COURSE NAME : MULTIVARIABLE CALCULUS

COURSE CODE: MATH 2403

LEVEL: II

NUMBER OF CREDITS: 3

SEMESTER: II

PREREQUISITES: (MATH1141, MATH1142 and MATH1151) or (MATH1185) or (M10A and M10B)

RATIONALE:

Some of the models of real life situations in nature are not one dimensional and it is not possible to study these models with one-variable calculus. Multivariable calculus is therefore used extensively in physics and engineering, especially in the description of electromagnetic fields, gravitational fields and fluid flow. Students must understand the principles of both their model and the calculus, be able to translate situations in their discipline into mathematical models, have the knowledge and skill to solve problems in the model, and then to translate mathematical solutions back into their discipline.

COURSE DESCRIPTION:

Multivariable Calculus applies the techniques and theory of differentiation and integration to vector-valued functions and functions of more than one variable. The course presents a thorough study of vectors in two and three dimensions, vector-valued functions, curves and surfaces, motion in two and three dimensions, and an introduction to vector fields. Students will be exposed to modern mathematical software to visually represent these 2D and 3D objects.

CONTENT:

Parametric and polar curves; vectors and vector-valued functions; functions of several variables; multiple integration; vector calculus.

LEARNING OUTCOMES

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

- analyse and sketch surfaces in three-dimensional space;
- analyse and apply the algebraic and geometric properties of vectors and vector functions in two and three dimensions;
- compute dot products and cross products and interpret their geometric meaning;
- compute derivatives and integrals of vector functions;
- compute partial derivatives of functions of several variables;
- compute directional derivatives and gradients of scalar functions and explain their meaning;

- solve multiple variable maximum and minimum value problems;
- set up and evaluate double and triple integrals using a variety of coordinate systems;
- evaluate line integrals through scalar or vector fields and explain some physical interpretations of these integrals;
- apply Green's theorem to evaluate line integrals over curves in $\mathbb{R}^2$;
- evaluate surface integrals and apply Stoke theorem to evaluate line integrals over curves in $\mathbb{R}^3$.

CONTENT

Parametric and Polar curves:

- Parametric Equations - Polar coordinates - Conic sections

Vectors and Vector valued Functions:

- Vectors in 2D and 3D, dot and cross products, Lines and curves in space, Calculus of Vector valued functions, Motion in space, Length of curves, Curvature and normal vector

Functions of Several Variables:

- Planes and Surfaces, Graphs and level curves, Review: Limits, continuity and Partial derivatives, Directional derivatives and Gradient, Tangent planes, Maxima/Minima

Multiple Integration:

- Review: Double and triple integrals, Polar, cylindrical and spherical coordinates

Vector Calculus:

- Vector fields, Line integrals, Green's theorem, surface integrals, Stokes theorem, Divergence theorem

TEACHING METHODOLOGY:

This course will be delivered through a combination of informative lectures, participative tutorials and practical laboratories. The total estimated 39 contact hours are broken down as follows: 27 hours of lectures, 8 hours of lab (counted as 4 contact hours) and 8 tutorials. The course material will be posted on the webpage

http://ourvle.mona.uwi.edu/

ASSESSMENT:

The course assessment will be broken into two components; a coursework component worth 30% and a final exam worth 70%.

1. Two course work exams (1 hour each) and each of these exams will be worth 15% of the student's final grade.
2. The final exam will be two hours in length.

REFERENCE MATERIAL:

Books:

Prescribed

STEWART, James. *Multivariable Calculus.* Brooks Cole; 6th edition (2007): ISBN-13: 978-0495011637

Recommended

MARSDEN, J. & A. Tromba. *Vector Calculus*, W.H. Freeman & Company, 4th edition (1996): ISBN-13: 978-0716724322

Highly Recommended

LANG, Serge. *Calculus of Several Variables*. Springer, 3rd edition (1987): ISBN-13: 978-0387964058

These are standard books that cover the detailed syllabus of the course and concepts are very well written and with numerous examples and explanations.

Online Resources:

http://web.monroecc.edu/calcNSF/: Students can explore the visualization of multivariable calculus esp. 2D and 3D objects.