ENEX13005 *Machine Design and Vibrations*
Term 1 - 2018

Profile information current as at 07/05/2024 03:46 pm

General Information

Overview

This unit will introduce you to the fundamental synthesis of mechanisms and machines. You will start by carrying out analysis of linkages in terms of their transmission angles, toggle positions and mobility for a certain mechanism. The kinematic analysis of any mechanism requires an acceleration analysis that depends on its position and velocity. You will be able to carry out this position, velocity, and acceleration analysis of these mechanisms (kinematic systems) using analytical equations and graphical methods. This unit will enable you to work on 3D CAD modelling and computer simulation of various mechanisms or machines. You will move on to kinetic analysis of systems thereby discussing static and dynamic balancing of rotating masses. After learning concepts of dynamics, you will study vibrations (free and forced) of single and multi degree of freedom systems and will be able to carry out analysis of such systems using force and energy methods. Students enrolled in distance mode are required to attend a compulsory Residential school and have access to a computer and make frequent use of the internet.

Details

Career Level: *Undergraduate*
Unit Level: *Level 3*
Credit Points: *6*
Student Contribution Band: *8*
Fraction of Full-Time Student Load: *0.125*

Pre-requisites or Co-requisites

MATH11219 Applied calculus AND [ENEM12007 Statics & Dynamics OR ENEM12010 Engineering Dynamics].
Important note: Students enrolled in a subsequent unit who failed their pre-requisite unit, should drop the subsequent unit before the census date or within 10 working days of Fail grade notification. Students who do not drop the unit in this timeframe cannot later drop the unit without academic and financial liability. See details in the Assessment Policy and Procedure (Higher Education Coursework).

Offerings For Term 1 - 2018

- Mackay
- Mixed Mode

Attendance Requirements

All on-campus students are expected to attend scheduled classes – in some units, these classes are identified as a mandatory (pass/fail) component and attendance is compulsory. International students, on a student visa, must maintain a full time study load and meet both attendance and academic progress requirements in each study period (satisfactory attendance for International students is defined as maintaining at least an 80% attendance record).

Residential Schools

This unit has a Compulsory Residential School for distance mode students and the details are:
Click here to see your Residential School Timetable.

Website

This unit has a website, within the Moodle system, which is available two weeks before the start of term. It is important that you visit your Moodle site throughout the term. Please visit Moodle for more information.

Class and Assessment Overview

Recommended Student Time Commitment

Each 6-credit Undergraduate unit at CQUniversity requires an overall time commitment of an average of 12.5 hours of study per week, making a total of 150 hours for the unit.

Class Timetable

Regional Campuses
Bundaberg, Cairns, Emerald, Gladstone, Mackay, Rockhampton, Townsville

Metropolitan Campuses
Adelaide, Brisbane, Melbourne, Perth, Sydney

Assessment Overview

1. **Written Assessment**
Weighting: 20%
2. **Written Assessment**
Weighting: 20%
3. **Practical Assessment**
Weighting: 20%
4. **Portfolio**
Weighting: 40%

Assessment Grading

This is a graded unit: your overall grade will be calculated from the marks or grades for each assessment task, based on the relative weightings shown in the table above. You must obtain an overall mark for the unit of at least 50%, or an overall grade of 'pass' in order to pass the unit. If any 'pass/fail' tasks are shown in the table above they must also be completed successfully ('pass' grade). You must also meet any minimum mark requirements specified for a particular assessment task, as detailed in the 'assessment task' section (note that in some instances, the minimum mark for a task may be greater than 50%). Consult the University's Grades and Results Policy for more details of interim results and final grades.

CQUniversity Policies

All University policies are available on the CQUniversity Policy site.
You may wish to view these policies:

- Grades and Results Policy
- Assessment Policy and Procedure (Higher Education Coursework)
- Review of Grade Procedure
- Student Academic Integrity Policy and Procedure
- Monitoring Academic Progress (MAP) Policy and Procedure – Domestic Students
- Monitoring Academic Progress (MAP) Policy and Procedure – International Students
- Student Refund and Credit Balance Policy and Procedure
- Student Feedback – Compliments and Complaints Policy and Procedure
- Information and Communications Technology Acceptable Use Policy and Procedure

This list is not an exhaustive list of all University policies. The full list of University policies are available on the CQUniversity Policy site.

Unit Learning Outcomes

On successful completion of this unit, you will be able to:

1. Apply key concepts of kinetics and kinematics to analyse machine design and synthesis
2. Use analytical and graphical techniques to carry out position, velocity, and acceleration analysis
3. Apply concepts of dynamics in balancing of rotating components
4. Analyse vibrations in single and multiple degree of freedom systems
5. Communicate professionally using relevant technical terminology, symbols, and diagrams and effectively document calculations and solutions
6. Work autonomously and as a team member to analyse problems and present solutions.

Learning outcomes will be linked to Engineers Australia stage 1 competency standards for Professional Engineers.

Alignment of Learning Outcomes, Assessment and Graduate Attributes

— N/A Level | ● Introductory Level | ● Intermediate Level | ● Graduate Level | ◦ Professional Level | ◦ Advanced Level

Alignment of Assessment Tasks to Learning Outcomes

Assessment Tasks	Learning Outcomes					
	1	2	3	4	5	6
1 - Written Assessment - 20%	●	●				
2 - Written Assessment - 20%			●	●		
3 - Practical Assessment - 20%					●	●
4 - Portfolio - 40%	●	●	●	●	●	●

Alignment of Graduate Attributes to Learning Outcomes

Graduate Attributes	Learning Outcomes					
	1	2	3	4	5	6
1 - Communication					●	●
2 - Problem Solving	●	●	●	●		●
3 - Critical Thinking	●	●	●	●		●
4 - Information Literacy						
5 - Team Work						●
6 - Information Technology Competence	●	●	●	●	●	●
7 - Cross Cultural Competence						●
8 - Ethical practice					●	●

Graduate Attributes	Learning Outcomes					
	1	2	3	4	5	6
9 - Social Innovation						
10 - Aboriginal and Torres Strait Islander Cultures						

Alignment of Assessment Tasks to Graduate Attributes

Assessment Tasks	Graduate Attributes									
	1	2	3	4	5	6	7	8	9	10
1 - Written Assessment - 20%	•	•	•			•		•		
2 - Written Assessment - 20%	•	•	•			•		•		
3 - Practical Assessment - 20%	•	•	•		•	•	•	•		
4 - Portfolio - 40%	•	•	•			•		•		

Textbooks and Resources

Textbooks

ENEX13005

Prescribed

Design of Machinery
Edition: Fifth (2012)
Authors: Robert L. Norton
McGraw-Hill Higher Education
ISBN: 9780077421717
Binding: Hardcover
ENEX13005

Supplementary

Theory of Vibrations with Applications
Edition: Fifth (2013)
Authors: William T. Thomson
Pearson Higher Ed USA
ISBN: 9781292042718
Binding: Other

Additional Textbook Information
It is not mandatory to purchase the textbooks but recommended chapter readings and tutorial questions are referred to from these textbooks. Tutorial questions sourced from these textbooks will be provided to students.

IT Resources

You will need access to the following IT resources:

- CQUniversity Student Email
- Internet
- Unit Website (Moodle)

Referencing Style

All submissions for this unit must use the referencing style: Harvard (author-date)
For further information, see the Assessment Tasks.

Teaching Contacts

Jay Sul Unit Coordinator
j.sul@cqu.edu.au

Schedule

Week 1 - 05 Mar 2018

Module/Topic	Chapter	Events and Submissions/Topic
Introduction and Kinematics fundamentals • Introduction to the unit and information session • Introduction to the machine design and vibration • Applications of kinematics • DOF in 2D and types of motion • Joints, links and kinematic diagrams	Design of Machinery (R. L. Norton) • Chapters 1 and 2	

Week 2 - 12 Mar 2018

Module/Topic	Chapter	Events and Submissions/Topic
Graphical linkage synthesis • Linkage synthesis - Graphical, manual and dimensional techniques with examples • Two-position synthesis • Three-position synthesis	Design of Machinery (R. L. Norton) • Chapter 3	

Week 3 - 19 Mar 2018

Module/Topic	Chapter	Events and Submissions/Topic
Position analysis of linkages • Types of motion • Position analysis - Graphical, algebraic & vector loop methods for four-bar linkages & four-bar-crank slider	Design of Machinery (R. L. Norton) • Chapter 4	Computer lab session

Week 4 - 26 Mar 2018

Module/Topic	Chapter	Events and Submissions/Topic
Analytical linkage synthesis • 2 and 3 position motion generation by analytical and graphical synthesis • 4 and 5 position motion generation using analytical synthesis	Design of Machinery (R. L. Norton) • Chapter 5	

Week 5 - 02 Apr 2018

Module/Topic	Chapter	Events and Submissions/Topic
Velocity analysis of linkages • Recap of Engineering Dynamics • Graphical (vector) and instant centre methods (Kennedy's theorem) • Mechanical advantages	Design of Machinery (R. L. Norton) • Chapter 6	

Vacation Week - 09 Apr 2018

Module/Topic	Chapter	Events and Submissions/Topic
Week 6 - 16 Apr 2018		
Acceleration analysis of linkages • Graphical (vector) and analytical methods • Coriolis acceleration	Design of Machinery (R. L. Norton) • Chapter 7	Computer lab session
Week 7 - 23 Apr 2018		
Dynamics fundamentals • Mass moment of inertia, centre of gravity, parallel axis theorem • Lumped models • Virtual work • Forces	Design of Machinery (R. L. Norton) • Chapter 10	**Assignment#1 - Analysis of kinematic linkages** Due: Week 7 Friday (27 Apr 2018) 5:00 pm AEST
Week 8 - 30 Apr 2018		
Static and Dynamic balancing • Static and dynamic balancing on rotating masses • Effect of balancing on shaking and input torque	Design of Machinery (R. L. Norton) • Chapter 12	Laboratory session#1 - Mass balance
Week 9 - 07 May 2018		
Free vibration • Vibration model • Natural frequency • Energy & Rayleigh method • Virtual work and damping	Theory of Vibrations with Applications (Thomson & Dahleh) • Chapters 1 and 2	Computer lab session
Week 10 - 14 May 2018		
Forced and transient vibration • Forced harmonic vibrations • Vibration isolation, viscous damping and resonance • Laplace transforms	Theory of Vibrations with Applications (Thomson & Dahleh) • Chapters 3 and 4	Residential School 13-15 May (Mandatory for flex/distance students)
Week 11 - 21 May 2018		
Multiple degree of freedom systems • Normal mode analysis • Initial conditions • Coordinate coupling	Theory of Vibrations with Applications (Thomson & Dahleh) • Chapter 5	Laboratory session#2 - Free & forced vibration
Week 12 - 28 May 2018		
Properties of vibrating systems • Flexibility influence coefficients • Stiffness coefficients and matrices	Theory of Vibrations with Applications (Thomson & Dahleh) • Chapter 6	Computer lab session **Assignment#2 - Design of a suspension system** Due: Week 12 Friday (1 June 2018) 5:00 pm AEST
Review/Exam Week - 04 Jun 2018		

		Laboratory report Due: Review/Exam Week Friday (8 Jun 2018) 5:00 pm AEST **Laboratory report** Due: Review/Exam Week Friday (8 June 2018) 5:00 pm AEST
Exam Week - 11 Jun 2018		
Module/Topic	**Chapter**	**Events and Submissions/Topic**
		Portfolio Due: Exam Week Friday (15 June 2018) 5:00 pm AEST

Assessment Tasks

1 Assignment#1 - Analysis of kinematic linkages

Assessment Type
Written Assessment

Task Description
This assignment assesses the content from Week 1 to Week 6. You must provide detailed solutions to the problems given in the assignment in order to demonstrate your knowledge and understanding of the concepts and processes incorporating relevant sketches, clear step-by-step solution and conclusion/judgements on the answer.

Assessment Due Date
Week 7 Friday (27 Apr 2018) 5:00 pm AEST

Return Date to Students
Week 9 Friday (11 May 2018)

Weighting
20%

Minimum mark or grade
50%

Assessment Criteria

- Correctly identify the problem to be solved (key terms, units, elements or parts of a problem)
- Choose the most appropriate approach to solving the problem
- Clearly present the solutions with sketches (if necessary) for the problems
- Attempt logical alternative approaches to solving the problem

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
Use the submission link to be provided in Moodle

Learning Outcomes Assessed

- Apply key concepts of kinetics and kinematics to analyse machine design and synthesis
- Use analytical and graphical techniques to carry out position, velocity, and acceleration analysis

Graduate Attributes

- Communication
- Problem Solving
- Critical Thinking
- Information Technology Competence
- Ethical practice

2 Assignment#2 - Design of a suspension system

Assessment Type
Written Assessment

Task Description
- Task 1: Design a shock absorber system - Find the necessary stiffness and damping constant of the shock absorber system to meet the design requirements
- Task 2: Demonstrate the performance of your design
- Deliverables

- Mathematical model and free-body diagram of the Patroller
- Demonstrate your analytical approach to each task
- Verify your analytical approach to each task using Matlab Simulink
- Discussion and conclusions of your own view on the performance of the system and suggestions for the client

Assessment Due Date
Week 12 Friday (1 June 2018) 5:00 pm AEST

Return Date to Students
Exam Week Friday (15 June 2018)

Weighting
20%

Minimum mark or grade
50%

Assessment Criteria
- Presentation (25%)
- Introduction and background (15%)
- Methods and results (25%)
- Discussion (20%)
- Conclusions (15%)

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
Use the submission link to be provided in Moodle

Learning Outcomes Assessed

- Apply concepts of dynamics in balancing of rotating components
- Analyse vibrations in single and multiple degree of freedom systems

Graduate Attributes

- Communication
- Problem Solving
- Critical Thinking
- Information Technology Competence
- Ethical practice

3 Laboratory report

Assessment Type
Practical Assessment

Task Description
You will conduct two laboratory sessions in a group and produce a group lab report.
- Mass balance
- Free and forced vibrations

Assessment Due Date
Review/Exam Week Friday (8 June 2018) 5:00 pm AEST

Return Date to Students

Two weeks after submission

Weighting
20%

Minimum mark or grade
50%

Assessment Criteria
- Presentation (15%)
- Introduction and background (10%)
- Methods and results (15%)
- Discussion (20%)
- Conclusions and reflection (10%)
- Peer-assessment (30%)

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
Use the submission link to be provided in Moodle

Learning Outcomes Assessed

- Communicate professionally using relevant technical terminology, symbols, and diagrams and effectively document calculations and solutions
- Work autonomously and as a team member to analyse problems and present solutions.

Graduate Attributes

- Communication
- Problem Solving
- Critical Thinking
- Team Work
- Information Technology Competence
- Cross Cultural Competence
- Ethical practice

4 Portfolio

Assessment Type
Portfolio

Task Description
You will be given a series of tasks to

- conduct a static force analysis on a damped multiple-linkage mechanism,
- conduct a dynamic force analysis on the system,
- suggest an improved mechanism,
- and replicate both the systems in Autodesk Inventor to verify your analysis and design.

Assessment Due Date
Exam Week Friday (15 June 2018) 5:00 pm AEST

Return Date to Students

Two weeks after submission

Weighting
40%

Minimum mark or grade
50%

Assessment Criteria

- Presentation (25%)

- The report is in a professional and consistent format.
- The report meets the proposed specification (file format, length, etc.).
- Good quality of English expression is demonstrated and its language is clear and concise.
- The report is sectioned properly and discussed in the text.
- All figures and tables are labelled properly and discussed in the text.
- Figures and tables are relevant and informative.
- Correct citation and reference style is used in accordance with the suggested referencing system.
- Good use of visual aids is demonstrated.

- Introduction and background (15%)

- A clear statement about why the report was commissioned in the first place.
- Comprehensive, detailed and focused context about the chosen application is given.
- Succinctly lead the reader to the purpose of the work being documented.
- The objectives of the work are expressed well.
- Previous reports and research, if the present report builds on, are included.

- Methods and results (25%)

- Detailed information on the approach/theory used in the study.
- Sufficient references are provided to support the methodology used in the report.
- Results are presented in a logical way.
- Clear but concise evidence in the form of statistics, graphs and tables.
- Justification for conclusions and recommendations.

- Discussions (20%)

- Analysis using your own words on the method and results.
- Good interpretation and explanations of the results.
- Relation of the results with the literature.
- Examine whether and how the questions raised in the introduction have been answered.

- Conclusions (15%)

- Clear agreement with all the objectives that were set out in the introduction is made.
- The significant findings and elements from the report are highlighted.
- The main points of the report are drawn.
- A clear statement about how the topic relates to its context (an evaluation of the importance of the topic, implications and/or recommendations for future studies)

Referencing Style

- Harvard (author-date)

Submission
Online

Submission Instructions
Use the submission link to be provided in Moodle

Learning Outcomes Assessed

- Apply key concepts of kinetics and kinematics to analyse machine design and synthesis
- Use analytical and graphical techniques to carry out position, velocity, and acceleration analysis
- Apply concepts of dynamics in balancing of rotating components
- Analyse vibrations in single and multiple degree of freedom systems
- Communicate professionally using relevant technical terminology, symbols, and diagrams and effectively document calculations and solutions
- Work autonomously and as a team member to analyse problems and present solutions.

Graduate Attributes

- Communication
- Problem Solving
- Critical Thinking
- Information Technology Competence
- Ethical practice

Academic Integrity Statement

As a CQUniversity student you are expected to act honestly in all aspects of your academic work.

Any assessable work undertaken or submitted for review or assessment must be your own work. Assessable work is any type of work you do to meet the assessment requirements in the unit, including draft work submitted for review and feedback and final work to be assessed.

When you use the ideas, words or data of others in your assessment, you must thoroughly and clearly acknowledge the source of this information by using the correct referencing style for your unit. Using others' work without proper acknowledgement may be considered a form of intellectual dishonesty.

Participating honestly, respectfully, responsibly, and fairly in your university study ensures the CQUniversity qualification you earn will be valued as a true indication of your individual academic achievement and will continue to receive the respect and recognition it deserves.

As a student, you are responsible for reading and following CQUniversity's policies, including the **Student Academic Integrity Policy and Procedure**. This policy sets out CQUniversity's expectations of you to act with integrity, examples of academic integrity breaches to avoid, the processes used to address alleged breaches of academic integrity, and potential penalties.

What is a breach of academic integrity?
A breach of academic integrity includes but is not limited to plagiarism, self-plagiarism, collusion, cheating, contract cheating, and academic misconduct. The Student Academic Integrity Policy and Procedure defines what these terms mean and gives examples.

Why is academic integrity important?
A breach of academic integrity may result in one or more penalties, including suspension or even expulsion from the University. It can also have negative implications for student visas and future enrolment at CQUniversity or elsewhere. Students who engage in contract cheating also risk being blackmailed by contract cheating services.

Where can I get assistance?
For academic advice and guidance, the Academic Learning Centre (ALC) can support you in becoming confident in completing assessments with integrity and of high standard.

What can you do to act with integrity?

Be Honest
If your assessment task is done by someone else, it would be dishonest of you to claim it as your own

Seek Help
If you are not sure about how to cite or reference in essays, reports etc, then seek help from your lecturer, the library or the Academic Learning Centre (ALC)

Produce Original Work
Originality comes from your ability to read widely, think critically, and apply your gained knowledge to address a question or problem