Module Specification

Aerospace Mathematics and Applications

Version: 2024-25, v1.0, 29 Jul 2024

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Part 1: Information

Module title: Aerospace Mathematics and Applications

Module code: UFMEAK-30-1

Level: Level 4

For implementation from: 2024-25

UWE credit rating: 30

ECTS credit rating: 15

College: College of Arts, Technology and Environment

School: CATE School of Engineering

Partner institutions: None

Field: Engineering, Design and Mathematics

Module type: Module

Pre-requisites: None

Excluded combinations: None

Co-requisites: None

Continuing professional development: No

Professional, statutory or regulatory body requirements: None

Part 2: Description

Overview: This module will provide apprentices with the requisite mathematical knowledge used to synthesise, analyse and evaluate different engineering situations commonly found in Aeronautics and Aerospace Engineering, but also the skills used to model and simulate a variety of engineering problems as a core.

Features: Not applicable

Educational aims: Knowledge of a range of mathematical tools which are used to synthesise, analyse and evaluate different engineering situations is fundamental to aeronautical engineering. The student is introduced to a range of mathematical methods which are required and developed for modules across all study years.

Outline syllabus: Term 1
Algebra and Functions
Dimensions of physical quantities, revision of standard engineering functions such as polynomials, rational functions, partial fractions, exponential and logarithmic functions and trigonometric functions.

Complex Numbers: Roots of polynomial equations, basic algebraic operations, rectangular, polar and exponential forms, Argand diagram, Euler's identity, De Moivre's theorem.

Matrix and Vector Algebra: Properties of matrices and determinants, the inverse matrix, Gaussian elimination, applications to systems of linear equations. Vector and scalar quantities, resolution of forces, properties of vector quantities, vector addition, unit vectors, position vectors, scalar product, vector product. Eigenvalues and eigenvectors.

Calculus
Differential Calculus: Concept of a limit, revision of standard derivatives, linear properties, product rule, quotient rule and chain rule. Higher order derivatives, classification of turning points, parametric differentiation. Sequences and Series, Binomial theorem, MacLaurin+Taylor series expansions.

Integral Calculus: Revision of standard integrals, indefinite and definite integration, integration by parts, applications of the definite integral such as finding the average value of a function, centre of mass and moments of inertia. Green's Theorem.

Solution of Differential Equations: Modelling of simple systems, solution of first and second order linear constant co-efficient ordinary differential equations, natural and forced response; applications such as cooling problems, mechanical and damping systems.

Term 2
Matlab Programming: Arithmetic, variables, vectors, matrices, linear systems of equations, data visualisation, conditional statements, functions, programming procedures (for, while), numerical methods for time-step approach to dynamics problems.

Engineering applications: modelling, implementation and verification through Matlab to applications such as: displacement, velocity and acceleration extended to non-uniform acceleration incorporating numerical methods, projectile motion, tanks, missiles, Newton's laws, work and energy, momentum and force impulse, torque, cooling problems, mechanical and dynamical systems.

Part 3: Teaching and learning methods

Teaching and learning methods: Scheduled teaching hours will take the form of:

Whole group lectures, used to deliver new material and to consolidate previous material.

Small-group or individual tutorials, with activities designed to enhance the understanding of the material delivered in the lectures and to apply the skills and knowledge learned from the lectures. These will also include practical sessions to work on PC's where this is appropriate.

The module is delivered by means of lectures and tutorials or workshops. To prepare for assessment, students will be expected to undertake self-directed learning in addition to the directed learning which supports taught classes.

Module Learning outcomes: On successful completion of this module students will achieve the following learning outcomes.

MO1 Demonstrate the ability to use a range of fundamental engineering mathematical techniques related to aeronautical engineering.

MO2 Apply mathematical methods and engineering principles to formulate, implement and validate an appropriately constructed mathematical model of aeronautical engineering problems.

MO3 Use programming software to model, simulate and implement appropriate mathematical solutions to engineering problems.

Hours to be allocated: 300

Contact hours:

Independent study/self-guided study = 225 hours

Face-to-face learning = 75 hours

Total = 0

Reading list: The reading list for this module can be accessed at readinglists.uwe.ac.uk via the following link https://rl.talis.com/3/uwe/lists/CD8137DA-0109-371E-AE85-1E359CF9E0DB.html?lang=en-GB

Part 4: Assessment

Assessment strategy: The assessments is designed to allow apprentices to build confidence in their mathematical abilities over time to be able to demonstrate the use of computer-based methods for implementing mathematical solutions to aerospace engineering problems. There are a total of two assessments for this module:

- Apprentices will take a face-to-face examination under invigilated conditions to consolidate their knowledge. This will assess apprentices' understanding of concepts and techniques, and their ability to apply them in aerospace related problems.

- A computer-based problem-solving activity where apprentices demonstrate their ability to crate computer-based solutions to Aeronautical and Aerospace Engineering problems that require mathematical approach.

The resit assessments repeats the same pattern as given in the summative assessment.

Assessment tasks:

Examination (First Sit)
Description: In person exam (2 hours)
Weighting: 30 %
Final assessment: No
Group work: No
Learning outcomes tested: MO1

Portfolio (First Sit)
Description: Software modelling and code review (time constrained one week).
Weighting: 70 %
Final assessment: Yes
Group work: No
Learning outcomes tested: MO2, MO3

Examination (Resit)
Description: In person exam (2 hours)
Weighting: 30 %
Final assessment: No
Group work: No
Learning outcomes tested: MO1

Portfolio (Resit)
Description: Software modelling and code review (time constrained one week).
Weighting: 70 %
Final assessment: Yes
Group work: No
Learning outcomes tested: MO2, MO3

Part 5: Contributes towards

This module contributes towards the following programmes of study:

Aeronautical Engineering {Apprenticeship-UCW}[UCW] BEng (Hons) 2024-25