Course Outline (Higher Education)

School: Faculty of Science and Technology

Course Title: MODELLING THE ENVIRONMENT

Course ID: MATHS3004

Credit Points: 15.00

Prerequisite(s): (MATHS2016)

Co-requisite(s): Nil

Exclusion(s): Nil

ASCED: 010101

Description of the Course :

MATHS3004 introduces the modelling of environmental systems, through conceptual models showing linkages of variables, and full mathematical models. Using discrete and continuous models of biological, chemical and physical processes, the ecology and physical behaviour of environmental systems is represented by models with analytic or numerical solutions. A range of mathematical methods including analytic and approximate methods (through spreadsheets) for ordinary differential equations, Fourier series solutions for partial differential equations, matrix models and simple difference equations are used to explore models, and their use in depicting the behaviour of simple physical systems.

Grade Scheme: Graded (HD, D, C, etc.)

Work Experience:

No work experience: Student is not undertaking work experience in industry.

Placement Component: No

Supplementary Assessment: Yes

Where supplementary assessment is available a student must have failed overall in the course but gained a final mark of 45 per cent or above and submitted all major assessment tasks..

Program Level:

Level of course in Program	AQF Level of Program					
	5	6	7	8	9	10
Introductory						

Level of course in Program	AQF Level of Program					
	5	6	7	8	9	10
Intermediate						
Advanced			✔			

Learning Outcomes:

Knowledge:

K1. Model natural processes with mathematical and stochastic methods.

Skills:

S1. Apply the modelling cycle and understand the components of a model.
S2. Compute analytical solutions to systems of ordinary and partial differential equations.
S3. Solve models using matrices and time series analysis.
S4. Numerically solve complex systems of ordinary and partial differential equations.

Application of knowledge and skills:

A1. Use methods of calculus, including numerical approximation by software, for predicting natural phenomena.
A2. Predict outcomes of evolving environmental systems by applying probabilistic methods.

Course Content:

Modelling of environmental systems, through conceptual models showing linkages of variables, and full mathematical models. Using discrete and continuous models of biological, chemical and physical processes, the ecology and physical behaviour of environmental systems is represented by models with analytic or numerical solutions. A range of mathematical methods including: analytic and approximate methods (through spreadsheets) for ordinary differential equations, Fourier series solutions for partial differential equations, matrix models and simple difference equations; elementary systems analysis; are used to explore models, and their use in depicting the behaviour of simple physical systems.

Topics may include:

- - Introduction and overview of modelling, empirical, dimensional analysis, ordinary differential equations (ODE's).

  - Population like models, development of terms, Von Bertalanffy fish model, Bernoulli differential equations (DE's).

  - Numerical methods for ODE's: Euler's method, Runge-Kutta methods.

  - Systems of ODE's: analytical and numerical solution, decomposition of high order DE's.

  - Markov chains, classification and long-run behavior.

  - Time Series, Markov annual stream flow.

  - Modelling with partial differential equations (PDE's), directly integrable, advection and method of characteristics.

- Method of separation of variables, Fourier series, Euler's formulas.
- Dirichlet, Gibbs and Parseval phenomenon, odd and even extensions.
- Diffusion equation with numerical methods.
- Wave equation with numerical methods.

Values:

V1. Appreciate the roles of mathematics and statistics for finding solution to real world problems.

Graduate Attributes

The Federation University FedUni graduate attributes (GA) are entrenched in the Higher Education Graduate Attributes Policy (LT1228). FedUni graduates develop these graduate attributes through their engagement in explicit learning and teaching and assessment tasks that are embedded in all FedUni programs. Graduate attribute attainment typically follows an incremental development process mapped through program progression. **One or more graduate attributes must be evident in the specified learning outcomes and assessment for each FedUni course, and all attributes must be directly assessed in each program**

Graduate attribute and descriptor		Development and acquisition of GAs in the course			
		Learning Outcomes (KSA)	**Code** A. Direct B. Indirect N/A Not addressed	**Assessment task (AT#)**	**Code** A. Certain B. Likely C. Possible N/A Not likely
GA 1 Thinkers	Our graduates are curious, reflective and critical. Able to analyse the world in a way that generates valued insights, they are change makers seeking and creating new solutions.	Students will acquire and use a set of mathematical skills with which they will be able to analyse real-world modelling problems.	A.	AT#1,2,3.	A.
GA 2 Innovators	Our graduates have ideas and are able to realise their dreams. They think and act creatively to achieve and inspire positive change.	Not applicable	Not applicable	Not applicable	Not applicable
GA 3 Citizens	Our graduates engage in socially and culturally appropriate ways to advance individual, community and global well-being. They are socially and environmentally aware, acting ethically, equitably and compassionately.	Students develop environmental and ethical awareness by analysing the assumptions underpinning the development of mathematical models.	B.	AT#1,2.	B.
GA 4 Communicators	Our graduates create, exchange, impart and convey information, ideas, and concepts effectively. They are respectful, inclusive and empathetic towards their audience, and express thoughts, feelings and information in ways that help others to understand.	Students develop mathematical and written communication skills by analysing and reporting on modelling problems based on real-life scenarios.	A.	AT#1,2.	A.

Graduate attribute and descriptor		Development and acquisition of GAs in the course			
		Learning Outcomes (KSA)	**Code** A. Direct B. Indirect N/A Not addressed	**Assessment task (AT#)**	**Code** A. Certain B. Likely C. Possible N/A Not likely
GA 5 Leaders	Our graduates display and promote positive behaviours, and aspire to make a difference. They act with integrity, are receptive to alternatives and foster sustainable and resilient practices.	Not applicable	Not applicable	Not applicable	Not applicable

Learning Task and Assessment:

Learning Outcomes Assessed	Learning Tasks	Assessment Type	Weighting
K1, S1 - S4, A1, A2	Problem solving and modelling techniques, analytical and numerical solution of models involving ordinary and partial differential equations, use of software, applied matrix methods, time series analysis.	Written assignments	30% - 50%
K1, S1 - S4, A1, A2	Demonstrate knowledge of solution and interpretation of mathematical models.	Written examination	50% - 70%

Adopted Reference Style:

APA