Module Specification

Graphs, Algebra and Algorithms

Version: 2021-22, v1.0, 29 Sep 2020

Contents

Part 1: Information

Module title: Graphs, Algebra and Algorithms

Module code: UFMFMV-30-2

Level: Level 5

For implementation from: 2021-22

UWE credit rating: 30

ECTS credit rating: 15

Faculty: Faculty of Environment & Technology

Department: FET Dept of Engineering Design & Mathematics

Partner institutions: None

Delivery locations: Frenchay Campus

Field:

Module type: Standard

Pre-requisites: None

Excluded combinations: None

Co-requisites: None

Continuing professional development: No

Professional, statutory or regulatory body requirements: None

Part 2: Description

Overview: This module develops algebraic and algorithmic aspects of graph theory, the latter being an area of Mathematics that is very important, both from a theoretical viewpoint and in terms of its many applications in solving real-world problems.

The module also considers algorithms in a more general context and explore some uses of algorithms in areas other than graph theory. The module involves a

continuation of the development of linear algebra that was initiated in Level Four. If appropriate, then software or programs will be used for computations. Simple applications will be introduced at appropriate points.

Features: Not applicable

Educational aims: The aim of this module is develop a deeper understanding of structures within mathematics.

The module demonstrates the central role of linear algebra in mathematics with particular focus on graph theory and its applications.

The module also introduces algorithms in order to implement theoretical aspects and to consider applications.

Outline syllabus: Basic Graph Theory [3 weeks]
Simple graphs (basic definitions and properties)
Special families of simple graphs, bipartite graphs and regular graphs
Subgraphs
Homomorphisms, isomorphisms and graph invariants
Operations on graphs
Connectivity
Metric space aspects

Chromatic Graph Theory [3 weeks]
Vertex colourings
Colourings and homomorphisms
The chromatic number
The chromatic polynomial
The Four Colour Theorem

Spectral Graph Theory [5 weeks]
Vector spaces and linear transformations associated with a simple graph
The adjacency spectrum
The Laplacian spectrum
Spectra of special graphs

Cospectral graphs
The interaction between linear algebra properties and graph theoretic properties (possible examples include diameter, connectivity, clique number and chromatic number)

Introduction to Algorithms [2 weeks]
Purpose and design
Computational complexity
Correctness
Programming aspects

Algorithms in Action [8 weeks]
Indicative application areas
Depth-first search and breadth-first search
Walks and paths (including the Travelling Salesperson Problem)
Network flows
Coding theory
Number theory
Linear algebra
Abstract algebra

Part 3: Teaching and learning methods

Teaching and learning methods: The teaching and learning strategy will involve taught material that is interspersed with individual or group activities that develop understanding of the theory and of its applications. The activities will include calculations and investigations within a framework of problem-based learning. It is envisaged that a single multi-purpose room, e.g., a TEAL space, will be utilised for all the contact sessions.

Module Learning outcomes:

MO1 Select and apply appropriate techniques to analyse and to solve algebraic problems related to graph theory.

MO2 Define and identify the mathematical structure of graphs and of algorithms.

MO3 Use software to implement and to adapt mathematical algorithms.

MO4 Communicate mathematical arguments clearly and effectively, by selecting and using appropriate notation, logic, concepts and techniques.

Hours to be allocated: 300

Contact hours:

Independent study/self-guided study = 228 hours

Face-to-face learning = 72 hours

Total = 300

Reading list: The reading list for this module can be accessed at readinglists.uwe.ac.uk via the following link https://rl.talis.com/3/uwe/lists/9EA54638-3264-8A68-62D8-8C1AD4FAD0E3.html?lang=en-GB&login=1

Part 4: Assessment

Assessment strategy: The module will be assessed by a single component of assessment consisting of two elements. The first element will be a mid-module examination containing pre-seen scenarios where student prepare material to be taken into the assessment to answer unseen questions. This assessment provides feedback as to level of achievement mid-way through the module.

The second element is a 2 hour end of module examination which contains a mixture of questions testing theoretical concepts and applications. Again some questions will have a partially seen format.

The resit assessment will be a single 3 hour examination.

Assessment components:

Examination (Online) - Component A (First Sit)
Description: Online exam (24 hours)

Weighting: 25 %

Final assessment: No

Group work: No

Learning outcomes tested: MO1, MO2, MO4

Examination (Online) - Component A (First Sit)

Description: Online exam (24 hours)

Weighting: 75 %

Final assessment: Yes

Group work: No

Learning outcomes tested: MO1, MO2, MO3, MO4

Examination (Online) - Component A (Resit)

Description: Online exam (24 hours)

Weighting: 100 %

Final assessment: No

Group work: No

Learning outcomes tested: MO1, MO2, MO3, MO4

Part 5: Contributes towards

This module contributes towards the following programmes of study:

Mathematics [Sep][FT][Frenchay][3yrs] BSc (Hons) 2020-21

Mathematics [Sep][SW][Frenchay][4yrs] BSc (Hons) 2020-21

Mathematics with Qualified Teacher Status [Sep][FT][Frenchay][3yrs] BSc 2020-21