Exams	0	Practical Exams		
DETAILS OF SUMMATIVE	ASSESSMENT					
Form of Assessment	% of Credit	Size of Assessment (e.g. duration	on/length)	ILOs Assessed	Feedback Method	
Coursework 1 Coursework 2 Individual Project	40 40 20	30 hours 30 hours 15 hours	sn.	Ali Ali Ali	Written feedback Written feedback Written feedback	
DETAILS OF RE-ASSESSMENT (where required by referral or deferral)						
Original Form of Assessmen	t	Form of Re-assessment	ILOs Re-assessed	Time Scale for R	e-assessment	
Coursework 1 Coursework 2 Individual Project	( ( 	Coursework 1 Coursework 2 ndividual Project	All All All	August Ref/Def Per August Ref/Def Per August Ref/Def Per	iod iod iod	

# **RE-ASSESSMENT NOTES**

Reassessment will be by coursework in the failed or deferred element only. For referred candidates, the module mark will be capped at 50%. For deferred candidates, the module mark will be uncapped.

	RES	SOURCES					
INDICATIVE LEARNING RESOURC	CES - The following list is offer ted to consult. Further guidan	ed as an indication of the	e type e Modu	& level of Ile Conve	ner		
Basic reading:							
ELE: http://vle.exeter.ac.uk/							
Web based and Electronic Resources	:						
Other Resources:							
Reading list for this module:							
Type Author	Title		Edition	Publisher	Year	ISBN	Search
Set Sterling, T., Anderson, M. and Broc M.	lowicz, High Performance Computing	: Modern Systems and Practices	1st	Elsevier	2018	978-0-12-420158- 3	[Library]
CREDIT VALUE	15	ECTS VALUE		7.5			
PRE-REQUISITE MODULES	None						
CO-REQUISITE MODULES	None						
NQF LEVEL (FHEQ)	7	AVAILABLE AS DISTANCE LE	ARNING	No			
ORIGIN DATE	Tuesday 10 July 2018	LAST REVISION DATE		Friday 09 [	Decem	ber 2022	
KEY WORDS SEARCH	computer modelling, computer simula	tion, performance evaluation					