Module Code	MEU44B17
Module Name	Multibody Dynamics
ECTS Weighting	5 ECTS
Semester taught	Semester 1
Module Coordinator/s	Professor Ciaran Simms
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/

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**

Assessment Component	Assessment Description	LO Addressed	% of total	Week due (provisional)
Written examination	End of semester examination online	1-6	70	Exam period
Computer Laboratory online	Ball kicking simulation	1 - 4	5	Week 3
Assignments online	Software based assignments	1-3	25	Week 11

Reassessment Requirements

Written Examination online

Contact Hours and Indicative Student Workload Error! Bookmark not defined.	**Contact hours: 46 (33 Lectures, 11 tutorials, 2 Lab)** **Independent Study (preparation for course and review of materials): 30** **Independent Study (preparation for assessment, incl. completion of assessment): 44**
Recommended Reading List	• Wittenburg, Dynamics of Multibody systems, Springer, 2008. • Moon, Applied Dynamics with Applications to Multibody and Mechatronic Systems, Wiley 1998. • Simms and Wood, "Pedestrian and Cyclist impact, a Biomechanical Perspective", Springer, 2009
Module Pre-requisite	MEU11E07 Mechanics; MEU33B05 Mechanics of Machines
Module Co-requisite	NA
Module Website	https://www.tcd.ie/Engineering/undergraduate/baiyear4/modules/4B17.pdf
Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.	No
Module Approval Date	
Approved by	
Academic Start Year	
Academic Year of Date	