Module Specification

Structural Design & Inspection

Version: 2023-24, v6.0, 18 Sep 2023

Contents

Part 1: Information

Module title: Structural Design & Inspection

Module code: UFMFE9-30-3

Level: Level 6

For implementation from: 2023-24

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: The course aims to provide a rounded understanding of structural design and inspection (mechanics of materials, FEA, composites engineering and inspection) so that students are competent with the subject when they work in industry.

Features: Not applicable

Educational aims: See Learning Outcomes.

Outline syllabus: The syllabus includes:

Mechanics of Materials and FEA

Energy Methods in Structural Analysis:
Strain energy and complementary energy; The principle of the stationary value of the total complementary energy; Unit load method; Flexibility method; Application to deflection problems; Application to the solution of statically indeterminate systems; Total potential energy; The principle of the stationary value of the total potential energy.

Weighted Residuals:
Approximation of differential equations by the weighted residuals method; Galerkin's, collocation's and subdomains' methods; Application of the weighted residuals to the beam-deflection second order differential equation; Weak formulations; Weighted residuals for the theory of elasticity.

Finite Element Method:
Derivation of the FEM from the weighted residuals method; Shape functions, integration and derivation in the FEM; Finite elements for plane stress, plane strain, beam analysis, plates and shells, and 3D continuum structures; ABAQUS finite element software; Defining a FE model with ABAQUS/CAE; ABAQUS implicit versus ABAQUS explicit; Boundary conditions and loads in ABAQUS; Finite elements for plane stress, plane strain, beams, plates and shells and 3D solids in ABAQUS; Material models and yield criterions in ABAQUS.

Composite Engineering

Classification and structure of composite materials, composition and structural relationships.
Composite materials: matrix materials, fibres, fabrics, core materials.
Calculation of physical and mechanical properties: rule of mixtures, Hart-Smith and the Classical Laminate Analysis method.
Design of composite structures: fundamental principles, design guidelines, balance,

symmetry, thickness law.
Testing of composite materials: reasons for importance, destructive and non-destructive methods.
Performance of composite structures: tension, compression, bending, shear, impact toughness, fatigue, failure criterion.
Sustainability and recycling of composites: natural fibres and matrices, reduced weight, conflicts.

Component Inspection

Inspection principles using machine vision.
Use of software for image-based inspection.
Surface and subsurface inspection techniques.

Part 3: Teaching and learning methods

Teaching and learning methods: Large group lecture supported by small group tutorial sessions. Study time outside of contact hours will be spent on going through exercises and example problems.

Lab sessions will provide experience of empirical methods, modelling and simulation and will require time outside for assignment preparation.

Scheduled learning: lectures, tutorials, laboratory work and FEA activities.

Independent learning: essential reading, preparation, assignment preparation and completion.

Contact Hours:

Activity:
Contact: 75 hours
Assimilation and skill development: 150 hours

Coursework: 19 hours

Exam preparation: 56 hours

Total: 300 hours

Contact hours include workshop time under technician supervision.

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

MO1 Show a detailed knowledge and understanding of key theoretical principles and results

MO2 Model and simplify real engineering problems

MO3 Demonstrate key transferable skills in problem formulation and decision-making

MO4 Design optimum solutions with composite materials

MO5 Appraise the performance and discuss the key conflicts with composite materials with regard to sustainability and recyclability

MO6 Calculate the mechanical properties of composite materials and justify their application

MO7 Appraise the use of machine vision in inspection and testing, its advantages and limitations

MO8 Develop simple machine vision computer scripts for image-based inspection tasks

Hours to be allocated: 300

Contact hours:

Independent study/self-guided study = 225 hours

Face-to-face learning = 75 hours

Total = 300

Reading list: The reading list for this module can be accessed at readinglists.uwe.ac.uk via the following link https://uwe.rl.talis.com/modules/ufmfe9-30-3.html

Part 4: Assessment

Assessment strategy: The assessment for this module is as follows:

The examination is summative and assesses the students' understanding of concepts and techniques, and their ability to apply them to relatively straightforward problems.

The coursework is both summative and formative. The assignments provide the students with the opportunity to apply theory and test their understanding of the course material through an applied learning cycle. Feedback from the coursework is intended to assist students with their preparations for the end-of-year examination.

Resit is the same as the first sit

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

Assessment tasks:

Examination (Online) (First Sit)
Description: Online Examination: 3 hours + 2 hours for submission
Weighting: 50 %
Final assessment: Yes
Group work: No
Learning outcomes tested: MO1, MO2, MO3, MO4, MO5, MO6

Presentation (First Sit)
Description: Composite engineering/inspection assignment (Group Presentation)
Weighting: 50 %
Final assessment: No
Group work: Yes
Learning outcomes tested: MO1, MO3, MO6, MO7, MO8

Examination (Online) (Resit)
Description: Online Examination: 3 hours + 2 hours for submission
Weighting: 50 %
Final assessment: Yes
Group work: No
Learning outcomes tested: MO1, MO2, MO3, MO4, MO5, MO6

Presentation (Resit)
Description: Composite engineering/inspection assignment (Group Presentation)

Resit deliverable(s) will be scaled appropriately to group size and task complexity
Weighting: 50 %
Final assessment: No
Group work: Yes
Learning outcomes tested: MO1, MO3, MO6, MO7, MO8

Part 5: Contributes towards

This module contributes towards the following programmes of study:

Aerospace Engineering (Manufacturing) [Sep][SW][Frenchay][5yrs] - Not Running MEng 2020-21

Aerospace Engineering (Design) [Sep][SW][Frenchay][5yrs] - Not Running MEng 2020-21

Aerospace Engineering (Design) [Sep][SW][Frenchay][4yrs] - Not Running BEng (Hons) 2020-21

Aerospace Engineering (Manufacturing) [Sep][SW][Frenchay][4yrs] - Not Running BEng (Hons) 2020-21

Aerospace Engineering (Manufacturing) {Foundation} [Sep][FT][Frenchay][4yrs] - Not Running BEng (Hons) 2020-21

Aerospace Engineering (Design) {Foundation} [Sep][FT][Frenchay][4yrs] - Not Running BEng (Hons) 2020-21

Aerospace Engineering (Manufacturing) {Apprenticeship-UCW} [Sep][FT][UCW][5yrs] - Not Running BEng (Hons) 2020-21

Aerospace Engineering with Pilot Studies (Manufacturing) [Sep][SW][Frenchay][5yrs] - Not Running MEng 2020-21

Aerospace Engineering with Pilot Studies (Design) [Sep][SW][Frenchay][5yrs] - Not Running MEng 2020-21

Aerospace Engineering with Pilot Studies (Design) [Sep][SW][Frenchay][4yrs] - Not Running BEng (Hons) 2020-21

Aerospace Engineering with Pilot Studies (Manufacturing) {Foundation} [Sep][FT][Frenchay][4yrs] - Not Running BEng (Hons) 2020-21

Aerospace Engineering with Pilot Studies (Design) {Foundation} [Sep][FT][Frenchay][4yrs] - Not Running BEng (Hons) 2020-21

Aerospace Engineering (Design) {Foundation} [Sep][SW][Frenchay][5yrs] BEng (Hons) 2019-20

Aerospace Engineering with Pilot Studies (Design) {Foundation} [Sep][SW][Frenchay][5yrs] BEng (Hons) 2019-20

Aerospace Engineering with Pilot Studies (Manufacturing) {Foundation} [Sep][SW][Frenchay][5yrs] BEng (Hons) 2019-20

Aerospace Engineering (Manufacturing) {Foundation} [Sep][SW][Frenchay][5yrs] BEng (Hons) 2019-20

Aerospace Engineering (Design) [Sep][PT][Frenchay][8yrs] MEng 2018-19

Aerospace Engineering (Manufacturing) [Sep][PT][Frenchay][8yrs] MEng 2018-19

Aerospace Engineering with Pilot Studies (Manufacturing) [Sep][PT][Frenchay][6yrs] BEng (Hons) 2018-19

Aerospace Engineering with Pilot Studies (Design) [Sep][PT][Frenchay][6yrs] BEng (Hons) 2018-19

Aerospace Engineering [Sep][SW][Frenchay][5yrs] - Withdrawn MEng 2020-21

Aerospace Engineering [Sep][SW][Frenchay][4yrs] - Not Running BEng (Hons) 2020-21

Aerospace Engineering {Foundation} [Sep][FT][Frenchay][4yrs] - Not Running BEng (Hons) 2020-21

Aerospace Engineering with Pilot Studies [Sep][SW][Frenchay][4yrs] - Not Running BEng (Hons) 2020-21

Aerospace Engineering with Pilot Studies (Manufacturing) [Sep][SW][Frenchay][4yrs] - Not Running BEng (Hons) 2020-21

Aerospace Engineering with Pilot Studies {Foundation} [Sep][FT][Frenchay][4yrs] - Not Running BEng (Hons) 2020-21

Aerospace Engineering with Pilot Studies [Sep][SW][Frenchay][5yrs] - Withdrawn MEng 2020-21

Aerospace Engineering with Pilot Studies {Foundation} [Sep][SW][Frenchay][5yrs] BEng (Hons) 2019-20

Aerospace Engineering {Foundation} [Sep][SW][Frenchay][5yrs] BEng (Hons) 2019-20

Aerospace Engineering with Pilot Studies [Sep][PT][Frenchay][6yrs] BEng (Hons) 2018-19

Aerospace Engineering [Sep][PT][Frenchay][8yrs] MEng 2018-19