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Module specification

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Module Code	ENG495
Module Title	Analytical Engineering Techniques
Level	4
Credit value	20
Faculty	Faculty of Arts, Computing & Engineering
HECoS Code	100403
Cost Code	GAME

Programmes in which module to be offered

Programme title	Is the module core or option for this programme
BEng (Hons) Production Engineering	Core
BEng (Hons) Industrial Engineering Design (Mechanical)	Core
BEng (Hons) Industrial Engineering Design (Electrical & Electronic)	Core
BEng (Hons) Low Carbon Energy, Efficiency and Sustainability	Core
BEng (Hons) Civil Engineering DA (Degree Apprenticeship)	Core
FdEng Industrial Engineering (Mechanical)	Core
FdEng Industrial Engineering (Manufacturing and Production)	Core
FdEng Industrial Engineering (Electrical and Automation)	Core

Pre-requisites

None

Breakdown of module hours

Learning and teaching hours	40 hrs
Placement tutor support	0 hrs
Supervised learning e.g. practical classes, workshops	0 hrs
Project supervision (level 6 projects and dissertation modules only)	0 hrs
Total active learning and teaching hours	**40** hrs
Placement / work-based learning	0 hrs
Guided independent study	160 hrs
Module duration (total hours)	200 hrs

For office use only	
Initial approval date	11/09/2019

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With effect from date	11/09/2019
Date and details of revision	3rd July 2024 – Addition of BEng (Hons) Civil Engineering (Degree Apprenticeship) during Built Environment suite revalidation
Version number	8

Module aims

This module is intended to develop an analytical approach to the derivation of mathematical functions and expressions in the solution of engineering problems. Including the use of computer modelling software.

Module Learning Outcomes - at the end of this module, learners will be able to:

1	Apply algebraic and numerical manipulations.
2	Manipulate vectors and matrices. Apply complex numbers and be able to find powers and roots of complex numbers.
3	Solve first-order differential equations. Ability to interpret solutions and draw conclusions from them.
4	Use industry standard IT software which supports engineering applications (such as spreadsheets, MATLAB etc.)

Assessment

Indicative Assessment Tasks:
Assessment One: A 2-hour examination to cover outcomes 1, 2, and 3. It is an unseen time-constrained one with a fixed number of questions, typically five, where learners are required to answer only three out of the five possible.

Assessment Two: A series of tasks, involving computer software (such as spreadsheets, MATLAB etc.) relating to mathematical engineering problems. Examples of assessments are:

- calculate the area under a curve/the integral of a function by spreadsheet calculation;
- investigate the relationship between given function and its linear transformation by graphing both functions for variety of values;
- solve algebraic/trigonometric equation, return the full solution to an equation; visualize and plot solution.

Assessment number	Learning Outcomes to be met	Type of assessment	Weighting (%)
1	1,2,3	Examination	50
2	4	Coursework	50

Derogations

A derogation from regulations has been approved for this module which means that whilst the pass mark is 40% overall, each element of assessment (where there is more than one assessment) requires a minimum mark of 30%.

Learning and Teaching Strategies

The module will be presented to learners through lectures, tutorials, and practically based assignments. Half of the time will be devoted to practical investigations and will include the use of computer simulation software.
The tutorials will be used for learners to practice problem solving to reinforce the lecture material and to provide individual attention where needed.

Indicative Syllabus Outline

Number systems: Numbers, place value, scientific notation, and significant figures. Fractions. Use of calculator.

Algebra: Rules and manipulation of algebraic expressions. Language of derivation (and symbols). Solutions of equations. Introduction to polynomials.

Functions and Graphs: Define function. Plotting and interpreting graphs. Slopes, intersection.

Trigonometry: Trigonometric ratios. Solving right- angled triangles using Pythagoras. Trigonometric Rules.

Complex numbers: Different forms and arithmetic, polar and exponential forms, powers, and roots.

Vector algebra: Addition and subtraction, scalar multiplication, unit vectors.

Differentiation: Products, quotients, implicit and parametric differentiation, use of logs for complex products and quotients, applications.

Integration: Methods of substitution, partial fractions and by parts. Definite indefinite integrals, applications, Numerical integration.

First Order Differential equations: Linear first order differential equations; separation of variables, use of integrating factor. Second order with zero input - three types of solutions.

Statistics and Probability: Events and sets, Probability models, Standard probability distributions, e.g. Binomial, Poisson, Normal Distribution, and the area under the standard normal curve (z values). Confidence intervals, application to sampling, component and system reliability

Software: Mathematical modelling software to support other elements of this module, emphasizing potential as an analytical tool.

Indicative Bibliography:

Please note the essential reads and other indicative reading are subject to annual review and update.

Essential Reads

J. Bird, *Engineering Mathematics*. 8th ed. London: Routledge, 2017.

Other indicative reading

K. Singh, *Engineering Mathematics through Applications*. 2nd ed. Palgrave Macmillan, 2011.

G. James, *Modern Engineering Mathematics*. 5th ed. Harlow: Pearson, 2015.

S. Attaway, *Matlab: A Practical Introduction to Programming and Problem Solving*, 4th ed.

Oxford: Butterworth-Heinemann, 2017.