

COURSE NAME: Mathematical Modelling

COURSE CODE: MATH3422

LEVEL: III

SEMESTER: I

NUMBER OF CREDITS: 3

PREREQUISITES:

Elements of Mathematical Analysis (MATH2401)

A First Course in Linear Algebra (MATH2410)

Ordinary Differential Equations (MATH2420)

RATIONALE:

The successful use of mathematics to describe a real-world system requires a good background in mathematical theory. More than this, it requires facility with the process of constructing mathematical models: a separate skill that must be gained through exposure to the modelling process and practical experience. This course provides students with the opportunity to develop such modelling skills.

COURSE DESCRIPTION:

The course looks at the stages of modeling and guides the student through carefully chosen examples designed to show how the process of constructing and analyzing a mathematical model is performed.

LEARNING OUTCOMES:

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

- Identify appropriate modelling strategies for a range of real-world systems;
- Implement and analyse a model using graphs of functions;
- Formulate and analyse models for deterministic processes evolving in discrete time;
- Formulate and analyse multi-species population and epidemiological models;
- Demonstrate the construction of models for stochastically evolving processes.

CONTENT:

Introduction to modelling:

Purpose of modelling; Constructing a model – problem statement, formulation, solution, validation; Illustrative examples; Decision-making with mathematical models; Arms race models; Economic models of the effect of taxation.

Discrete models:

Discrete-time modelling; Discrete approximation of continuous-time models; Equilibria and long-run behavior; Case studies

Continuous Models:

Modeling with a differential equation: Numerical Methods; Solving first order differential equation, generate solution curves and direction fields using mathematical software; case studies in applications to biology and epidemiology etc..

Modelling with systems differential equations: modeling; Analysis of system of equations using software; Case studies

Lab Component

Simulating the models using Mathematical software

TEACHING METHODOLOGY:

Students will be exposed to the theoretical aspects of mathematical modelling through informative lectures. Tutorials (provided as needed during scheduled lecture hours) will reinforce their learning. A project will provide students with an opportunity to work hands-on with the modelling process.

The total estimated 39 contact hours may be accounted for as follows: 26 hours of lectures and 13 hours of tutorials. Course material, including practice problems, will be posted on the webpage <http://ourvle.mona.uwi.edu/>

ASSESSMENT:

The course assessment has three components:

1. In-course test (1 hour) - 20% of overall grade;
2. One group project - 20% of overall grade;
3. Final examination - 60% of overall grade.

The final examination will be two hours in length and consist of compulsory questions.

REFERENCE MATERIAL:**Books:**

Prescribed: Frank R. Giordano and Maurice D. Weir. *A first course in mathematical modelling*. 3rd Edition. Brooks Cole, 2003. ISBN 0534384285

Highly Recommended :

BRAUN, Martin. *Differential equations and their applications: An Introduction to Applied Mathematics*. 4th Edition. Springer, 1993. ISBN 0387978941

These books address the theoretical elements of the syllabus, providing useful case studies and examples.

Online Resources:

<http://www.mathmodels.org/problems/> - access to several online databases of mathematical modeling problems, searches may be categorized by student level, problem level, application and area of mathematics.