

MODULE DESCRIPTION FORM

DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING

M1361 (M1305/M1318) DYNAMICS AND CONTROL - BAHRAIN

Module Registrar: Dr Edmondo Minisci edmondo.minisci@strath.ac.uk	Taught To (Course): Cohorts for whom the module is compulsory or optional		
Other Lecturers Involved: Dr Waseem Siddique waseem.siddique@strath.ac.uk	Credit Weighting: 20 (ECTS 10)	Semester: 1 and 2	
Assumed Prerequisites: refer to below	Compulsory/ optional/ module	Academic Level: 3	Suitable for Exchange: N

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

Semester 1: M1305 Dynamics 3 – Bahrain [10 Credits / ECTS 5]

Semester 2: M1318 Measurement, Instrumentation and Control – Bahrain [10 Credits / ECTS 5]

Required prerequisites

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

L1 Mathematics, Engineering Analysis, and Numerical Methods

M1232 Engineering Mechanics 2 – Bahrain (or equivalent)

MM117 Mathematics 1M (or equivalent)

M1209 Mathematical Modelling and Analysis – Bahrain (or equivalent)

Mathematical methods:

Calculus, linear algebra, vectors & matrices.

Numerical methods:

Solution of linear and nonlinear equations; differentiation and integration; ordinary and partial differential equations

Mechanics:

Classical mechanics including principles of work, energy, momentum, inertia

General plane motion of rigid bodies, kinematics and kinetics of particles

Coordinate transforms and frames of reference

Simple harmonic motion

Programming skills (suggested):

Knowledge of basic programming principles:

- manipulation of scalar, vectors and matrices variables;
- use of operators, expressions and statements (including conditional statements);
- structured programming logic and flow diagrams; loops; functions and scripts; data flow (inputs, outputs)

The supported programming development environment is MATLAB/Simulink. However, it is possible to use other programming environments and languages (e.g., Python).

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

Lecture	Tutorial	Laboratory	Groupwork on assessments	External	Online	Project	Assignments	Private Study	Total
42	28		20					110	200

Educational Aim

The semester 1 (Dynamics) course will:

- 1) Introduce the modelling and analysis of vibrations in single- and multi-degree-of-freedom mechanical systems.
- 2) Consider the effect of transmitted vibrations in mechanical systems.

- 3) Consider the use of energy methods in dynamical modelling.
- 4) Introduce state-space modelling and ways of assessing the stability of dynamic systems in this form.

The semester 2 (Control) course will:

- 1) Introduce control theory and its application to engineering systems.
- 2) Study methods to develop mathematical models for the control of engineering systems.
- 3) Introduce control system analysis techniques in order to predict the system response to given inputs.
- 4) Show the link between analytical methods and models, and computer models, and explain how to run simulations and analyse the performance of modelled systems.

Learning Outcomes

On completion of semester 1, the student is expected to be able to:

- LO1 Model single- and multi-degree-of-freedom systems using force- and energy-based methods then categorise, compare, and describe the behaviour of these systems.
- LO2 Examine the impact of transmitted vibrations through base excitation (considering displacement and force transmissibility).
- LO3 Describe dynamic systems using state-space representations and use phase portraits and eigenvalue analysis to assess their stability.

On completion of semester 2, the student is expected to be able to:

- LO4 Determine a linearised mathematical model of the dynamics and control of an engineering system in the time and frequency domains and determine system response characteristics based on the system model and input.
- LO5 Analyse the performance of 2nd order systems and apply fundamental stability theory correctly to assess closed-loop system stability.

Syllabus

The module will teach the following:

Dynamics (semester 1)

- Mathematical modelling of dynamic systems and system responses
- Free undamped vibration of single-degree-of-freedom systems
- Free vibrations with viscous friction
- Forced and transmitted vibrations
- Applications for single-degree-of-freedom vibration theory
- Concepts of analysis for two-degree-of-freedom vibration and modes of vibration
- Application of energy methods to deriving system differential equations

Control (semester 2)

- Mathematical modelling (Laplace Transforms, transfer functions, block diagrams, s-plane analysis, general solution for feedback systems)
- Feedback control system characterisation and performance (errors in closed-loop systems, sensitivity of controllers)
- Performance of feedback control systems (test input signals and second order systems)
- Stability analysis

Assessment of Learning Outcomes

For each of the Learning Outcomes, the following learning criteria will apply such that students should be able to:

Semester 1

LO1

- C01 Mathematically model the dynamics of simple 1-DOF systems using Newton's Laws.
- C02 Mathematically model the dynamics of simple 1-DOF systems using energy conservation.
- C03 Mathematically model the dynamics of multi-DOF systems using Lagrange's method.
- C04 Mathematically solve ordinary differential equations describing the motion of 1-DOF systems.
- C05 Understand the principles and the main mechanisms of free damped and undamped vibration.
- C06 Describe and categorise the behaviour of vibrating systems using measures such as their natural and damped frequencies, damping ratios, periods of vibration, and logarithmic decrement.
- C07 Analyse a 2-DOF system to ascertain its natural frequencies.
- C08 Use the matrix representation of a 2-DOF system to obtain its mode shapes.

LO2

- C01 Understand the principles and the main mechanisms of forced damped and undamped vibratory motion.
- C02 Model the mechanism of base excitation in mechanical systems.
- C03 Examine systems with base excitations to assess displacement and force transmissibility.
- C04 Investigate the impact of varying levels of damping on transmitted vibration problems.

LO3

- C01 Convert 2nd-order ODEs into appropriate state-space representations.
- C02 Sketch phase portraits corresponding to state-space models.
- C03 Qualitatively describe the stability observed from phase portraits.
- C04 Determine the eigenvalues of state-space models and use these to assess stability.

Semester 2**LO4**

- C01 Find a set of linearised differential equations to model the dynamics of appropriate systems.
- C02 Represent the mathematical model as a block diagram.
- C03 Use differential equations and block diagrams to determine system transfer functions.
- C04 Solve analytically for the output response in the frequency domain of a system based on a specific input function and a mathematical model.
- C05 Determine the output response of a system in both the time and frequency domains using numerical techniques given a computer model and a specific input.

LO5

- C01 Determine the poles and zeros of a system.
- C02 Determine the tracking error and the steady-state error of a system.
- C03 Design models for dynamic and control responses
- C04 Design a specific control system and assess its performance.
- C05 Assess the characteristics of a system response and its stability by constructing and evaluating a Routh-Hurwitz array.
- C06 Assess the response of a system on the threshold of stability.

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

Principles of Assessment and Feedback

(within Assessment and Feedback Policy – search for ‘Academic policies & procedures’ at: <https://www.strath.ac.uk/>)

Assessment in Semester 1 is conducted via two methods. LO1-2 will be assessed via an individual coursework in which students develop their own mock multiple-choice questions. Students will be required to show how feedback was used to develop their submission. LO1-3 will be assessed via an exam in the Semester 1 exam diet.

Assessment in Semester 2 is conducted via coursework and an exam. Students will complete the coursework in groups and will have the opportunity to complete a peer assessment activity associated with this. The coursework will focus on an authentic control systems design problem. The assessment of this coursework will evaluate the efficacy of each group's product and will allow assessors to ask groups questions based on their submissions. A final exam will subsequently be used to individually assess theoretical understanding and analytical problem-solving.

In both semesters, feedback is given in different forms:

- Self-directed feedback and self-assessment through worked examples and tutorial question sets with answers/solutions
- Peer feedback in group work during tutorials and coursework
- Informal feedback will be provided through an online forum, by peers and teaching staff
- Comments will be provided to groups based on the coursework they submit.

Tutorials are the primary mechanism for providing regular feedback. This is achieved through discussions/Q&A with lecturers, tutors, and other students, and through self- and peer-assessment during module participation.

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	1.5hrs	35%	1 (sem1)	15%				
1	Apr/May	1.5hrs	35%	1 (sem2)	15%				
*LO1-5				*LO1-5					

For this module, peer assessment will be applied to each group-based assignment. Students will evaluate their peers' contributions to the assignment using Myplace. The students' grade will be determined by combining the staff grade for that assignment with the students' weighted contribution – determined from each member's evaluation of the student.

* LOs: Indicate which Learning Outcomes (LO1, LO2, etc) are to be assessed by exam/coursework/practical/project as required.

NOTE: For M1305 or M1318 registered students, marks from relevant assessments (weighted at 50%) will be scaled to 100%

Coursework / Submission deadlines (*academic weeks*):

For semester 1:

A coursework (MCQs; worth 15%) will be released in week 4 and submitted in week 7.

For semester 2:

- A coursework (group; control design; worth 15%) will be released in week 3, submitted in week 9, and assessed in week 10.

Resit Assessment Procedures:

For students who have not passed the module by the Exam Board: 2hr (for M1361) / 1hr (for M1305 and M1318) examination in July/August diet.

For students registered as Academic Assessment Only:

M1361: 1.5hr exam in Semester 1 (LO1-3), and 1.5hr exam in Semester 2 (LO4-5)

M1305: 1.5hr exam in Semester 1 (LO1-3)

M1318: 1.5hr exam in Semester 2 (LO4-5)

For students who are Reattending or Registered With Attendance: Standard assessment will apply:

M1361: 2x coursework and 2x exam across both semesters (as per preceding table)

M1305: 1x coursework and 1x exam in Semester 1 (as per preceding table)

M1318: 1x coursework and 1x exam in Semester 2 (as per preceding table)

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 July/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**

Semester 1

- (1) **Beer F., Johnston R., Cornwell P., Self B., Vector Mechanics for Engineering: Dynamics, McGraw Hill
- (2) **Inman D., Engineering vibration, Pearson Prentice Hall.
- (3) Schmitz T., Smith K., Mechanical vibrations: modelling and measurement, Springer

Semester 2

- (1) **Bishop R., Dorf R., Modern Control System, Pearson
- (2) To, Cho W. S., Introduction to Dynamics and Control in Mechanical Engineering Systems, American Society of Mechanical Engineers

Additional Student Feedback

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

Date	Time	Room No
		Check Myplace, and timetable webpages for details

Session: 2026/27

Approved:

Programme Lead / Director Signature: Dr Edmondo Minisci

Date of Last Modifications: 14/09/2026

MODULE TIMETABLE

Module Code:

**M1361
(M1305, M1318)**

Module Title:

Dynamics and Control - Bahrain

Brief Description of Assessment:

Semester 1 (M1305) is assessed by one coursework and an exam.
Semester 2 (M1318) is assessed by one coursework and an exam.

Assessment Timing

Indicated in 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. Set Choose an item.	Choose an item.	Choose an item. Choose an item.	Course work Submit	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.	Course work Set	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.	Course work Submit	Present ation	Choose an item. Choose an item.	Exam