ROBERT GORDON UNIVERSITY ABERDEEN

MODULE DESCRIPTOR

Module Title

Advanced Computational Methods in Renewable Energy

Reference	ENM270	Version	1
Created	February 2023	SCQF Level	SCQF 11
Approved	June 2023	SCQF Points	15
Amended		ECTS Points	7.5

Aims of Module

To enable the student to understand, implement and interpret advanced computational analysis and testing methods in the analysis of complex renewable energy systems.

Learning Outcomes for Module

On completion of this module, students are expected to be able to:

1	Evaluate dynamic behaviour of beam structures through Finite Element analysis and experimental measurements.
2	Appraise shape functions and element formulations for higher order elements such as beams and plates.
3	Create models for structural non-linearities by applying Finite Element package.
4	Synthesise advanced concepts related to complex flow systems, boundary layers, turbulence and thermofluids properties.
5	Critically evaluate various analytical and numerical analysis techniques for solving complex fluid dynamics problems.

Indicative Module Content

Thermofluids: Fundamentals of Fluid Mechanics: the conservation laws and their application, boundary layers, turbulence and thermofluid properties. Computational Fluid Dynamics. Overview of discretisation methods: Finite-difference, Finite-Element, Finite-Volume etc., conduction and convection heat transfer. Validation of CFD. Applications taken from (but not limited to): atmospherics (wind energy), oceanic flows (wave and tidal energy), open and closed channel flow (tidal energy), geothermal. Dynamic analysis: Multi-degree-of-freedom lumped parameter and continuous systems: Lagrangian dynamics. Matrix representation. Dealing with damping. Dynamic analysis using FEM: Elemental mass and stiffness matrices. Eigenvalue extraction. Experimental modal analysis: Vibration measurement. Signal processing requirements. Excitation techniques. Frequency response function. Modal extraction techniques. FEA: Beam Elements: Shape Functions. Higher Order Element Formulations. Structural Non-linearity using FEM: Inelastic materials. Contact Analysis. Newton-Raphson Method.

Module Ref:	ENM270 v1

Module Delivery

This module is delivered in both blended learning full-time and online learning part-time modes. For blended learning full-time students, the module will use in-person lectures supplemented with computer labs. For online learning part-time students, the module will use online lectures supplemented with virtual computer labs. Both cohorts will engage in case study work and forum discussions.

Indicative Student Workload	Full Time	Part Time
Contact Hours	35	35
Non-Contact Hours	115	115
Placement/Work-Based Learning Experience [Notional] Hours	N/A	N/A
TOTAL	150	150
Actual Placement hours for professional, statutory or regulatory body		

ASSESSMENT PLAN

If a major/minor model is used and box is ticked, % weightings below are indicative only.

Component 1

Type:	Practical Exam	Weighting:	100%	Outcomes Assessed:	1, 2, 3, 4, 5
Description:	Computer-based exam. Students will be provided an indicative model and expected to produce and analyse results based on a given set of input parameters. Exam will be based around analysis of a industry-oriented problem.				

MODULE PERFORMANCE DESCRIPTOR

Explanatory Text

An overall Grade D is required to pass the module.

Module Grade	Minimum Requirements to achieve Module Grade:
A	A
B	B
C	C
D	D
E	E
F	F
NS	Non-submission of work by published deadline or non-attendance for examination

Module Requirements

Prerequisites for Module	Normally a UK honours degree, or equivalent, class 2.2 or above and proficiency in English language for academic purposes (IELTS minimum score of 6.5 or equivalent)
Corequisites for module	None.
Precluded Modules	None.

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ADDITIONAL NOTES

Part Time refers to Online Learning Part Time (OLPT).

INDICATIVE BIBLIOGRAPHY

1	VERSTEEG, H. and MALALASEKERA, W., 2007, An introduction to computational fluid dynamics-The finite volume method, 2nd ed. Harlow:Pearson
2	FERZIGER, JOEL H and MILOVAN PERIC., 2002. Computational methods for fluid dynamics. 3rd ed. Berlin: Springer.
3	CORREA, J., JUAN, C. A., LOZANO GUZMAN, A. A., 2020. Mechanical vibrations and condition monitoring, London : Academic Press, ISBN : 9780128203903
4	SZEIDL, G., KISS, L. P., 2020. Mechanical Vibrations, an introduction. SPRINGER NATURE, ISBN : 9783030450748
5	RAO, SINGIRESU S. 2018. Mechanical vibrations in SI units, 6th Edition, Harlow: Pearson, ISBN : 9781292178615
6	HAN, Q., WEI, J., HAN, Q., ZHANG, H., 2016. Dynamics and Vibration Analyses of Gearbox in Wind Turbine. Singapore : Springer Singapore, ISBN : 9789811027475
7	ZHUMING, B., 2019. Finite Element Analysis Applications: A Systematic and Practical, Academic Press, ISBN 978-0-12-809952-0
8	ANDERSON, D. A., TANNEHILL, J. C. and PLETCHER, R. H., 1984.Computational fluid mechanics and heat transfer, Hemisphere Pub. Corp. ISBN: 0070503281