Module Specification

Advanced FEA for Design

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Part 1: Information

Module title: Advanced FEA for Design

Module code: UFMEBA-15-3

Level: Level 6

For implementation from: 2028-29

UWE credit rating: 15

ECTS credit rating: 7.5

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 modules gives students access to advanced methods of stress analysis to be used in the design of mechanical components.

On the theory side, stress determining techniques are expanded by introducing energy methods and failure mechanisms are refined by considering more realistic and complex aspects of fracture mechanics and fatigue.

On the simulation side, common practices are further developed (meshing , treatment of contact) and more advanced features of Ansys are introduced, such as nonlinear or composite materials, dynamic simulations and multi-physics.

When appropriate, the simulation tutorials relate to the theory (fatigue, residual stress).

Finally, the module introduces real engineering scenarios that involve design, analysis and recommendations, to holistically tie the analysis and failure aspects together.

Features: Not applicable

Educational aims: In this module, students apply their knowledge and understanding of advanced stress analysis and simulation techniques as well as detailed failure mechanisms to solve complex engineering problems and design mechanical components.

Outline syllabus: Advanced Stress Analysis and Failure:

Energy methods: unit load (virtual work) and Castigliano's theorem for trusses, beams and combined problems, Impact.

Introduction to plasticity for torsion and bending, calculation of residual stresses

Advanced FEA:

Non-Linear Materials

Composite Materials Contact

Advanced meshing

FEA for fatigue analysis

Dynamic FEA: vibration

Dynamic FEA: impact

Simulation of residual stress

Introduction to Multi-physics

Part 3: Teaching and learning methods

Teaching and learning methods: The module is organised around the structural analysis, FEA modelling and design of typical mechanical components, including complex factors such as the effects of non-linearity, impacts and fatigue.

Lectures will be used to present the problems and explore the key features and issues. Computer workshops will be used to practice calculations (Excel, Matlab) and Simulations (Ansys).
Typically students will work in pairs.

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

MO1 Analyse complex mechanical components, including hypotheses and results validation.

MO2 Design complex mechanical components using detailed analyses of stress and failure.

Hours to be allocated: 150

Contact hours:

Independent study/self-guided study = 114 hours

Face-to-face learning = 36 hours

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/A1CDE9C9-8C47-4583-5679-71B1D0FD54D9.html

Part 4: Assessment

Assessment strategy: The assessment will be organised around an industrially relevant case study involving a structural element design task.
Students (typically working in pairs) will be expected to demonstrate understanding and ability to apply basic principles and taught processes through the production of a 10 page technical report.

The report will not be marked but will form the basis for the controlled assessment which will take the form of a 30 minute oral presentation by each pair on the work including a series of questions that will determine the individual mark.

In addition, in order to allow students to practice and gain rapid feedback on the use of standard stress calculation and analysis techniques, students will be provided with a series of formative e-assessments. Although the e-assessments' marks do not count towards the module mark, they will be used to form the groups for the group report.

Resit is the same as the first sit.

Resit deliverable(s) will be scaled appropriately to group size and task complexity.

Assessment tasks:

Presentation (First Sit)
Description: Presentation (30 minutes)
Weighting: 100 %
Final assessment: No
Group work: Yes

Learning outcomes tested: MO1, MO2

Presentation (Resit)
Description: Presentation (30 mins)
Weighting: 100 %
Final assessment: No
Group work: Yes
Learning outcomes tested: MO1, MO2

Part 5: Contributes towards

This module contributes towards the following programmes of study:

Automotive Engineering {Foundation} [Frenchay] BEng (Hons) 2025-26

Automotive Engineering [Frenchay] BEng (Hons) 2026-27

Mechanical Engineering {Foundation} [Frenchay] BEng (Hons) 2025-26

Mechanical Engineering [Frenchay] BEng (Hons) 2026-27

Mechanical Engineering [Frenchay] MEng 2026-27