Description: Dynamics II

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<th>Subject</th>
<th>Cat-Nbr</th>
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<th>Term</th>
<th>Mode</th>
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<td>MEC</td>
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<td>2, 2002</td>
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Academic Group: FOENS
Academic Org: FOES02
HECS Band: 2
ASCED Code: 030701

STAFFING
Examiner: Thanh Tran-Cong
Moderator: Chris Snook

PRE-REQUISITES
Pre-requisite: MEC 2401 and MAT 2100

SYNOPSIS
The application of the principles of Mechanics is abound in our daily life. Buildings and bridges are designed to operate under normal conditions with the help of the principles of Statics. Under extraordinary conditions such as earthquake or high wind speed, the design is governed by the principles of Dynamics (loading conditions vary significantly with time). Mechanical systems are inherently dynamic. Moving parts exist in many products and equipment: simple household electrical appliances, office equipment, cars, robots, production factories, mining, construction, agricultural machineries, ships, aeroplanes and spacecrafts, etc. Knowledge of dynamics plays an essential role in the design and analysis of any of these systems. Apart from pure mechanical functionalities, modern systems incorporate more robust and accurate control with the help of electronic devices. Flexible and intelligent systems such as robots, computer controlled factories, autonomous vehicles are now common. These achievements are possible because very detailed and accurate system dynamics is understood and advanced electronics and control are available. This advanced course covers the formulation of vector mechanics for general three dimensional systems of rigid bodies and the theory of vibration and its applications. The principles and methods covered are essential to the understanding of mechanical systems.

OBJECTIVES
On completion of this course, students should be able to:

- understand the fundamental physical postulates of the theory of Newtonian Mechanics;
• understand the relevant mathematical foundation for Newtonian Mechanics;
• understand the principles of 3D kinematics and apply those principles to the analysis of 3D mechanical systems such as articulated robots;
• understand physical singularities and recognise their mathematical manifestation in inverse kinematics;
• understand Hamilton's Principle and apply Lagrange's equations;
• understand the physical concept of inertia and apply Newton's first law;
• understand the physical concept of mass and force and apply Newton's second law;
• understand the concept of energy and momentum and make use of the associated laws of conservation;
• understand and apply Newton's third law and law of universal gravitation;
• apply basic equations of motion derived from the fundamental principles;
• model, formulate and solve problems in 3D kinematics and kinetics of rigid bodies;
• understand and apply the principles of vibration theory, vibration measurements and control;
• understand the process of and carry out discrete modelling of vibratory continuous systems;
• determine the vibrational behaviour of systems of discrete bodies having two or more degrees of freedom, with or without viscous damping;
• understand the limitation of closed form analytical methods and be aware of and appreciate the use of computer discrete modelling tools;
• appreciate important phenomena such as dynamic imbalance and resonance and explain these phenomena mathematically;
• develop and write simple computer programs for the solution of certain problems in Mechanics.

**TOPICS**

<table>
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<th>Description</th>
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<tr>
<td>1. Space rigid body kinematics</td>
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<td>2. Space rigid body kinetics</td>
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<tr>
<td>3. Theory of multi-DOF vibration</td>
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**TEXT and MATERIALS required to be PURCHASED or ACCESSED:**

Books can be ordered by fax or telephone. For costs and further details use the 'Book Search' facility at http://bookshop.usq.edu.au by entering the author or title of the text.

The Student Edition of MATLAB (Manual and CD), Prentice Hall.

Tran-Cong, T. *Dynamics for Engineering Students*, USQ Publication,
REFERENCE MATERIALS

Reference materials are materials that, if accessed by students, may improve their knowledge and understanding of the material in the course and enrich their learning experience.

(SI Version)
Rao, S. S. *Mechanical Vibrations*, 2nd edition, Addison Wesley,

STUDENT WORKLOAD REQUIREMENTS

<table>
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<tr>
<th>ACTIVITY</th>
<th>HOURS</th>
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<td>Examinations</td>
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<td>Private Study</td>
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ASSESSMENT DETAILS

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<tr>
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<td>CMA</td>
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<td>3 HOUR OPEN EXAMINATION</td>
<td>700.00</td>
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NOTES:

3. Student Administration will advise students of the dates of their examinations during the semester.

OTHER REQUIREMENTS

1. To satisfactorily complete each of the assignments students must normally obtain at least half of the marks available for each assignment.
2. To satisfactorily complete the examinations in the course, students must normally obtain at least half of the marks available for each examination.
3. To receive a passing grade in this course a student must normally attempt all of the assessments and achieve at least 50% of the available marks for the course.
4. Grading scheme: HD: At least 90% overall, A: At least 80% overall, B: At least 70% overall.
5. A minimum standard of communication skills must be demonstrated in order for a passing grade to be achieved.
6 The due date for an assignment is the date by which a student must submit the assignment to the USQ. The onus is on the student to provide proof of the submit date, if requested by the Examiner.

7 Students must retain a copy of each item submitted for assessment. This must be produced within five days if required by the Examiner.

8 In accordance with University's Assignment Extension Policy (Regulation 5.6.1), the examiner of a course may grant an extension of the due date of an assignment in extenuating circumstances.

9 If students submit assignments after the due date without prior approval then a penalty of up to 20% of the total marks for the assignment will apply for each working day late.

10 In the event that a due date for an assignment falls on a local public holiday in their area, such as a Show holiday, the due date for the assignment will be the next day. Students are to note on the assignment cover the date of the public holiday for the Examiner's convenience.

11 The Faculty of Engineering and Surveying will NOT accept submission of hand written or typed assignments by facsimile, e-mail or computer diskette. Students in remote locations who do not have regular access to postal services may be given special consideration.

12 An open examination indicates that the candidate may have access to any material during the examination except the following: electronic communication devices, bulky materials, devices requiring mains power and material likely to disturb other students.

13 The Faculty of Engineering and Surveying does not offer supplementary examinations.

14 Students who have undertaken all of the required assessments in a course but who have failed to meet some of the specified objectives of a course within the normally prescribed time may be awarded the temporary grade: IM (Incomplete - Make up). An IM grade will only be awarded when, in the opinion of the examiner, a student will be able to achieve the remaining objectives of the course after a period of non directed personal study.

15 Students who, for medical, family/personal, or employment-related reasons, are unable to complete an assignment or to sit for an examination at the scheduled time may apply to defer an assessment in a course. Such a request must be accompanied by appropriate supporting documentation. One of the following temporary grades may be awarded IDS (Incomplete - Deferred Examination; IDM (Incomplete Deferred Make-up; IDSM (Incomplete Deferred Examination and Make-up).