UCD Engineering Programmes

BSc Eng, BE, ME

Mechanical Engineering Students

24 March 2015
UCD Engineering Degree Programme Pathways
DN150

Choose one of:
- Biomedical
- Chemical & Bioprocess
- Civil
- Electronic & Electrical
- Mechanical

Stage 1 (60 Credit)

Year 1

DN150
Stage One Engineering (Common)

Stage 2 (60 Credit)
Stage 3 (60 Credit)

Year 2 Year 3

Single-Stage ME (2-years, 120 Credit)

Year 4 Year 5

Minimum GPA required for entry to ME Programmes

*ME: 6-8 month Professional Engineering Work Placement - Stage 4 Semester 2
BSc (Engineering Science) Degree

- Bachelor of Science degree  Level 8
  - not a professional engineering qualification
  - 3 years, 180 credits
  - 30% based on Stage 2,  70% on Stage 3

- To be compatible with European system:
  - first cycle = Bachelor degree (often 3 years)
  - second cycle = Master degree (typ. 2 years)
  - third cycle = PhD (min. 3 years)
  - could choose now if want ME programme in Europe...

- To provide exit from Engineering
  - provides strong technical foundation
  - to pursue career in another field
  - to continue studies in another area
The BE Degree Programme

- You entered the BE degree programme
  - you can chose Mech, Biomedical, Energy
  - you graduate with BE degree
Bachelor of Engineering (BE) Degree

• Traditional qualification in Engineering
  – still respected in the workplace
  – no longer sufficient for Chartered Engineer
    ▪ further study would be needed (later in career?)

• Four years study in total
  – stage 4 mostly core modules, two options
  – project module – 15 credits
  – no formal work placement

• No additional barriers to progression
  – normal progression rules apply
  – you need 50 credits in stage 3 to progress & register for project module
BE - Mechanical Engineering (Stage 4)

• Core Modules
  - BE Project
  - Process Instrumentation and Control or Control Theory
  - Mechanics of Fluids 2
  - Manufacturing Engineering 2
  - Computational Continuum Mechanics 1
  - Thermodynamics 3
  - Materials Science and Engineering 3
  - Professional Engineering (Management)

• Option Modules (Choose 2)
  - Energy Systems and Climate Change
  - Technical Ceramics
  - Materials Thermodynamics and Kinetics
  - Medical Device Design
  - Advanced Metals/Materials Processing
  - Composites and Polymer Engineering
  - Nanomaterials
BE Project Module

- **Project choice and allocation**
  - we propose a list of projects
  - you choose your preferences
  - allocation according to Stage 3 GPA
  - option to propose your own project – act early!

- **Independent work through both semesters**
  - research and/or design, putting theory into practice
  - guided by supervisor – meet typically weekly
  - work in parallel with 4 or 5 taught modules
  - time management is critical...

- **Assessment through the year**
  - interim report, final report
  - oral presentations (Semester 1 and Semester 2)
  - interview – supervisor and another examiner
After the BE...

• **Work**
  – often with further training, specific to employer
  – maybe a higher degree later in career?

• **Taught Master’s degree**
  – in engineering or another area
  – minimum 90 credits (three semesters or full year)
  – fees payable

• **Research Master’s degree**
  – 18 months to 2 years...

• **PhD**
  – typically 4 years research, can be more...
  – substantial thesis, original work
  – fees payable, but often scholarship available...
### Available ME Routes

#### Stage 2 (Year 2)
- **Mechanical Engineering**

#### Stage 3 (Year 3)
- **ME – Mechanical Engineering**
- **ME – Materials Science and Engineering**
- **ME – Mechanical Eng. with Business**
- **ME - Energy Systems Engineering**
- **ME – Biomedical Engineering**

#### Year 4
- **ME**

#### Year 5
- **ME**

### Instructions
- **Head towards an ME degree programme now**
  - if eligible – GPA requirement greater than 2.8

- **Continue BE, or graduate now, BSc (Engineering Science)**
  - BSc if eligible, 180 credits with at least 100 level 2 & 3
Master of Engineering (ME) Degree

• Professional qualification for the future
  – level required to become Chartered Engineer
  – level expected in most of Europe

• Two years of specialised study in chosen field
  – making five years in total
  – includes work placement (6-8 months)
  – includes major project at Masters level

• Entry requirement
  – based on stages 2 and 3, weighted 3 and 7
  – 2015, minimum GPA 2.8
  – GPA of 2.8 or higher recommended!
    ▪ no easy way back to BE if finding ME too hard...
Master of Engineering (ME) Degree

• **Work Placement**
  - 30 credit, 6-8 months, start January 2016
    ▪ replaces entire spring semester
    ▪ May to Dec 2016 for ME Engineering with Business
  - UCD helps to arrange placements
    ▪ each student picks four companies from list of employers
    ▪ selected CVs sent, meetings/ interviews in Oct. and Nov.
    ▪ you may propose your own placement
  - Alternative: 10 credit 2-3 months (Jun-Aug) 2016
    ▪ take additional 4 modules Semester 2 2016

• **ME (Mech) Project**
  - runs through last two semesters (Stage 5)
  - 25 credits, (15 for ME with Business)
  - Master’s level ...
Chartered Engineer – CEng

- **Used in Ireland, UK, India, ...**
  - US, Canada: PE = professional engineer
  - Australia, NZ: CPEng = chartered prof. engineer

- **Registered title, protected by law**
  - required by law for certain engineering activities

- **Awarded by professional body**
  - Engineers Ireland, must also be member!

- **Requirements:**
  - education to suitable standard - accredited degree
    - from 2013, Master’s level or equivalent
  - development of competence in practice
    - minimum 4 years responsible experience
  - continuing professional development - CPD
Summary - Your Options

• Graduate with BSc (Eng. Sci.) in 2015
  – for work or further study
    ▪ e.g. ME in Europe, qualification in a different field
  – not professional Engineer

• Continue in BE programme
  – graduate in 2016
  – work as engineer
  – further postgraduate study
  – but further master qualification needed for Chartered Engineer

• Continue towards ME in UCD (if eligible)
  – graduate in 2017 with fully accredited degree

• Decision required soon
  – return form to Programme Office by Friday, 10th April
Programme Coordinators

- Dr. Donal Finn  donal.finn@ucd.ie
  - BSc Eng, BE Mechanical Engineering
- Dr. Malachy O’Rourke  malachy.orourke@ucd.ie
  - ME Mechanical Engineering
- Dr. David Timoney  david.timoney@ucd.ie
  - ME Energy Systems Engineering
- Dr. Ken Stanton  kenneth.stanton@ucd.ie
  - ME Materials Science and Engineering
- Dr. Eamonn Ambrose  eamonn.ambrose@ucd.ie
  - ME Engineering with Business
- Dr. Madeleine Lowery  madeleine.lowery@ucd.ie
  - ME Biomedical Engineering
UCD Taught Masters Programmes
ME in Mechanical Engineering

Prof. Alojz Ivankovic
Programme Director

Dr Malachy O’Rourke
Programme Coordinator

Malachy.ORourke@ucd.ie
Programme Overview

Aims to provide students with the opportunity to gain advanced theoretical, conceptual and practical knowledge in the application of Mechanical Engineering

Emphasis is placed on

- core subject areas such as continuum mechanics, solid mechanics and fluid dynamics
- acquiring the skills required to generate new knowledge through research
- independent and project based learning while working with UCD academics and researchers on contemporary research projects
- professional engineering practice during work placement
Programme Structure

2-Year Full Time Programme (120 ECTS Credits)

Year 1
- 30 credits (6 taught modules) in semester one
- 30 credit work placement in semester two
  or
  4 taught modules in semester two + 10 credit work placement either during semester 2 or summer semester

Year 2
- Year long 30 credit research project + research skills and techniques
- 30 credits (6 taught modules) distributed across semesters 1 & 2
YEAR 1

Semester 1
• Engineering Thermodynamics III
• Mechanics of Fluids II
• Manufacturing Engineering II
• Computational Continuum Mechanics I
• Fracture Mechanics
• Mechanics of Solids III

Semester 2
• Professional Work Experience (30 credits)

YEAR 2

Semester 1
• Computational Continuum Mechanics II
• Research Skills and Techniques

Semester 2
• Mechanics of Fluids III
• Professional Engineering (Management)

Semester 1 and 2
• ME Mechanical Thesis (25 credits)

Semester 1 or 2
• Control Theory
• Option modules 1 & 2

All semesters are 30 credits.
All modules are 5 credits unless otherwise stated.
Module Choice

**Core Modules**
- Computational Continuum Mechanics 1
- Computational Continuum Mechanics 2
- Mechanics of Solids 3
- Mechanics of Fluids 2
- Mechanics of Fluids 3
- Materials Science and Engineering 2
- Fracture Mechanics
- Professional Engineering Management
- Manufacturing Engineering 2
- Engineering Thermodynamics 3
- Control Theory

**Option Modules**
- Energy Systems and Climate Change
- Applied and Computational Mathematics
- Technical Ceramics
- Kinetics and Thermodynamics of Materials
- Technical Communications
- Advanced Metals/Materials Processing
- Advanced Composites and Polymer Engineering
- Nanomaterials
UCD School of Mechanical and Materials Engineering

Work Placement

- Takes place during semester 2 of year 1
- Students apply for positions during semester 1 of year 1

Companies involved in work placement to date include:

- Accenture (Dublin & UK)
- BD Medical
- BMR
- Boston Scientific
- Caterpillar (UK)
- CCM (Delaware, USA)
- CTS (USA)
- De Puy
- Dublin Port
- Eirecomposites
- Element 6
- Henkel
- Irish Rail
- Jaguar Landrover (UK)
- MSD
- Nypro Healthcare
- PCH (China)
- ProCut
- Tech Eng Tools
- Technology from Ideas
ME: MATERIALS SCIENCE AND ENGINEERING

- Master of Engineering in Materials Science and Engineering
  - A materials science degree course with a focus on engineering applications of advanced materials
  - The only such course in the country

- 2-year full-time 120 credit (ECTS) programme

- Professionally dual accredited
  - Institute of Materials, Minerals and Mining (IOM3)
  - Engineers Ireland
  - A member of the Washington Accord signatory institutions
ME: MATERIALS SCIENCE AND ENGINEERING

- Fundamentals and applications of metals, ceramics, polymers, composites, semi-conductors and materials processing
- Options for programme focus on materials for:
  - Biomedical devices
  - Nanotechnology
  - Energy
  - Manufacturing
- Includes 6-month industrial work placement
ME MSE: Indicative Modules

Core:
- Manufacturing Engineering I
- Material Science and Engineering II
- Technical Ceramics
- Professional Engineering (Finance)
- Solid-State Electronics I
- Fracture Mechanics
- Kinetics & Thermodynamics of Materials
- Material Science & Engineering III
- Advanced Composites and Polymer Engineering
- Research Project
- Research Skills and Techniques;
- Professional Work Placement

Options:
- Computational Continuum Mechanics I
- Energy Systems and Climate Change
- Manufacturing Engineering I
- Design and Innovation
- Medical Device Design
- Chemistry of Materials
- Physics of nanomaterials
- Advanced Metals/Materials Processing
- Nanomaterials
- Mechanics of Solids II
- Solid State Electronics II
- Professional Engineering (Management)
Information Session for Stage Three Engineering Students

Energy Systems Engineering

Dr. David Timoney,  
Programme Director, ME (Energy Systems)
World Primary Energy Consumption by Fuel (1987 – 2012)

Million Tonnes of Oil Equivalent

- Coal
- Renewables
- Hydroelectricity
- Nuclear energy
- Natural gas
- Oil

1987: 7,600 MTOE
2012: 12,400 MTOE (+63%)

BP Statistical Review of World Energy June 2013
Energy Systems Engineering

Maintenance of current living standards in the developed world will require new ways to use energy more efficiently and also much bigger contributions from:

- solar energy
- wind energy
- wave / tidal energy
- energy from crops / biomass / algae
- nuclear energy
- advanced fossil fuel technologies

- Greater use of electrical energy in buildings and in transport is likely
- “Smart Grid” and Energy Storage Technologies are needed
Energy Systems - many different technologies
Wind Energy

- Most mature of all new renewable energy technologies (excluding hydropower)
- Competitive with conventional fuels
- Continually evolving and improving
  - Offshore Wind Power
  - Floating Turbines
    - E.g. Hywind – Statoil, Ideol
- Electrical/Civil/Mechanical
Wind Turbine Design and Manufacturing

ENERCON

DRIVE SYSTEM
Open Hydro - an Irish Company

2MW, 16m Diameter - Deployment France October 2011
Fossil Fuels and Geology

[Images of fossil fuels and geology]
This programme aims to provide students with a strong understanding of the complex multi-disciplinary and often conflicting issues that arise in the search for effective solutions to the energy challenges of the future.
ME in Energy Systems Engineering

Not restricted to renewable energy systems - aims to take a holistic or full-systems view. Includes modules dealing with nuclear power, with fossil fuel extraction, processing, combustion and carbon sequestration and storage.

Inputs to the programme are provided from;

1. Mechanical & Materials Engineering
2. Electrical, Electronic & Communications Engineering
3. Civil, Structural & Environmental Engineering
4. Biosystems Engineering
5. Chemical & Bioprocess Engineering
6. Geological Sciences
7. Physics
8. Economics
9. Business
ME (Energy Systems) at UCD - Modules

- Energy Systems & Climate Change
- Fossil Fuels, Carbon Capture & Storage
- Engineering Thermodynamics II & III
- Chemical Process of Sustainable & Renewable Energy
- Wind Energy
- Power System Operation
- Energy Systems in Buildings
- Energy in Transport
- Kinetics & Thermodynamics of Materials, Nanomaterials
- Air Pollution / Environmental Engineering Fundamentals
- Nuclear Physics
- Energy Economics and Policy
- Entrepreneurial Management / Entrepreneurship in Engineering
- Control Theory / Process Instrumentation & Control
- Electrical & Electronic Circuits / Electrical Energy Systems II
- Power System Design / Power System Engineering
- Power Electronics and Drives / Applications of Power Electronics
- Research Skills and Techniques / Technical Communication
- Research Project / Thesis
M.E. in Engineering with Business
Eamonn Ambrose (Hannah Kent)
Engineering with Business

• Specialise in one branch of Engineering
  – to level similar to BE degree
  – technical modules ~30 credits

• Eamonn Ambrose

• eamonn.ambrose@ucd.ie
Why Engineering with Business?

• There is a perceived lack of “industry-ready” engineers coming out of third level education.

• Industry leaders have been looking to recruit “T-shaped” individuals combining specialist skills with a broad understanding of the business environment.

• The ME (Engineering with Business) produces fully qualified and accredited engineers who have a particular interest in and understanding of the business context within which engineers usually operate.

• ME (Engineering with Business) graduates can also consider careers in technical or management consulting, the financial sector and IT.
Learning Outcomes

- Personal Learning
- General Learning
- Technical Learning
My Role:

- Integration Testing
- Devil’s Advocate
- Creating and Implementing Tests
- Creating Functional Documentation Specifications
- SIR Tracking
- Creating Tutorial Videos for Customers
Deloitte Responsibilities:

- Communications Team
- Knowledge Management Team
• Social Events
• Sports Club
• Charity Events
Engineering with Business

- **Specialise in one branch of Engineering**
  - to level similar to BE degree
  - technical modules ~30 credits

- **Add business and management modules**
  - ~55 credits

- **Work placement**
  - June to December
  - 20 credits

- **Masters thesis 15 credits**
  - 15 credits in final semester
  - mix of engineering and business
  - industry based research thesis
ME (Engineering with Business)

Continuing discipline-specific engineering subjects
30 credits

Technology management and business subjects
50 credits

Work Placement/ Research/ Masters Project
40 credits

Civil, electrical, electronic or mechanical

Entrepreneurship
Marketing
Operations Management
Business Information Systems
Organisational Behaviour
Economics
Project Management
Supply Chain Design

6 month work placement, research methods, major project
ME Structure

Year 1

Sem 1
- Management and Org Behaviour
- Project Management
- Supply Chain Design
- 3 Technical Core

Sem 2
- Operations Management
- Entrepreneurship
- 3 Technical Options

Year 2

Sem 1
- Work Placement (June to Dec)
- Research Methods

Sem 2
- Business Information Systems
- Marketing
- Professional Eng. (Mgmt)
- Masters Thesis
ME with Business – Mechanical Engineering

- Core Business Modules
  - Operations Management
  - Project Management
  - Supply Chain Design and Analysis
  - Mgmt & Org Behaviour
  - Professional Eng. (Mgt.)
  - Entrepreneurial Mgt.
  - Marketing Management
  - Research Methods/ Thesis
  - Work Placement

- Technical Modules
  4 Technical Core
  - Process Instrumentation/ Control Theory
  - Computational Continuum Mechanics I
  - Engineering Thermodynamics III
  - Process Instrumentation & Control
  2 Options (indicative)
  - Material Science and Engineering III
  - Technical Communication
  - Nanomaterials
  - ……
Biomedical Engineering

- Biomedical Engineering
  ‘The application of engineering principles to understand, modify or control biological systems’

- Wide variety of application areas
  - Medical device industry
  - Biosignal and bioimage processing
  - Rehabilitation engineering, orthopaedics…

- Foundation in Electrical/Electronic or Mechanical Engineering
  - Complemented with relevant physiology and anatomy
  - Brought together in specialised Biomedical Engineering modules
# ME Biomedical Engineering

## Year 1

### Semester 1

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>ANAT40010</td>
<td>Medical Sciences for Biomedical Engineers (unless already taken)</td>
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<tr>
<td>MEEN40620</td>
<td>Biomechanics</td>
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<tr>
<td>MEEN40630</td>
<td>Biomaterials</td>
</tr>
<tr>
<td>MEEN40600</td>
<td>Medical Device Design</td>
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</table>

*2 or 3 Modules From Below or Equivalent Engineering Modules*

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>EEEN30160</td>
<td>Biomedical Signal and Image Analysis</td>
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<tr>
<td>EEEN40010</td>
<td>Control Theory</td>
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<tr>
<td>EEEN40050</td>
<td>Wireless Systems</td>
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<tr>
<td>EEEN40030</td>
<td>Photonic Engineering</td>
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<tr>
<td>EEEN40150</td>
<td>Radio Frequency Electronics</td>
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<tr>
<td>MEEN30030</td>
<td>Mechanical Engineering Design II</td>
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<tr>
<td>MEEN40060</td>
<td>Fracture Mechanics</td>
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<tr>
<td>MEEN20010</td>
<td>Mechanics of Fluids I</td>
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<tr>
<td>MEEN40020</td>
<td>Mechanics of Fluids II</td>
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<tr>
<td>MEEN30100</td>
<td>Engineering Thermodynamics II</td>
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<tr>
<td>EEEN40300</td>
<td>Engineering Entrepreneurship</td>
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<td>EEME 30040</td>
<td>Professional Engineering (Finance)</td>
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*Modules from outside Engineering*

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<tr>
<td>PHYS20040</td>
<td>An introduction to Physiology: Human cells and tissues</td>
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<tr>
<td>PHYS30010</td>
<td>Physiology of the Cardiovascular System</td>
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<tr>
<td>NEUR30080</td>
<td>Neuromuscular and membrane biology</td>
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<tr>
<td>PHYC40430</td>
<td>Nanomechanics - from single molecules to single cells</td>
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<tr>
<td>STAT30240</td>
<td>Linear Models I (Statistics)</td>
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<tr>
<td>ACM40290</td>
<td>Numerical Algorithms</td>
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</table>
## ME Biomedical Engineering

### Year 2

<table>
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<tr>
<th></th>
<th>Semester 1</th>
<th>Semester 2</th>
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<tbody>
<tr>
<td>MEEN40610</td>
<td>Research Project / Thesis</td>
<td>MEEN40610</td>
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<tr>
<td>MEEN40560</td>
<td>Research Skills and Techniques</td>
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<tr>
<td><strong>3 Modules From Below or Equivalent</strong></td>
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<td>EEEN40010</td>
<td>Control Theory</td>
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<td>EEEN40050</td>
<td>Wireless Systems</td>
<td>CHEN40470</td>
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<td>EEEN30030</td>
<td>Electromagnetic Waves</td>
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<td>EEEN40150</td>
<td>Radio Frequency Electronics</td>
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<td>Mechanical Engineering Design II</td>
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<td>MEEN40060</td>
<td>Fracture Mechanics</td>
<td>MEEN40180</td>
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<td>Mechanics of Fluids II</td>
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<td>MEEN30100</td>
<td>Engineering Thermodynamics II</td>
<td>MEEN40070</td>
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<tr>
<td>MEEN30090</td>
<td>Materials Science and Engineering II</td>
<td>MEEN40430</td>
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<td>MEEN30030</td>
<td>Mechanical Engineering Design II</td>
<td>MEEN40670</td>
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<td><strong>Modules from outside Engineering</strong></td>
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<td><strong>Modules from outside Engineering</strong></td>
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<tr>
<td>PHYS300010</td>
<td>Neurophysiology</td>
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<tr>
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<td>Physiology of the internal environment of the human body</td>
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## Biomedical Engineering Stream Stage 4

### Stage 4

<table>
<thead>
<tr>
<th>Semester 1</th>
<th>Semester 2</th>
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<tbody>
<tr>
<td>EEEN30170  BE Biomedical Project</td>
<td>EEEN30170  BE Biomedical Project</td>
</tr>
<tr>
<td>MEEN40600  Medical Device Design</td>
<td>CHEN40470  Cell Culture &amp; Tissue Eng</td>
</tr>
<tr>
<td>MEEN40620  Biomechanics</td>
<td>EEEN40070  Neural Engineering</td>
</tr>
<tr>
<td>EEEN30160  Biomedical Signals and Images</td>
<td>EEEN40350  Rehabilitation Engineering</td>
</tr>
<tr>
<td>MEEN40630  Biomaterials</td>
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</tbody>
</table>

### Plus 1 Option from:

- EEEN30110  Signals and Systems
- EEEN40010  Control Theory
- EEEN40050  Wireless Systems
- EEEN40300  Entrepreneurship in Engineering
- MEEN30030  Mechanical Engineering Design II
- MEEN30100  Engineering Thermodynamics II
- MEEN30140  Professional Engineering (Finance)
- MEEN40020  Mechanics of Fluids II
Sample ME Projects 2013 and 2014

- The Left Heart Simulator: Measurement of Papillary Muscle Force in Porcine Mitral Valves
- Development of a Bioreactor for Monotonic and Oscillatory Stresses
- Determine optimal coating and performance for Flextome Cutting Balloon Protector Caps
- Design of needle system to reliably inject dye into the submucosa of the intestine via an elongate flexible endoscope
- Cannula Pull Strength of the Pen Needle Assembly
- The biomechanical effects of playing surfaces during specific activities in Rugby Union
- Biaxial testing of heart valve tissue
- Computer aided design and manufacture using the Mori Seiki CNC machine
- Nanostructured apatite-mullite glass-ceramic surfaces
- Bioreactor design for carotid artery graphs
- PMMA Bone cement – Analysis of influence of vibration on cement penetration into trabecular bone analogue
- Haemodynamics of mitral heart valves
- Design of a High Speed Micro-indentation Process for Micro-structuring Biomedical Surfaces
- Development of a test method for rotational impacts of sports helmets
- Image Processing of Digital Holographic Microscope Images of Cells
- Multi-class brain-computer interface
- Analysing brain signals during anaesthesia in human
- Analysing respiration in heart failure using contact and non-contact sensors
- Analysing brain signals during execution and imagination of a motor task
- Novel applications of the BiancaMed SleepMinder
- Myoelectric control schemes for multifunction prosthetic hands
Recent Graduates
Programme Coordinators

- **Dr. Donal Finn**  donal.finn@ucd.ie
  - BSc Eng, BE Mechanical Engineering
- **Dr. Malachy O’Rourke**  malachy.orourke@ucd.ie
  - ME Mechanical Engineering
- **Dr. David Timoney**  david.timoney@ucd.ie
  - ME Energy Systems Engineering
- **Dr. Ken Stanton**  kenneth.stanton@ucd.ie
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  - ME Biomedical Engineering
UCD Engineering Programmes

BSc Eng, BE, ME

Mechanical and Flexible Option Students

24 March 2015

UCD School of Mechanical and Materials Engineering