MODULE DESCRIPTOR

Module Title

Optimisation

Reference	CM4140	Version	1
Created	December 2023	SCQF Level	SCQF 10
Approved	April 2024	SCQF Points	15
Amended		ECTS Points	7.5

Aims of Module

This modules aims to introduce students to a range of techniques for modelling and solving optimisation problems, including well-known meta-heuristic techniques such as genetic algorithms and particle swarm optimisation.

Learning Outcomes for Module

On completion of this module, students are expected to be able to:

1	Compose an appropriate encoding of an optimisation problem using standard representations.
2	Develop a number of well-know heuristic algorithms to solve an optimisation problem.
3	Test the effectiveness and efficiency of bio-inspired meta-heuristic algorithms for solving a given optimisation problem.
4	Examine the performance of extensions and modifications to standard optimisation algorithms.
5	Examine state-of-the-art research-led questions and approaches to optimisation.

Indicative Module Content

Fitness landscapes, fitness functions, neighbourhoods, encodings, exploration and exploitation, constrained optimisation. Random search, random walk, hill-climbing, tabu search, simulated annealing, iterated local search, Particle swarm optimisation (PSO), ant colony optimisation (ACO), artificial immune systems, evolutionary algorithms (EA), genetic algorithms (GA), estimation of distribution algorithm (EDA). Crossover, mutation and selection methods, elitism, parallelisation, hyper-heuristics. Research-led teaching such as multi-objective optimisation, surrogate modelling, dynamic optimisation, explainable optimisation, visualisation.

Module Delivery

This module is based on lectures supplemented with laboratory sessions, where practical skills will be developed to solve varied learning tasks and practical exercises.

Module Ref:	CM4140 v1

Indicative Student Workload	Full Time	Part Time
Contact Hours	30	N/A
Non-Contact Hours	120	N/A
Placement/Work-Based Learning Experience [Notional] Hours	N/A	N/A
TOTAL	150	N/A
Actual Placement hours for professional, statutory or regulatory body		

ASSESSMENT PLAN

If a major/minor model is used and box is ticked, % weightings below are indicative only.

Component 1

Type:	Coursework	Weighting:	100%	Outcomes Assessed:	1, 2, 3, 4, 5
Description:	A coursework in which the techniques studied on the course are used to study an optimisation problem.				

MODULE PERFORMANCE DESCRIPTOR

Explanatory Text

The calculation of the overall grade for this module is based on 100% weighting of component 1. An overall minimum grade D is required to pass the module.

Module Grade	Minimum Requirements to achieve Module Grade:
A	The student must achieve an A in C1
B	The student must achieve a B in C1
C	The student must achieve a C in C1
D	The student must achieve a D in C1
E	The student must achieve an E in C1
F	The student must achieve an F in C1
NS	Non-submission of work by published deadline or non-attendance for examination

Module Requirements

Prerequisites for Module	None.
Corequisites for module	None.
Precluded Modules	None.

INDICATIVE BIBLIOGRAPHY

1	An Introduction to Metaheuristics for Optimization. Chopard, Bastien; Tomassini, Marco. 2018
2	Representations for genetic and evolutionary algorithms Rothlauf, Franz, 2006
3	Evolutionary and swarm intelligence algorithms Bansal, Jagdish Chand, editor.; Sim?ha, Pramoda Kuma?ra, editor.; Pal, Nikhil R., editor. 2019
4	Evolutionary algorithms and neural networks : theory and applications Mirjalili, Seyedali, 2019
5	Introduction to evolutionary algorithms Yu, Xinjie.; Gen, Mitsuo, 2010