MODULE DESCRIPTION FORM

DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING

ME414 (16415 sem1) Advanced Mechanics & Dynamics

Module Registrar: Dr Jinglang Feng jinglang.feng@strath.ac.uk	**Taught To (Course): Cohorts for whom class is compulsory/optional - y4 UGs MAE (ME414) / EME (16415)**	
Other Lecturers Involved: Prof D Nash, Prof D Mackenzie	**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	30							130	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 have developed understanding of the possible deformation and failure modes of loaded engineering materials and structures (ME414 only)

LO2 to have acquired experience in applying analytical methods to design against excessive deformation and failure in materials and structures (ME414 only)

LO3 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)

LO4 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)

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. Vibration of continuous systems - longitudinal, torsional and bending. Gyroscopic motion. Understand the concept of generalised co-ordinates, virtual displacements and virtual work and apply Lagrange's equations to obtain equations of motion for multi-degree of freedom systems (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. Development of thin shell element theory, route to implementation in modern finite element codes and verification with classical edge bending shell theory.(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 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)

LO3 & LO4 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)

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	***Weighting***	Number	***Weighting***	Number	***Weighting***	Number	***Weighting***
1	Dec	2hr	50%						
1	Apr/May	2hr	50% / 100% (16415)						
* 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 (all LOs) 3hr / **16415** (LO1 & LO2): 1.5hr examination in July/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, 11th Edition (2016)
** ''Mechanical behavior of materials: engineering methods for deformation, fracture, and fatigue'' by Siva Prasad, Katakam, Narayanasamy, R., Pearson, 4th Edition (2013)

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

Date	Time	Room No
TBA		Check timetable webpages for details

Session: 2024/25

Approved:

Programme Lead/Director Signature: Dr G Houston-Scott and Dr A McLaren

Date of Last Modifications: 19/08/24

(MAE template updated July 2024)

MODULE TIMETABLE

Module Code:	**ME414 / 16415**	**Module Title:**	**Advanced Mechanics and Dynamics / Engineering Dynamics**

Brief Description of Assessment:

ME414: 2hour exam in December exam period (50%) and 2hour exam in Apr/May exam period (50%)

16415: 2hour exam in December exam period (100%)

Assessment Timing:-

Indicated on the table below are the start/submission dates for each assignment/project and the timing of each exam/assessment.

Please note: Timings could change during unforeseen periods of disruption; this should only be used as a guide.

Semester One	W&D Wk	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	Exam Period
	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Exam

Semester Two	C&D Wk	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	Exam Period
	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Exam