

## MODULE DESCRIPTION FORM

### DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING

## ME414 (16415 sem1) Advanced Mechanics & Dynamics

Module Registrar: Dr M Wheel <a href="mailto:marcus.wheel@strath.ac.uk">marcus.wheel@strath.ac.uk</a>	Taught To (Course): Cohorts for whom class is compulsory / optional - y4 undergraduates MAE (ME414), EME (16415, optional)	
Other Lecturers Involved: Prof D Nash, Dr R Hamilton, Dr T Comlekci	Credit Weighting: 20 (ECTS 10)	Semester: 1 & 2
Compulsory (ME414) / Optional (16415) class	Academic Level: 4	Suitable for Exchange: Y

#### Alternative codes and credit values for those taking only one semester:

Semester 1: 16415 Engineering Dynamics (10cr / ECTS 5)

#### Required prerequisites

**Note:** It is the responsibility of ALL students to ensure that they satisfy the prerequisite knowledge for this module BEFORE adding as part of curriculum selection. If unsure, please contact the Module Registrar or discuss with your Programme/Year Adviser of Studies.

#### Understanding of intermediate dynamics (ME414 & 16415):

- vector mathematics;
- rigid body kinematics, the relationships between displacement, velocity & acceleration, and relative motion;
- rigid body dynamics in two dimensions;
- the application of Newton's second law in deriving equations of motion of rigid bodies;
- vibration of single degree of freedom mass, spring, damper systems.

#### Understanding of intermediate solid & structural mechanics (ME414 only):

- stress & stress transformation;
- strain, strain transformation in two dimensions and its graphical representation through Mohr's circle;
- relationships between stress and strain in three dimensions (constitutive relations);
- deformation of transversely loaded beam structures;
- deformation of pressurised axisymmetric (cylindrical) structures.

#### Module Format and Delivery (HOURS i.e. 1 credit = 10hrs of study):

Lecture	Tutorial	Laboratory	Groupwork	External	Online	Project	Assignments	Private Study	Total
	40				40			120	200

#### Educational Aim

This module encompasses two main areas with their corresponding main aims as listed below:

- 1) The application of analytical techniques to the solution of important engineering dynamics problems. It aims to develop the student understanding and their ability to solve advanced dynamics problems related to machine dynamics and vibration. (ME414 & 16415)
- 2) The deformation and failure of statically loaded engineering materials and structures and the analytical procedures that can be utilised to preclude such failures. This part aims to enhance the student understanding of the deformation and failure of statically loaded engineering materials and structures and the analytical procedures that can be utilised to preclude such failures. (ME414 only)

#### Learning Outcomes

On completion of the module the student is expected:

LO1 to be able to apply vector mechanics methods to determine the dynamic behaviour of systems of particles and bodies in 3 dimensional motion (ME414 &16415)

LO2 to be able to analyse lumped parameter systems to determine natural frequencies, mode shapes and forced response, and derive governing equations for the vibration of continuous systems and solve these to obtain their natural frequencies and mode shapes (ME414 &16415)

LO3 to have developed understanding of the possible deformation and failure modes of loaded engineering materials and structures (ME414 only)

LO4 to have acquired experience in applying analytical methods in order to design against excessive deformation and failure in materials and structures (ME414 only)

## Syllabus

The module will teach the following:

Fundamentals of the analytical approach to the behaviour of dynamic systems. (ME414 & 16415)

Kinematics of particles and systems of particles and rigid bodies in 3 dimensional motion. Angular momentum; momentum equations of motion. Vibration of single and multi-degree of freedom lumped parameter systems. Introduction to matrix methods for multi-degree of freedom system vibration. Eigenvalues/vectors; orthogonality. Modal characteristics of vibrating systems. Vibration of continuous systems - longitudinal, torsional and bending. Gyroscopic motion. (ME414 & 16415)

Behaviour of loaded materials and structures: (ME414 only)

Failure of materials and structures due to buckling, fracture, fatigue and plastic collapse. Deformation of plates and shells. (ME414 only)

## Assessment of Learning Outcomes

### Criteria

For each of the Module Learning Outcomes the following criteria will be used to make judgements on student learning:

LO1 & LO2 will be assessed by performance in the end of first semester examination (50%). The exam will assess the understanding of particle and rigid body kinematic motion and the vibration of discrete and continuous systems through the solution of a series of relevant problems. (ME414 & 16415)

LO3 & LO4 will be assessed by performance in the end of second semester examination (50%). The exam will assess the understanding of material and structural excess deformation and failure and the means of mitigating these through the solution of a series of relevant problems. (ME414 only)

The standards set for each criterion per Module Learning Outcome to achieve a pass grade are indicated on the assessment sheet for all assessment.

### Principles of Assessment and Feedback

(within Assessment and Feedback Policy at: <https://www.strath.ac.uk/professionalservices/staff/policies/academic/> )

Formative feedback will be provided at tutorial sessions primarily through individual or group discussion of work prepared in advance by students (note - to receive this feedback, students should participate in these tutorials but attendance is not mandatory)

Summative feedback will be provided by the return of examination marks to students after assessment (note - exam scripts will not be returned to students and no individual or collective discussion of exam performance will be facilitated).

**Assessment Method(s) Including Percentage Breakdown and Duration of Exams (*individual weightings*)**

Examination				Coursework		Practical		Project	
Number	Month(s)	Duration	<i>Weighting</i>	Number	<i>Weighting</i>	Number	<i>Weighting</i>	Number	<i>Weighting</i>
1	Dec	2hr	50% / 100% (16415)						
1	Apr/May	2hr	50%						
* LO1 & LO2 (Dec); LO3 & LO4 (Apr/May)				*		*		*	

\* **L/Os:** Indicate which Learning Outcomes (L01, L02, etc) are to be assessed by exam/coursework/practical/project as required.

**Coursework / Submission deadlines (*academic weeks*):**

None

**Resit Assessment Procedures:**

**ME414** (LO1, LO2, LO3 & LO4): 2hr examination in August diet. / **16415** (LO1 & LO2): 1.25hr examination in August diet.

**PLEASE NOTE:**

Students must gain a summative mark of 40% to pass the module. Students who fail the module at the first attempt will be re-assessed during the August diet. This re-assessment will consist entirely of an exam. No marks from any previous attempts will be transferred to a new resit attempt.

**Recommended Reading**

\*\*\*Purchase recommended    \*\*Highly recommended reading    \*For reference

\*\*\* Vector Mechanics for Engineers – Dynamics” by Beer, Johnston & Clausen, McGraw Hill, 7<sup>th</sup> or 8<sup>th</sup> Edition (2004, 2007)

**Additional Student Feedback**

(Please specify details of when additional feedback will be provided)

Date	Time	Room No
TBA		Check timetable webpages for details

Session: 2021/22

**Approved:**

**Course Director Signature:** Dr E Henderson (SG)

**Date of Last Modifications:** September 14, 2021

(Updated July 2021-MAE)

