<table>
<thead>
<tr>
<th><strong>Module Code</strong></th>
<th>MEU44B17</th>
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<tbody>
<tr>
<td><strong>Module Name</strong></td>
<td>Multibody Dynamics</td>
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<tr>
<td><strong>ECTS Weighting</strong></td>
<td>5 ECTS</td>
</tr>
<tr>
<td><strong>Semester taught</strong></td>
<td>Semester 1</td>
</tr>
<tr>
<td><strong>Module Coordinator/s</strong></td>
<td>Professor Ciaran Simms</td>
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**Module Learning Outcomes with reference to the Graduate Attributes and how they are developed in discipline**

On successful completion of this module, students should be able to:

LO1. Use vector and tensor algebra to describe three dimensional kinematics/dynamics.

LO2. Apply the principles of Newtonian mechanics to the analysis of physical systems in which components can be modelled as essentially rigid.

LO3. Analyze the motion of linked rigid body systems in 3-D including the formulation of constraints due to kinematic joints.

LO4. Model contact interactions between rigid bodies using software such as MADYMO.

LO5. Implement simulation of rigid body systems using the Principle of Virtual Power in computer code such as generalised software (Matlab) and in dedicated software (MADYMO.

LO6. Apply the above theory and computational methods to the analysis of vehicle systems and human gait and impact analysis and robotics.

**Graduate Attributes: levels of attainment**

To act responsibly - Enhanced
To think independently - Enhanced
To develop continuously - Enhanced
To communicate effectively - Enhanced
### Module Content

This module on the Dynamics of Multibody systems addresses kinematics and dynamics and is focused on applications in biomechanics. It reviews the fundamental matrix algebra required for kinematics and dynamics analysis and computations, introduces three-dimensional kinematics and dynamics, and covers the theory and procedures for modelling systems of rigid bodies connected by kinematic joints. Applications to human body modeling for gait and impact analysis, vehicle dynamics and robotics are considered.

For a short video, see:

[https://www.tcd.ie/bioengineering/biomaterials/simmslab/teaching/](https://www.tcd.ie/bioengineering/biomaterials/simmslab/teaching/)

### Teaching and Learning Methods

This module uses Blackboard Collaborate lectures, self-directed group and individual assignments, and tutorials to help students achieve the required learning outcomes.

In the current Covid-19 situation, the following changes to the normal teaching methods apply, and the same will apply in case of a new possible lockdown scenario during teaching term:

- All lectures and tutorials will be delivered online using Blackboard Collaborate Ultra. These sessions will be recorded and available for viewing via Blackboard at a later time.
- The lab will be entirely online, with support provided in an online tutorial session.
- The end of semester exam modalities will probably be online/remote, although this is subject to change and will follow College guidelines.

### Assessment Details

Please include the following:

- Assessment Component
- Assessment Description
- Learning Outcome(s) addressed
- % of total
- Assessment due date

<table>
<thead>
<tr>
<th>Assessment Component</th>
<th>Assessment Description</th>
<th>LO Addressed</th>
<th>% of total</th>
<th>Week due (provisional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written examination</td>
<td>End of semester examination online</td>
<td>1-6</td>
<td>70</td>
<td>Exam period</td>
</tr>
<tr>
<td>Computer Laboratory online</td>
<td>Ball kicking simulation</td>
<td>1 - 4</td>
<td>5</td>
<td>Week 3</td>
</tr>
<tr>
<td>Assignments online</td>
<td>Software based assignments</td>
<td>1-3</td>
<td>25</td>
<td>Week 11</td>
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### Reassessment Requirements

Written Examination online
### Contact Hours and Indicative Student Workload

<table>
<thead>
<tr>
<th>Contact hours: 46 (33 Lectures, 11 tutorials, 2 Lab)</th>
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<tbody>
<tr>
<td>Independent Study (preparation for course and review of materials): 30</td>
</tr>
<tr>
<td>Independent Study (preparation for assessment, incl. completion of assessment): 44</td>
</tr>
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### Recommended Reading List


### Module Pre-requisite

- MEU11E07 Mechanics; MEU33B05 Mechanics of Machines

### Module Co-requisite

- NA

### Module Website


### Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.

- No