MODULE SPECIFICATION PROFORMA

Module Code:	ENG741

Module Title:	Engineering Systems Modelling and Simulations

Level:	7	**Credit Value:**	20

Cost Centre(s):	GSAC	JACS3 **code**:	J500

School:	Applied Science, Computing & Engineering	**Module Leader:**	Dr Shafiul Monir

Scheduled learning and teaching hours	40 hrs
Guided independent study	160 hrs
Placement	0 hrs
Module duration (total hours)	200 hrs

Programme(s) in which to be offered (not including exit awards)	Core	Option
MSc Engineering (Aeronautical) MSc Engineering (Mechanical Manufacture) MSc Engineering (Automotive) MSc Engineering (Composite Materials) MSc Engineering (Renewable & Sustainable Energy) MSc Engineering (Electrical & Electronic) MSc Engineering (Mechatronics)	✓	☐

Pre-requisites
N/A

Office use only
Initial approval: 19/06/2018 Version no:3
With effect from: 01/09/2018
Date and details of revision: Version no:

Module Aims

- To build upon analytical skills and knowledge of the engineering design process and how it can be improved through the use of advanced engineering systems modelling and simulations.

- To be able to perform in depth analysis of systems and data using currently available programme specific modelling, simulation and analysis software. Typical examples might be ABAQUS and ANSYS for Mechanically related programmes, and MATLAB, SIMULINK and VEE for Electrically related programmes.

Intended Learning Outcomes

Key skills for employability

KS1	Written, oral and media communication skills
KS2	Leadership, team working and networking skills
KS3	Opportunity, creativity and problem solving skills
KS4	Information technology skills and digital literacy
KS5	Information management skills
KS6	Research skills
KS7	Intercultural and sustainability skills
KS8	Career management skills
KS9	Learning to learn (managing personal and professional development, self-management)
KS10	Numeracy

At the end of this module, students will be able to		Key Skills	
1	Apply advanced modelling and analysis to the solutions of practical and complex design problems.	KS1	KS3
		KS4	KS6
		KS9	KS10
2	Define the key stages associated with utilising design parameters in performing advanced modelling.	KS1	KS2
		KS4	KS6
		KS9	KS10
3	Demonstrate a proficiency in the use of and an ability to produce representative models with proprietary numerical modelling.	KS1	KS4
		KS5	KS6
		KS9	KS10

Transferable skills and other attributes

1. Communication
2. ICT Technologies
3. Time management and organisation
4. Interpersonal skills
5. Problem solving
6. Information handling including numeracy

Derogations

Credits shall be awarded by an assessment board for those Level 7 modules in which an overall mark of at least 50% has been achieved with a minimum mark of 40% in each assessment element.

Assessment:

Indicative Assessment Tasks:

Assessment One: An individually prepared report for solutions, discussion of results obtained by computer modelling.

Assessment Two: An individual report in which interpretation, specification and implementation of an engineering system is to be analysed through computer modelling simulation.

Assessment number	Learning Outcomes to be met	Type of assessment	Weighting (%)	Duration (if exam)	Word count (or equivalent if appropriate)
1	1	Coursework	50	N/A	2500
2	2, 3	Coursework	50	N/A	2500

Learning and Teaching Strategies:

The module will be delivered mainly through lead lectures and student-driven investigative work. It is assumed that the student will have an engineering background and have previously acquired knowledge of solid mechanics & electronic system modelling. The study time will be made up from formal lectures, tutorials and individual study; but also with access to computer laboratory facilities for directed activities. It is expected that the student will regularly access analytical and dynamic software to develop familiarity, understanding and skills as directed by the lecturer. Detailed software tutorial guides will be issued with problems and solutions which will form a foundation for the students' subsequent problem based learning activities. Problems, without tutorial instruction, will then require the student to explore the capabilities of the software. This initial familiarisation will equip the student with the skills necessary to complete any numerical analyses as required in assignment work.

Syllabus outline:

Introduction to Numerical Analysis Techniques

Introduction to numerical analysis techniques: finite element method and the boundary element method. Uniaxial bar elements. Beam elements. Shape functions. Continuum elements. Higher order elements. Accuracy of FEA solutions. Introduction to non-linear FEA.

CAD

3D modelling of complex parts and assemblies. 2D drafting of components and assemblies to international standards. Modelling of mechanisms and rendering.

FEA applications

Modelling of practical problems including crack propagation due to fatigue.

CFD modelling

CFD modelling strategies and techniques. Types of models used; 2/3D. Modelling issues; errors, use of symmetry, convergence issue. Comparison of different formulations, mesh generation and refinement, CAD-CFD interaction.

Overview of advanced CFD applications

Heat transfer, boundary layer, flows in typical complicated geometries.

Electronic and Filter Design

Develop electronics models and test features to produce a high frequency design, and develop FIR and IIR filters.

Mathematical Modelling

Solve equations, such as Laplace, Z functions, Eigen vectors and differential equations.

Data Analysis

Perform analysis of data files to investigate complex results and highlight areas of interest e.g. parametric trends, sound spectrograms, graphic topography and video files.

Indicative Bibliography:

Essential reading

Ferziger, J. H and Peric, M. (2004) Computational Methods for Fluid Dynamics. 3rdEdn. Springer.

Mitra, S.K. (2012) Digital Signal Processing.3rd Edn. McGraw-Hill.

Other indicative reading

Versteeg, H. K. and Malalasekera, W. (2007) An Introduction to Computational Fluid Mechanics. ABAQUS Handbooks. Simulia, Dassult Industries.

BEASY Handbooks. BEASY.

Megson, T.H.G., Aircraft Structures for Engineering Students.4th Edn. Butterworth-Heinemann.

Ogata, K. (2010) Modern Control Engineering. 5th Edn. Pearson.

Archibald, M. (2000) Mechanical Engineering Design with pro/Engineer. Schroff Development.

Pope, S. B. (2000) Turbulent Flow. Cambridge: University Press.

Riley, P. (2000) Computer Aided Engineering. International Business Press.

Proakis, J.G. and Manolakis, D.G. (1998) Digital Signal Processing Principles. Maxwell McMillan.

Palm, W.J. (2011) Introduction to Matlab for Engineers.3rd Edn. Mc Graw-Hill.