Module Specification

Vibrational Dynamics

Version: 2022-23, v4.0, 17 Feb 2022

Contents

Part 1: Information

Module title: Vibrational Dynamics

Module code: UFMFXJ-15-3

Level: Level 6

For implementation from: 2022-23

UWE credit rating: 15

ECTS credit rating: 7.5

Faculty: Faculty of Environment & Technology

Department: FET Dept of Engineering Design & Mathematics

Partner institutions: None

Delivery locations: Frenchay Campus, Global College of Engineering and Technology (GCET)

Field: Engineering, Design and Mathematics

Module type: Standard

Pre-requisites: Dynamics 2022-23

Excluded combinations: None

Co-requisites: None

Continuing professional development: No

Professional, statutory or regulatory body requirements: None

Part 2: Description

Overview: Dynamics is a fundamental pillar of Mechanical Engineering, and the understanding and ability to analyse dynamic vibrations is a key aspect that influences the performance operation of all engineering systems.

This module builds upon the previous modules covering Dynamics, specifically the

module taught at Level 5 which focusses on introducing student to the idea of mechanical oscillation and vibrations. This module takes this concept further, introducing non-sinusoidal forcing functions, and introducing more complex multiple degrees of freedom and forcing function models that represent a wide range of real-world systems. This goes on to introduce a method to model non-linear systems (including strategies to linearise such problems) before introducing the concept of random vibration including quantifying statistical values and dealing with systems whereby the inputs and outputs are given as statistical quantities rather than deterministic values. Despite the focus of analytical solutions, this module uses real-world examples as vehicles on which to apply and implement the technical content. The module continues the strategy adopted at levels 4 and 5 of the programme of teaching relevant mathematical topics alongside engineering content to increase motivation and promote understanding of the mathematical material.

Features: Not applicable

Educational aims: The aim of this module is to build on the technical knowledge and understanding of dynamics introduced at earlier levels so that students will be in a position to apply advanced methods of engineering analysis to a range of complex problems that occur in an engineering context.

Outline syllabus: Review of single free, forced, damped and undamped Single DOF systems (underpinned by mathematical topics of differential equations)
Response to certain non-periodic forcing functions (underpinned by mathematics of solving differential equations using complementary function and particular integrals)
Response to periodic forcing functions (underpinned by mathematics of solving differential equations, Fourier series, introduction to Fourier transforms)
Review of unforced multi-degree-of-freedom systems (underpinned by mathematics of eigenvalue and eigenvectors, matrix algebra and manipulation)
Analysis of forced multi-degree-of-freedom using modal analysis (underpinned by mathematics of matrices)
Analysis of non-linear systems using energy methods (underpinned by mathematical topics of partial differentiation, linearisation of non-linear equations)
Introduction to random vibration (underpinned by mathematical topics of statistical values, power spectral density, determination of complex frequency response and integration).

Part 3: Teaching and learning methods

Teaching and learning methods: This module will continue the delivery approach of dynamics modules covered at levels 4 and 5 and adopts a flipped delivery supported by recorded and on-line materials to encourage active learning.

Whole cohort teaching sessions are structured and focused on delivering active learning, based on students having conducted a wide range of pre-study activities. This is followed by structured, problem-focussed, tutorial sessions in collaborative teaching spaces (smaller groups), making effective use of technology and engendering peer-learning and tutor facilitation in ad-hoc groups.

Facilitated sessions make extensive of simulation software to visualise and elucidate solutions, and provide methods and approaches to solve complex problems where hand calculations are tedious and/or problematic.

Study time outside of contact hours will be spent on working through pre-study (i.e. new) material (via notes and videos), exercises and example problems. The learning on the module is strongly supported by the use of technology and students are encouraged to engage in this material both prior to and after class contact sessions.

Independent learning includes hours engaged with essential reading and assessment preparation.

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

MO1 Apply and implement knowledge of scientific and mathematical principles and methods necessary in the dynamics of vibrations, enabling appreciation of engineering context and the real-world application to vehicle dynamics. (SM1b, SM2b, EA1b, P8)

MO2 Select and apply mathematical methods, tools and notations proficiently in the analysis and solution of vibrational dynamics problems. (EA2, G1)

MO3 Apply and integrate knowledge of other engineering disciplines to support the study of vibrational dynamics involving complex systems. (SM3b)

MO4 Critically evaluate the performance of systems and components through the use of analytical, quantitative and qualitative methods and modelling techniques. (EA3b, P8, G1)

Hours to be allocated: 150

Contact hours:

Independent study/self-guided study = 114 hours

Face-to-face learning = 36 hours

Total = 150

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/ufmfxj-15-3.html

Part 4: Assessment

Assessment strategy: The principal method of assessment is through an examination delivered as Component A with a small element of assessment introduced in Component B to support the flipped class delivery strategy.

Component A
The interactive style of delivery leads to students receiving frequent formative feedback on their progress and hence students should be well prepared for the end of module assessment which takes the form of a technical examination. Questions in exam focus on a mix of technical competency, analysis of real-world applications of content, and questions focussed on understanding, interpretation and practical applications of analysis.

Component B
E-quizzes taken in each week are an additional means of ensuring engagement in

delivery process and although summative, feed into the module mark and provide a formative feedback to students as a measure of understanding.

The resit assessment strategy has the same profile as the first sit.
The GCET delivery of this exam is a 3 hour face-to-face/invigilated exam. It was agreed that GCET can deliver the exam in a different way to UWE for in-country reasons for 2021/22 and 2022/23 providing there is no change to the UWE assessment during this time.

Assessment components:

Examination (Online) - Component A (First Sit)
Description: End of semester online examination
Weighting: 80 %
Final assessment: Yes
Group work: No
Learning outcomes tested: MO1, MO2, MO3, MO4

Online Assignment - Component B (First Sit)
Description: E-quizzes
Weighting: 20 %
Final assessment: No
Group work: No
Learning outcomes tested: MO2, MO4

Examination (Online) - Component A (Resit)
Description: Online Examination
Weighting: 80 %
Final assessment: Yes
Group work: No
Learning outcomes tested: MO1, MO2, MO3, MO4

Online Assignment - Component B (Resit)
Description: E-quizzes

Weighting: 20 %

Final assessment: No

Group work: No

Learning outcomes tested: MO2, MO4

Part 5: Contributes towards

This module contributes towards the following programmes of study:

Automotive Engineering [Sep][FT][Frenchay][4yrs] - Not Running MEng 2020-21

Automotive Engineering [Sep][FT][Frenchay][3yrs] - Not Running BEng (Hons) 2020-21

Automotive Engineering [Sep][SW][Frenchay][5yrs] MEng 2019-20

Automotive Engineering {Foundation} [Sep][FT][Frenchay][5yrs] MEng 2019-20

Automotive Engineering [Sep][SW][Frenchay][4yrs] BEng (Hons) 2019-20

Automotive Engineering {Foundation} [Sep][FT][Frenchay][4yrs] BEng (Hons) 2019-20

Mechanical Engineering and Vehicle Technology {Foundation} [Feb][FT][GCET][4yrs] BEng (Hons) 2019-20

Mechanical Engineering and Vehicle Technology {Foundation} [Oct][FT][GCET][4yrs] BEng (Hons) 2019-20

Automotive Engineering {Foundation} [Sep][SW][Frenchay][6yrs] MEng 2018-19

Automotive Engineering {Foundation} [Sep][SW][Frenchay][5yrs] BEng (Hons) 2018-19

Mechanical Engineering [Sep][FT][Frenchay][4yrs] MEng 2020-21

Mechanical Engineering [Sep][FT][Frenchay][3yrs] BEng (Hons) 2020-21

Mechanical Engineering [Sep][PT][Frenchay][7yrs] MEng 2018-19

Mechanical Engineering {Foundation} [Sep][SW][Frenchay][5yrs] BEng (Hons) 2018-19

Mechanical Engineering {Foundation} [Sep][SW][Frenchay][6yrs] MEng 2018-19

Mechanical Engineering [Sep][PT][Frenchay][6yrs] BEng (Hons) 2018-19

Mechanical Engineering [Sep][PT][COBC][6yrs] BEng (Hons) 2018-19