

Module specification

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Module Code	ENG745
Module Title	Manufacturing Systems Modelling & Simulation
Level	Level 7
Credit value	20
Faculty	FACE
HECoS Code	100160
Cost Code	GAME
Pre-requisite module	N/A

Programmes in which module to be offered

Programme title	Core/Optional/Standalone
MSc Engineering (Advanced Manufacturing)	Core

Breakdown of module hours

Learning and teaching hours	0 hrs
Placement tutor support hours	0 hrs
Supervised learning hours e.g. practical classes, workshops	36 hrs
Project supervision hours	0 hrs
Active learning and teaching hours total	36 hrs
Placement hours	0 hrs
Guided independent study hours	164 hrs
Module duration (Total hours)	200 hrs

Module aims

This module delivers a fully immersive, research-intensive experience grounded in advanced laboratory or project activity. Learners exercise initiative and originality in tackling complex, unpredictable problems and in generating new insight within their field. The approach supports the development of professional competence, scholarly independence, and contribution to contemporary knowledge and practice.

This module aims to equip students with advanced skills in modelling, simulation, and finite element analysis to investigate, optimise, and critically evaluate complex manufacturing systems, including lightweight structures, lattice-based designs, and topology-optimised

components, preparing graduates for careers at the forefront of advanced and digital manufacturing.

Module Learning Outcomes

At the end of this module, students will be able to:

1	Select and apply appropriate computational and analytical techniques to model and simulate complex manufacturing systems, critically discussing the assumptions and limitations of the methods employed (AHEP-4 M3).
2	Critically evaluate emerging computational and analytical modelling paradigms, proposing and defending methodological enhancements with respect to their limitations, based on current research and practical constraints (AHEP-4 M3).
3	Design and conduct simulation-led investigations to explore complex scenarios, generating original, evidence-grounded insights that inform strategic engineering decisions.

Assessment

Indicative Assessment Tasks:

This section outlines the type of assessment task the student will be expected to complete as part of the module. More details will be made available in the relevant academic year module handbook.

Assessment 1:

Students will produce a technical report demonstrating their ability to design advanced models, critically evaluate modelling techniques, and conduct simulation-based investigations that address the module's learning outcomes.

Assessment number	Learning Outcomes to be met	Type of assessment	Duration/Word Count	Weighting (%)	Alternative assessment, if applicable
1	1-3	Coursework	4000	100	N/A

Derogations

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

Learning and Teaching Strategies

Learning is fully practice-led, with students engaging in intensive, research-oriented investigation and advanced technical application. Study is characterised by autonomy, originality, and critical evaluation of real-world or experimental problems. Virtual tools and

recorded resources facilitate reflective practice, while individual supervision ensures professional competence and contribution to knowledge creation.

Welsh Elements

This module will be delivered through the medium of English; however, students have the option to submit their assessments in the medium of Welsh. While this module is not currently offered fully through Welsh, Welsh language support and guidance are available, and some learning materials or tutorial discussions may incorporate Welsh elements where appropriate. To further promote bilingual learning, all students have the opportunity to take the 20-credit Welsh for STEM short course, designed to develop confidence and subject-specific language skills in both English and Welsh.

Indicative Syllabus Outline

- Advanced Modelling and Simulation in Manufacturing: Principles of computational modelling and simulation applied to complex manufacturing systems, with emphasis on accuracy, validation, and decision-making at system and component level.
- Digital Model Development and Data Exchange: Importing and exporting geometry and data between CAD, simulation, and analysis platforms, ensuring model fidelity and interoperability within digital manufacturing workflows.
- Finite Element Analysis (FEA): Application of linear and non-linear FEA techniques to analyse stress, deformation, and performance in manufactured components, including discussion of modelling assumptions and limitations.
- Lattice Structures for Lightweight Design: Design and simulation of lattice-based structures for weight reduction and performance optimisation, with consideration of manufacturability and structural efficiency.
- Topology Optimisation Techniques: Use of topology optimisation to generate high-performance designs under defined constraints, integrating simulation outputs into iterative engineering design processes.
- Critical Evaluation and Professional Communication: Interpretation, validation, and critical review of simulation results, with emphasis on professional reporting, peer review, and alignment with AHEP-4 graduate competencies

Indicative Bibliography

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

Essential Reads:

ANSYS, ANSYS Mechanical User's Guide, Canonsburg, PA, USA: ANSYS Inc., 2024 [Online].

Other indicative reading:

ANSYS, ANSYS Workbench Theory Reference, Canonsburg, PA, USA: ANSYS Inc., 2024 [Online].



ANSYS, Topology Optimization in ANSYS Mechanical, Canonsburg, PA, USA: ANSYS Inc., 2024 [Online]

ANSYS, Additive Manufacturing and Lattice Structures Using ANSYS, Canonsburg, PA, USA: ANSYS Inc., 2023 [Online]

Plus, various others to be signposted on Moodle.

Administrative Information

For office use only	
Initial approval date	June 2026
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Date and details of revision	
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