COURSE OUTLINE

MEC405 Advanced Dynamics and Control

School: School of Science, Technology and Engineering

2025 | Semester 2

UniSC Sunshine Coast
UniSC Moreton Bay

BLENDED LEARNING

Most of your course is on campus but you may be able to do some components of this course online.

Please go to unisc.edu.au for up to date information on the teaching sessions and campuses where this course is usually offered.

1. What is this course about?

1.1. Description

Mechanical engineering systems have moving parts that impact on each other. The interconnection of components and the existence of fluctuating forces cause vibrations that must be damped out. The relationships between motions, forces, moments and energy are all expressible as mathematical equations that can be developed from first principles. In this course, you will learn how to employ differential equations, vectors, operators, matrices and tensors to represent the motions in mechanical systems. These skills are built up as understandable solutions to practical engineering problems.

1.2. How will this course be delivered?

ACTIVITY	HOURS	BEGINNING WEEK	FREQUENCY
BLENDED LEARNING			
Learning materials – Students are required to watch a pre-recorded learning materials in Canvas	2hrs	Week 1	13 times
Tutorial/Workshop 1 – Students are asked to solve the tutorial questions based on the theories and methods in the learning materials	2hrs	Week 1	13 times

1.3. Course Topics

- Mathematical tools for analysis of dynamic systems
- Rigid body Kinematics
- 3D Kinematics of rigid body
- Theory of vibration
- Free, Forced and Damped vibration
- Harmonic vibration
- Vibration control
- Feedback loop control

2. What level is this course?

400 Level (Graduate)

Demonstrating coherence and breadth or depth of knowledge and skills. Independent application of knowledge and skills in unfamiliar contexts. Meeting professional requirements and AQF descriptors for the degree. May require pre-requisites where discipline specific introductory or developing knowledge or skills is necessary. Normally undertaken in the third or fourth full-time study year of an undergraduate program.

3. What is the unit value of this course?

12 units

4. How does this course contribute to my learning?

COURSE LEARNING OUTCOMES	GRADUATE QUALITIES MAPPING	PROFESSIONAL STANDARD MAPPING *
On successful completion of this course, you should be able to...	Completing these tasks successfully will contribute to you becoming...	Engineers Australia Stage 1 Professional Engineer Competency Standards
1 Analyse the kinematics and kinetics of 3D rigid bodies in mechanical engineering systems	Knowledgeable Creative and critical thinker	1.1, 1.2
2 Interpret and apply equations to model the dynamic behaviours of engineering systems	Empowered Engaged	2.1, 2.2
3 Construct and employ mathematical models of engineering systems to determine their dynamic characteristics	Knowledgeable Engaged	2.2, 2.3
4 Identify, explain and apply the principles of vibration theory, vibration measurements and control to mechanical systems	Knowledgeable Creative and critical thinker	1.1, 2.1

* Competencies by Professional Body

CODE	COMPETENCY
ENGINEERS AUSTRALIA STAGE 1 PROFESSIONAL ENGINEER COMPETENCY STANDARDS	
1.1	Knowledge and Skill Base: Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline.
1.2	Knowledge and Skill Base: Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline.
2.1	Engineering Application Ability: Application of established engineering methods to complex engineering problem solving.
2.2	Engineering Application Ability: Fluent application of engineering techniques, tools and resources.
2.3	Engineering Application Ability: Application of systematic engineering synthesis and design processes.

5. Am I eligible to enrol in this course?

Refer to the UniSC Glossary of terms for definitions of “pre-requisites, co-requisites and anti-requisites”.

5.1. Pre-requisites

(MTH202 or MTH104) and (ENG205 or MEC205 or MEC2401) and enrolled in Program SC410, SC411, SC425, SC404 or SC405

5.2. Co-requisites

Not applicable

5.3. Anti-requisites

ENG405 or MEC3403

5.4. Specific assumed prior knowledge and skills (where applicable)

Not applicable

5.5. Microcredential Information

Not applicable

6. How am I going to be assessed?

6.1. Grading Scale

Standard Grading (GRD)

High Distinction (HD), Distinction (DN), Credit (CR), Pass (PS), Fail (FL).

6.2. Details of early feedback on progress

In weeks 1-4, some questions from previous years' assessments will be peer-reviewed in the tutorial.

6.3. Assessment tasks

DELIVERY MODE	TASK NO.	ASSESSMENT PRODUCT	INDIVIDUAL OR GROUP	WEIGHTING %	WHAT IS THE DURATION / LENGTH?	WHEN SHOULD I SUBMIT?	WHERE SHOULD I SUBMIT IT?
All	1	Quiz/zes	Individual	30%	1000 Words	Refer to Format	Online Assignment Submission with plagiarism check
All	2	Written Piece	Individual	30%	1500 Words	Week 9	Online Submission
All	3	Examination - Centrally Scheduled	Individual	40%	2 hours	Exam Period	Exam Venue

All - Assessment Task 1: Online Tutorial Exercises

GOAL:	The goal is to explain the concepts of dynamics and apply this knowledge to solve problems in dynamic systems.
PRODUCT:	Quiz/zes
AUTHORSHIP STATEMENT:	
FORMAT:	Submit in Weeks 4, 7, and 10. This task is to ensure that you are building on the analytical skills required in solving Dynamics problems.
CRITERIA:	

No.		Learning Outcome assessed
1	Explanation of analytical problems in moving bodies	1 2 3 4
2	Application of concepts in dynamics to real engineering problems	1 3
3	Ability to represent motion and forces by mathematical equations	2 4

GENERIC SKILLS:	Problem solving, Applying technologies

All - Assessment Task 2: Assignment

GOAL:	The goal is to apply knowledge methods of representing and analysing relationships between forces, displacements, energy and momentum in mechanical systems
PRODUCT:	Written Piece
AUTHORSHIP STATEMENT:	
FORMAT:	A number of engineering problems involving movements of parts and applications of forces will be given. You will respond by analysing the problem and providing a solution by applying mathematical methods.

CRITERIA:

No.		Learning Outcome assessed
1	Application of equations to model the dynamic behaviours of engineering systems	1 2
2	Ability to construct and employ mathematical models to dynamic systems	1
3	Identify, explain and apply theory to real mechanical systems.	1 2
4	Written communication	1 2

GENERIC SKILLS:	Communication, Problem solving, Applying technologies

All - Assessment Task 3: Final Exam

GOAL:	This exam will cover the entire course and will allow you to demonstrate you have developed skills in analysing dynamics in engineering systems and be able to recommend solutions for problems encountered in dynamics
PRODUCT:	Examination - Centrally Scheduled
AUTHORSHIP STATEMENT:	
FORMAT:	You will respond to a set of questions representing problems from mechanical systems

CRITERIA:

No.		Learning Outcome assessed
1	Accuracy of the explanations of constructing mathematical models of dynamics concepts	1 2
2	Accuracy of the application of analytical approach in solving vibrations	3 4
3	Application of the concepts of control methods in vibration	1 2 3 4

GENERIC SKILLS:	Communication, Problem solving, Applying technologies

7. Directed study hours

A 12-unit course will have total of 150 learning hours which will include directed study hours (including online if required), self-directed learning and completion of assessable tasks. Student workload is calculated at 12.5 learning hours per one unit.

7.1. Schedule

PERIOD AND TOPIC	ACTIVITIES
1	Revising Newton's laws
2	Kinematics of Rigid Bodies
3	3D Kinematics I
4	3D Kinematics II
5	3D Kinematics III
6	3D Kinematics IV
7	Theory of Vibration I
8	Theory of Vibration II
9	Theory of Vibrations III
10	Theory of Vibrations IV and Review
11	Vibration and Control
12	Vibration Absorber and Vibration Measurement
13	Review

8. What resources do I need to undertake this course?

Please note: Course information, including specific information of recommended readings, learning activities, resources, weekly readings, etc. are available on the course Canvas site– Please log in as soon as possible.

8.1. Prescribed text(s) or course reader

You need regular access to the resource(s) below. Many texts are available as ebooks through the Library at no additional cost.

REQUIRED?	AUTHOR	YEAR	TITLE	EDITION	PUBLISHER
Required	R. C. Hibbeler	2016	Engineering Mechanics	14th edn	Pearson
Required	Singiresu S. Rao	2017	Mechanical Vibrations in SI Units	n/a	Pearson

8.2. Specific requirements

N/A

9. How are risks managed in this course?

Health and safety risks for this course have been assessed as low. It is your responsibility to review course material, search online, discuss with lecturers and peers and understand the health and safety risks associated with your specific course of study and to familiarise yourself with the University's general health and safety principles by reviewing the online induction training for students, and following the instructions of the University staff.

10. What administrative information is relevant to this course?

10.1. Assessment: Academic Integrity

Academic integrity is the ethical standard of university participation. It ensures that students graduate as a result of proving they are competent in their discipline. This is integral in maintaining the value of academic qualifications. Each industry has expectations and standards of the skills and knowledge within that discipline and these are reflected in assessment.

Academic integrity means that you do not engage in any activity that is considered to be academic fraud; including plagiarism, collusion or outsourcing any part of any assessment item to any other person. You are expected to be honest and ethical by completing all work yourself and indicating in your work which ideas and information were developed by you and which were taken from others. You cannot provide your assessment work to others. You are also expected to provide evidence of wide and critical reading, usually by using appropriate academic references.

In order to minimise incidents of academic fraud, this course may require that some of its assessment tasks, when submitted to Canvas, are electronically checked through Turnitin. This software allows for text comparisons to be made between your submitted assessment item and all other work to which Turnitin has access.

10.2. Assessment: Additional Requirements

Your eligibility for supplementary assessment in a course is dependent of the following conditions applying: The final mark is in the percentage range 47% to 49.4% The course is graded using the Standard Grading scale You have not failed an assessment task in the course due to academic misconduct

10.3. Assessment: Submission penalties

Late submission of assessment tasks may be penalised at the following maximum rate: - 5% (of the assessment task's identified value) per day for the first two days from the date identified as the due date for the assessment task. - 10% (of the assessment task's identified value) for the third day - 20% (of the assessment task's identified value) for the fourth day and subsequent days up to and including seven days from the date identified as the due date for the assessment task. - A result of zero is awarded for an assessment task submitted after seven days from the date identified as the due date for the assessment task. Weekdays and weekends are included in the calculation of days late. To request an extension you must contact your course coordinator to negotiate an outcome.

10.4. Links to relevant University policy and procedures

For more information on Academic Learning & Teaching categories including:

- Assessment: Courses and Coursework Programs
- Review of Assessment and Final Grades
- Supplementary Assessment
- Central Examinations
- Deferred Examinations
- Student Conduct
- Students with a Disability

For more information, visit https://www.usc.edu.au/explore/policies-and-procedures#academic-learning-and-teaching

10.5. Student Charter

UniSC is committed to excellence in teaching, research and engagement in an environment that is inclusive, inspiring, safe and respectful. The Student Charter sets out what students can expect from the University, and what in turn is expected of students, to achieve these outcomes.

10.6. General Enquiries

In person:

- **UniSC Sunshine Coast** - Student Central, Ground Floor, Building C, 90 Sippy Downs Drive, Sippy Downs
- **UniSC Moreton Bay** - Service Centre, Ground Floor, Foundation Building, Gympie Road, Petrie
- **UniSC SouthBank** - Student Central, Building A4 (SW1), 52 Merivale Street, South Brisbane
- **UniSC Gympie** - Student Central, 71 Cartwright Road, Gympie
- **UniSC Fraser Coast** - Student Central, Student Central, Building A, 161 Old Maryborough Rd, Hervey Bay
- **UniSC Caboolture** - Student Central, Level 1 Building J, Cnr Manley and Tallon Street, Caboolture

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