COURSE SPECIFICATION DOCUMENT

Academic School / Department: Science, Innovation & Technology

Programme: Mathematics and Data Science

***FHEQ* Level:** 4

Course Title: Calculus with Applications

Course Code: MATH 4103

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:
This course provides a sound understanding of the concepts of calculus and their applications to business courses, data science and scientific courses. There will be an emphasis on the rigorous approach to the concept of limits as a key pillar of many concepts of calculus. Theory and applications of calculus with numerous examples will be explained to students depending on specific majors. Topics to be covered will include co-ordinate geometry of straight lines, quadratic curves, exponential and logarithmic functions; elementary differentiation and integration of real-valued functions, exponential and logarithmic functions, and trigonometric functions. Applications of calculus concepts to maxima, minima, and optimization problems. Calculus of several variables to include partial derivatives and optimizing functions of two variables, and constrained optimization and method of Lagrange Multipliers. Double integrals and applications. Modelling with first-order ordinary differential equations.

Prerequisites:
None

Aims and Objectives:
The module aims to:

- Provide students with an understanding of the fundamentals of calculus and their applicability.
- Enable students to investigate a range of mathematical applications in areas of business, data science, and scientific areas as well as socialand life sciences.
- Enable students develop a rigorous approach to problem solving and understand the steps being employed.
- Equip students with relevant analytical skills to be able to transition smoothly to upper level mathematical courses.

Programme Outcomes:
AI, BI, CI, DI

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 the concept of different types of functions and have a sound and broad understanding of different types of functions.
- Understand the idea of limits and continuity from a simple approach to a more rigorous analytical approach and can determine and apply the concept of limits to specific problems.
- Understand the concepts and processes of finding derivatives and integration of functions of one variable, including geometrical interpretations.
- Understand how to analyse functions with two independent variables and the concept of calculus of several variables including partial derivatives, optimization of functions of two variables, Least-Square methods, Lagrange Multipliers and double integrals.
- Solve basic first-order differential equations and their applications.
- Identify and choose the correct method/strategy to solve practical oriented problems of specific majors and using appropriate mathematical language.

Indicative Content:

- Functions and Functional Models
- Limits and Continuity; L'Hopital Rule
- The Derivative and techniques of differentiation
- Application of the derivative
- Indefinite and definite integral
- Functions of several variables and partial derivatives
- Least-Square method in optimization
- Optimization of functions of two variables and the method of Lagrange Multipliers
- Double integrals

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.

Course material is presented and analysed in the following ways:

a) Formal presentation of topics and worked exercises.
b) Self-learning assignments and directed mathematical exercises.
c) Participation in individual and group investigations.
d) Where appropriate, students will be introduced to solution aids, such as hand- held calculators, mathematical tables and computer software.

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Indicative Text(s):

Hass, J., Heil, C. Bogacki, P. and Weir, M. (2022) *Thomas' Calculus: Early Transcendentals.* 15th edn. London: Pearson.

Laurence, H., Bradley, G., Sobecki, D. and Price, M. (2012) *Applied Calculus for Business, Economics, and the Social and Life Sciences.* 11th edn. USA: McGraw-Hill.

Margaret, L., Greenwell, R. and Ritchey, N. (2016) *Calculus with Applications.* 11th edn. London: Pearson.

Gilbert, S. and Herman, E. (2024) *Calculus.* 3 Vols. Rice, USA: Openstax.

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	