COURSE SPECIFICATION DOCUMENT

Academic School / Department: Science, Innovation & Technology

Programme: Mathematics and Data Science

***FHEQ* Level:** 5

Course Title: Linear Algebra and Multivariable Calculus

Course Code: MATH 5104

Total Hours: 160
Timetabled Hours: 45
Guided Learning Hours: 15
Independent Learning Hours: 100

Credits: 16 UK CATS credits
8 ECTS credits
4 US credits

Course Description:

The course provides a detailed study of set theory, systems of linear equations, theory of vectors and vector spaces, algebra of matrices, determinants and characteristic polynomials, mappings and linear transformations, canonical forms and invariance, eigenvectors and eigenvalues. LU-matrix factorization, matrix diagonalization and orthogonality, least square method, and inner-product spaces and applications. Multivariable calculus to include solutions of systems of linear ordinary differential equations (ODE) using matrix method. These concepts are useful as they form a basis of a deeper understanding of advanced mathematics and have wide applications in physical and social sciences. Applications to specific majors will be explored.

Prerequisites:

40 credits + MATH 4103 Calculus with Applications

Aims and Objectives:

The module aims to:

- Provide students with an understanding of matrix algebra, and how to solve systems of linear equations.
- Develop the theory of vector algebra and vector spaces as applied to algebra of matrices, determinants and characteristic polynomials, mappings and linear transformations.
- Identify canonical forms and invariance, eigenvectors and eigenvalues.
- Perform LU-matrix factorization, and matrix diagonalization, least square method, and inner-product spaces and its applications.
- Explore concept of multivariable calculus to include solutions of systems of linear differential equations using matrix method.
- Explore various areas where concepts of linear algebra are applied in physical cases.

Programme Outcomes:

L5 AI, AII, BI, BII, CI, CII, DI, DII

A detailed list of the programme outcomes is found in the Programme Specification. This is maintained by Registry and located at: https://www.richmond.ac.uk/programme-and-course-specifications/

Learning Outcomes:

By the end of this course, successful students should be able to:

- Understand how to perform binary operations.
- Understand how to solve systems of linear equations.
- Understand the concepts of vector and matrix algebra
- Understand the principles of eigenvalues and eigenvectors and their applications in different scenarios of applications.
- Understand the concept of linear transformations and present a rigorous analysis of problems involving linear transformations.
- Use matrix methods to solve systems of linear differential equations.
- Identify correct method/strategy to solve problems using appropriate mathematical routines and strategies.

Indicative Content:

- Systems of linear equations; Row reduction and Matrix Equation
- Linear Transformations, and Matrix Transformation
- Matrix Operations; Inverse Matrices where applicable
- Vector Spaces; Null Space
- Vector Algebra, Basis, dimension and rank
- Eigenvectors and Eigenvalues
- Linear Transformation
- Orthogonality and Gram-Schmidt Process
- Least-Square Problem
- Matrix solution to systems of linear ODEs

Assessment:

This course conforms to the University Assessment Norms approved at Academic Board and located at: https://www.richmond.ac.uk/university-policies/

Teaching Methodology:

This course will be delivered face to face through a combination of lectures and interactive sessions. In addition to classroom activities, there are guided learning elements that are tutor led and arranged through Blackboard. These activities can be asynchronous online sessions, flipped classrooms, set readings with discussion boards or set guest lectures for example. Set activities are monitored by the instructor to ascertain student engagement. Students are encouraged to prepare for class and to play an active part, to raise questions, following-up ideas and interact with a wide range of provided material.

Indicative Text(s):

Lay, D.C. (2021) *Linear Algebra and Its Applications*, 6th edn. London: Pearson.

See syllabus for complete reading list.

Change Log for this CSD:

Nature of Change	Date Approved & Approval Body (School or AB)	Change Actioned by Registry Services
First Edition	Nov 2024	