**Study Abroad Handbook for Postgraduate students**

**Department of Engineering**

**How to Apply**

**Grade requirement:**
You are expected to have a GPA of 3.0, a credit or grade B average or equivalent in a related degree.

**English requirements:**
If you are a non-native English language speaker, you will need to submit your most recent Secure English Language Test (SELT) certificate equivalent to IELTS 6.5 (with at least 6.0 in each element). This is usually a B2-C1 CEFR.

Students who have IELTS 6.0 (with at least 5.5 in each element) or Pearson PTE Academic 55 overall (with at least 51 in each element) can opt to take part in the 4 week [English for Academic Purposes](#) course instead of retaking their tests.

If you are an Erasmus+ student and you hold EU/EEA/Swiss citizenship, who has not taken a formal language test, please provide a letter from your home institution confirming that you meet our English Language Requirements (B2 - C1 based on the CEFR). *Please note that we may need to adjust the requirements depending on the Brexit outcome and immigration regulations after it.*

You are required to take 24 ECTS credits per term.

Although we make every effort to ensure the accuracy of information about modules, there may be some unavoidable changes. At the stage of the application, you are only completing a *provisional* study plan and it will only be confirmed when you arrive in Lancaster. We recommend you to have a strong list of back-up options in case you need to make changes to your provisional study plan.

Please note that you can change your mind if you need to and switch your modules during your first week at Lancaster.

**Modules available to Erasmus+ students**

Taught engineering modules typically consist of one week of full-time intensive lectures and group work, followed by some group or individual coursework. The modules are designed in such a way that they are self-contained.

Group working is an essential part of the learning experience. Students are allocated to groups by the module leader. The ideal is a mix students from different backgrounds to provide the groups with a wide spread of expertise and experience. Groups are expected to make their own arrangements to meet or communicate while working on a project and to review aspects of group working, which are required in the report submissions. All students, whatever their age, experience,
sex or nationality are treated as equal, and group working arrangements should be set up to allow all members to contribute.

**ENGR501: Design & Modelling of Systems**

**Term taught:** Michaelmas Term Only  
**US credits:** 4 semester credits  
**ECTS:** 8 ECTS credits  

**Pre-requisites:**  
- This module is only available to Postgraduate Erasmus+ students from selected partners  
- BEng in Mechanical Engineering or equivalent  
- Open mind and a willingness to think

**Module description**

**Educational Aims**
Aims to educate students in the importance of a structured approach to system and product design. The module will cover a design approach from the use requirements capture to detailing which will require the student to develop skills in mathematical modelling.

**Outline Syllabus**
- The concept of systems and systems design  
- Requirements capture and structured methods of functional decomposition  
- Functional modelling  
- Creative thinking tools

**Assessment proportions**
- Coursework: 20%  
- Exam: 80%

**ENGR502: Advanced Embedded Systems**

**Term taught:** Lent Term Only  
**US credits:** 4 semester credits  
**ECTS:** 8 ECTS credits  

**Pre-requisites:**  
- This module is only available to Postgraduate Erasmus+ students from selected partners  
- Experience of undergraduate digital electronics and programming

**Module description**
KL025Z board with ARM Cortex M0+ family of micro-controllers and supporting hardware and software. Several practical exercises for the understanding of the relevant function of the processors and one major application of the MCU for a control task.
Educational Aims
This module aims:

- To give students hands-on experience in interfacing microcontrollers to signals and motor drives, and writing programs to achieve specific objectives in Assembler and in C++.
- The ARM Cortex M0+ microcontroller is an advanced and modern device of the ARM family of microcontrollers and has sold in billions of units worldwide. This module aims to develop expertise in C++ and Assembler programming for the Cortex family. These are fundamental underlying skills for modern microcontroller systems in general.

Assessment proportions

- 80% Exam
- 20% Coursework

ENGR503: Renewable Energy

Term taught: Michaelmas Term Only
US credits: 4 semester credits
ECTS: 8 ECTS credits

Pre-requisites:

- This module is only available to Postgraduate Erasmus+ students from selected partners
- BEng or equivalent
- Trigonometry, aerodynamics, hydraulics, statistics and calculus, and elements of physics, including principle of energy conservation, kinematics and dynamics of particle motion in non-inertial reference frames

Module description
Students will gain an appreciation of energy needs and uses in the modern world, and the possibilities and limitations of using renewable sources to meet these needs.

Introduction to Renewable Energy: sources, economical, environmental and ethical aspects.

Wind Energy: resource assessment (probability distribution functions, boundary layer elements and wind shear analysis, atmospheric turbulence); wind turbine types and layout; wind turbine aerodynamics (dynamics of non-inertial reference frames, blade element momentum theory); yaw control, variable-pitch, variable speed, active and passive stall power regulation; generators; aeromechanical turbine design; cost analysis.

The module will also look at tidal energy: resource assessment; tidal turbine types and layout; tidal turbine hydrodynamics; power control; cavitation; hydromechanical turbine design; cost analysis and Hydropower. Solar will also be covered.

Educational Aims
The aim of this module is to introduce students to the fundamentals of a range of sources of renewable energy and means of its conversion into useful forms, and to highlight technical, economical, environmental and ethical issues associated with the exploitation of renewable energy
sources. The module focuses particularly on most aspects of wind-, tidal- and hydro-power, but many of the discussed principles are applicable to most other renewable energy forms. Students will gain an appreciation of the possibilities and limitations of utilising renewable energy sources to meet everyday energy needs. Additionally, they will become familiar with engineering models and general technologies for the formulation and solution of several multidisciplinary problems of renewable energy engineering. The discussion of realistic engineering problems will allow students to be exposed to technologies presently used in the Research and Development Departments of modern Renewable Energy industry.

Outline Syllabus
- Introduction to Renewable Energy: sources, economical, environmental and ethical aspects.
- Wind Energy: resource assessment (probability distribution functions, boundary layer elements and wind shear analysis, atmospheric turbulence); wind turbine types and layout; wind turbine aerodynamics (dynamics of non-inertial reference frames, blade element momentum theory); yaw control, variable-pitch, variable-speed, active and passive stall power regulation; generators; aeromechanical turbine design; cost analysis.
- Tidal Energy: resource assessment; tidal turbine types and layout; tidal turbine hydrodynamics; power control; cavitation; hydromechanical turbine design; cost analysis.
- Hydropower: resource assessment (geodetic, piezometric and total head); turbine hydrodynamics (velocity triangles in relative and absolute frames, degree of reaction, hydraulic efficiency); power control and turbine choice in relation to grid demands; relationship between turbine layout and characteristics of available resource; hydromechanical turbine design; cost analysis.

Assessment proportions
- 60% Exam
- 40% Groupwork

ENGR504: Mechanics and Actuators

Term taught: Michaelmas Term Only
US credits: 4 semester credits
ECTS: 8 ECTS credits
Pre-requisites:
- This module is only available to Postgraduate Erasmus+ students from selected partners
- BEng in Mechanical/Mechatronic Engineering or equivalent
- Prior experience in structures, dynamics and materials
- Mathematics

Module description
This module aims to enable students to identify, understand and set out the mechanism and mechanical design requirements for products and, in particular, actuators.

Educational Aims
The module aims to educate students in the importance of the mechanism and mechanical design requirements for products and systems. The module will cover the mechanics of robotic manipulators, their use in manufacturing and their programming. The students will also be educated to understand actuator operating principles and an approach to their selection. It also aims to introduce a range of interesting engineering products and systems and the generic techniques for analysing them.

Outline Syllabus

- Concepts of precision location and guidance of moving parts, design with flexural elements, kinematic design, and causes of errors in machine systems.
- Types of actuator (hydraulic, pneumatic, electric, piezoelectric and magnetostrictive), actuator operating principles, selection procedure and actuator developments, dynamics of real systems (including dynamic modelling of mechanical systems, dynamic responses in time-domain, dynamic responses in frequency domain, system analysis vs. vibration analysis).
- Geometry kinematics (including vector and complex notation, sliding contacts), motion path analysis, robot arm geometry, robot arm kinematics, and robot arm load analysis, multibody dynamics, 3D dynamics of rigid body, and the use of visual dynamics software. When possible, the lectures will be supported with an industrial site visit where various practical actuators are being used to deal with different tasks and processes.

Assessment proportions

- 80% Exam
- 20% Groupwork

ENGR505: Interfacing & Integration

Term taught: Michaelmas Term Only
US credits: 4 semester credits
ECTS: 8 ECTS credits

Pre-requisites:

- This module is only available to Postgraduate Erasmus+ students from selected partners
- Fundamentals in analogue and digital electronics at undergraduate level (years 1 & 2) is required. Some prior programming experience

Module description

This module aims to provide you with an understanding and the hardware and software skills necessary when interfacing and integrating complex electro-mechanical computer control systems, and to be aware of future developments in interfacing technology.

Educational Aims

On successful completion of this module students will:

- Understand the principles of digital and analogue interfacing
• Define and interpret interfacing requirements and device specifications
• Understand the problems associated with integration within engineering systems
• Design appropriate interface hardware, resolving issues of signal amplitude, level shifting, polarity, impedance and drive, using passive and active circuitry
• Experienced and resolve associated problems of power supply requirements, grounding and noise
• Aware of EMC issues relating to the interface and external equipment
• Experienced and appreciate the interaction of hardware and software, determining which functions are best performed by which, including hybrid functions

Outline Syllabus
• Definition of interfacing
• Interfacing - integration requirements
• Digital and analogue signal conditioning
• D/A and A/D conversion
• Power switching techniques and devices
• I/O multiplexing
• Hybrid HW/SW solutions
• National Instruments LabVIEW programming
• User interfaces
• EMC and noise
• Current trends in industry

Assessment proportions
• Practical demonstration 20%
• Report 80%

ENGR506: Intelligent System Control

Term taught: Lent Term Only

US credits: 4 semester credits

ECTS: 8 ECTS credits

Pre-requisites:
• This module is only available to Postgraduate Erasmus+ students from selected partners
• Students taking this module are expected to be able to confidently manipulate algebraic expressions, vectors and matrices, including scalar and vector products
• BEng in mechanical, electronic, electrical or nuclear engineering

Module description
This module introduces students to the design and application of intelligent control systems, with a focus on modern algorithmic, computer-aided design methods. Starting from the well-known proportional-integral algorithm, essential concepts such as digital and optimal control are introduced using straightforward algebra and block diagrams. The module addresses the needs of students across the engineering discipline who would like to advance their knowledge of automatic
control and optimisation, with practical worked-examples from robotics, industrial process control and environmental systems, among other areas. This module also introduces students to statistical modelling concepts that are rather different to classical engineering model development based on physical equations. These methods have wide ranging application for control, signal processing, and forecasting, with applications beyond engineering into medicine, economics, environment sciences, and so on.

Educational Aims
On successful completion of this module students will:
- understand various hierarchical architectures of intelligent control;
- be able to analyse and design discrete-time models and digital control systems;
- be able to design optimal model-based control systems;
- identify mathematical models from engineering data;
- design and evaluate system performance;
- be able to use statistical tools for the analysis of data;
- be able to use modern computational aids for the design of control systems;
- appreciate cutting-edge research developments in these areas;
- demonstrate an understanding of the control objectives and practical constraints, and be able to suggest design solutions for a range of case study examples.

Outline Syllabus
Intelligent control, hierarchical control architectures, reviews of classical and modern control, digital control systems, state-space design, and system identification, with fully worked practical examples from across the engineering discipline.

Assessment proportions
- Coursework: 80%
- Exam: 20%

ENGR507: High Frequency Electronics

Term taught: Michaelmas Term Only
US credits: 4 semester credits
ECTS: 8 ECTS credits

Pre-requisites:
- This module is only available to Postgraduate Erasmus+ students from selected partners
- RF Engineering Level 2, LRC circuits, frequency domain analysis

Module description
This is a Masters level module in high frequency electronics. It provides a background in RF, microwave and mm-wave from a scattering parameters approach, covering filters, amplifiers and impedance matching.
Educational Aims

This module aims to:

- develop an understanding of the impact, importance and application of high frequency electronics in the field of communications, remote control and wireless interface
- introduce students to the design of microwave circuits, including filters and amplifiers, using analytical techniques and computational design software
- consider impedance matching networks and the use of S-parameters and smith charts to solve RF problems
- introduce students to various RF digital communication schemes and RF measurement techniques
- provide students with practical skills in high frequency electronics and related fields
- give students experience of computational high frequency electronic design and a background to the most common high frequency systems, with a special attention to communication fields.

Outline Syllabus

The syllabus has three parts:

2. High Frequency Circuit Design: RF components (couplers, splitters, circulators), Filter design, RF Noise, Low Noise Oscillators, RF amplifiers, High power amplifiers, Mixers, RF detection.

In addition, practical projects cover RF circuit design in Microwave Office, together with building and testing the circuits.

Assessment proportions
- 75% Exam
- 25% Coursework

ENGR511: Advanced CAD/CAM

Term taught: Michaelmas Term Only
US credits: 4 semester credits
ECTS: 8 ECTS credits
Pre-requisites:
- This module is only available to Postgraduate Erasmus+ students from selected partners
- BEng in Mechanical Engineering or equivalent
- Prior experience in CAD and FEA, Mechanical Design

Module description

This module aims to extend students’ experience of a range of industrially relevant computer based engineering tools including computer aided design (CAD), finite element analysis (FEA), computer aided manufacture (CAM) and product data management (PDM). With this experience, students will
be able to critically analyse the tools and techniques available and competently apply them to real engineering scenarios. The impetus and development of the tools will be discussed as will their future directions. Students will gain practical experience with these tools and will be given the opportunity to apply their experience and knowledge to real world engineering problems.

The module will enhance students’ ability to critically evaluate mechanical designs using finite element analysis, and they will use their understanding of solid mechanics to devise appropriate FEA methodologies and assess the validity of their analysis. Additionally, students will create designs that can be reliably realised using computer aided manufacturing methodologies. They will also gain a comprehensive understanding of the use of product data management and be able to judge when it is to be used over alternative methods. Finally, students will develop solutions to meet real world engineering needs and will learn analysis and manufacturing strategies, all whilst making competent engineering decisions based on evidence.

Outline Syllabus
- CAD - 3D representations in CAD, solid and surface modelling, comparisons with 2D methods.
- Practical finite element analysis of mechanical designs using ANSYS, involving development of strategies for analysis and validation and verification.
- Practical exercises using CAE packages investigating 3 and 5 axis machine types, 3D tool-path generation, surface finish issues, job planning, fixtures and tool types.
- Introduction and practical sessions on Product Data Management.

Assessment proportions
- 80% Exam
- 20% Coursework

ENGR524: Microelectronics

Term taught: Lent Term Only
US credits: 4 semester credits
ECTS: 8 ECTS credits

Pre-requisites:
- This module is only available to Postgraduate Erasmus+ students from selected partners
- Level 2 electronics

Module description
This module addresses various topics concerning smart systems. Students will explore the principles of microelectromechanical systems (MEMS) and microfluidics in the context of system-on-chip and system-in-package technology, using optical and fluidic elements. Essentially, students will develop an understanding of scaling laws fabrication processes, metrology and inspection, in addition to specific technical information including the design of micro mechanics and bio-MEMS, packaging and integration technologies, microfluidics and embedded test strategies.

Practical sessions will explore the COMSOL based design of a fluidic system, in addition to electrostatic switch and microfluidic particles, Microfluidic technologies and bio-sensing will be
introduced through lectures and core practical classes, with case studies and examples sourced from previous European projects, partners and assembly processes, to ensure an industrial focus. On completion of this module, students will understand the use of nanocharacterisation tools and will be able to discuss various micro and nanofabrication tools available for making devices, equipped with a working knowledge of the fundamentals of microelectronics and their scaling laws in electrical, mechanics and assembly fields.

**Educational Aims**
This module aims to provide the primary educational resource around More than Moore technologies including intelligent Micro-Mechatronic and Bio-Fluidic Systems. The module addresses core Engineering Science around fabrication processes and assembly technology in both silicon and polymers, together with the materials technology and metrology needed to work at the sub 100nm scale. Scaling laws will be covered for multiple energy domain systems and the behaviour of mechanics, primarily in silicon based technologies will be considered. Microfluidic technologies and bio-sensing will be introduced through both lectures and a core practical class. Case studies and examples will be sourced from previous European projects, partners and assembly processes to ensure an industrial focus.

**Outline Syllabus**
- Scaling laws, fabrication processes, top-down, bottom up, metrology and inspection, design of micromechanics, bioMEMS, packaging and integration technologies, micro fluidics, embedded test strategies, markets for smart systems, applications and readout electronics.
- Practical work involving COMSOL based design of a fluidic system, a electrostatic switch and microfluidic practicals (mixing, separation).

**Assessment proportions**
- 70% Exam
- 30% Practical

**ENGR490: Advanced Reaction Engineering**

**Term taught:** Michaelmas Term Only
**US credits:** 4 semester credits
**ECTS:** 8 ECTS credits

**Pre-requisites:**
- This module is only available to Postgraduate Erasmus+ students from selected partners
- BEng in chemical engineering or equivalent
- Prior knowledge of chemical reactor design

**Module description**
This module offers advanced depth of reaction engineering fundamentals along with new developments on novel tools and techniques that go beyond “traditional” chemical engineering, leading to compact, safe, energy-efficient, and environment-friendly sustainable processes. Students expand on previous chemical engineering principles of reactor development gained in chemical reactor fundamentals by introducing realistic aspects of design of catalytic multiphase reactors.
through systematic and computational methods, process intensification and energy integration methods.

**Educational Aims**

The module aims to support students to:
- Develop detailed skills in an important area of chemical engineering
- Expand knowledge on catalytic systems from catalyst design to their use in reactor systems.
- Enable analysis of data and application to sustainable chemical reactor design under industrially relevant operating conditions, including deactivation of catalytic systems, multiphase flow, heat integration and green processing
- Experience interdisciplinary approach to solving specialty of engineering and science case studies
- Understand how their design of reactors comply with economic constraints, health and safety and environmental regulations
- Enhance problem solving skills in reactor design and analysis
- Apply knowledge to real-world situations

**Outline Syllabus**

1. Introduction to catalyst synthesis
   1.1 Preparation methods
   1.2 Analysis method
   1.3 Case of studies
2. Engineering for catalytic reactors
   2.1 Review of catalytic reactor design, computational methods for reactor analysis
   2.2 Catalyst deactivation, design for catalyst deactivation
3. Optimisation of catalytic reaction
   3.1 Generation of PDE’s for process modelling
   3.2 Use of MATLAB, EXCEL and CFD for the analysis of reactor performance and optimization.
4. Multiphase reactors
   4.1 Introduction, application of multiphase reactors in industry
   4.2 Mass transfer in multiphase reactors, reactor types
   4.3 Design considerations for multiphase reactors.
5. Process intensification and integration

**Assessment proportions**

- 60% Exam
- 40% Coursework

**ENGR492: Water Resources and Treatment Technologies**

**Term taught:** Michaelmas Term Only
**US credits:** 4 semester credits
**ECTS:** 8 ECTS credits

**Pre-requisites:**
- This module is only available to Postgraduate Erasmus+ students from selected partners
Module description
This module offers the student the opportunity to study reactor engineering in greater depth. It focuses on the use of industrial catalysts to enable difficult reactions to be carried out safely and effectively with full regard for energy efficiency and sustainability.

Outline Syllabus
- The natural water resource
  1. The hydrological cycle: introduction to water fluxes in the environment and the processes of renewall
  2. Distribution: Spatial and temporal distribution of water
  3. Water use: by industry, in agriculture and domestically in developed and developing economies
  4. Abstraction: Sustainable and over abstraction, water stress, International transboundary issues raised
- Contaminants and regulation
  5. Introduction to contaminants in abstracted water and their symptoms
  6. Introduction to and overview of european regulation
- Treatment technologies
- Students will be introduced to the design and operation of key treatment technologies and processes for the production of domestic potable water and industrial process water
  7. Coagulation and flocculation
  8. Depth filtration
  9. Membrane processes: Micro and ultra filtration and reverse osmosis
  10. Desalination: overview of the process technology
  11. Adsorption and ion exchange: Principals and configurations for the removal of micro-pollutants and the production of high grade industri water
  12. Redox processes for the removal of "hard" micro-pollutants
  13. Disinfection: Objectives, reagents and their applications

Assessment proportions
- 60% Exam
- 30% Coursework
- 10% Presentation (Assessed)

ENGR491: Nuclear Fuels and Energy Conversion

Term taught: Michaelmas Term Only
US credits: 4 semester credits
ECTS: 8 ECTS credits
Pre-requisites:
- This module is only available to Postgraduate Erasmus+ students from selected partners
- College-level Physics and Chemistry
- BEng in Chemical Engineering or equivalent
• Knowledge of atomic structure, isotopes and the principles of radiation
• Knowledge and understanding of bonding (ionic, covalent etc.) and chemical reactions (oxidation and reduction)

Module description
The module deals with fuel manufacture from ore extraction, concentration and refining to final manufacture into fuel pellets. The uranium and plutonium extraction process (PUREX) for reprocessing spent fuel is covered and economic and proliferation issues in respect of reprocessing are broached. The fuel cycle is completed with lectures on waste management and disposal. Students will also develop their understanding of reactor types and reactor control.

Educational Aims
This module aims to develop the students' knowledge and understanding of key aspects of the underlying engineering science relating to the production of nuclear fuels and the conversion of nuclear energy. The unique hazards associated with handling the materials in the manufacturing train such as criticality, radioactive exposure and chemical toxicity and flammability will be highlighted together with methods for their safe management. Students will be able to study advanced material balancing methods suited to the special requirements of nuclear materials including methods of reconciliation and active material accountancy.

Students will develop their knowledge of uranium fuels manufacture, the civil/military controversy and attempts to circumvent it. Students will be introduced to alternative manufacturing routes and fuels such as the thorium cycle.

Students will extend their knowledge of heat transfer with particular reference to the design of nuclear reactors and the complex boiling processes occurring in their geometries.

Outline Syllabus
On successful completion of this module students should be able to...

• Construct, solve and reconcile material balances relevant to accounting for radioactive materials
• Design a selection of unit operations relevant to the nuclear fuel manufacturing process with due regard for the material and criticality hazards and their management.
• Demonstrate understanding of a range of nuclear fuels, their associated manufacturing processes and their relationship with the civil/military controversy.
• Demonstrate the ability to analyse boiling heat transfer problems in the context of a nuclear reactor and synthesis approaches to their solution.
• Able to carry out design and rating calculations for boiling heat transfer from nuclear fuel pins in relevant geometric configurations.

Assessment Proportions
• 60% Exam
• 40% Coursework
ENGR422: Advanced Materials

Terms Taught: Lent Term Only
US credits: 4 semester credits
ECTS: 8 ECTS credits

Pre-requisites:
- This module is only available to Postgraduate Erasmus+ students from selected partners
- BEng or equivalent
- Prior experience in material properties, design and processing

Module Description
The module will familiarise students with families of advanced materials relevant to industries such as automotive, aerospace, machinery and energy. It will examine the materials science paradigm of relating product performance with materials properties, the underlying microstructure as a result of processing with a focus on advanced alloys. The shortcomings in existing families of materials will be identified, and routes for materials design will be presented.

Existing software for materials design will be presented, and it will be demonstrated how materials design plays a key role in the success of companies such as Rolls-Royce, Apple Computers and Airbus.

Educational Aims
The module will familiarise students with families of advanced materials relevant to industries such as automotive, aerospace, machinery and energy. It will examine the materials science paradigm of relating product performance with materials properties, the underlying microstructure as a result of processing with a focus on advanced alloys. The shortcomings in existing families of materials will be identified, and routes for materials design will be presented. Existing software for materials design will be presented, and it will be demonstrated how materials design plays a key role in the success of companies such as Rolls-Royce, Apple Computers and Airbus.

To give students numerical, simulation, and design skills to address a wide range of engineering problems, based on application examples in power engineering. To develop students’ ability to create and design solutions to meet ‘real-world’ engineering needs, think and argue critically, and plan and organise their work. They will gain an ability to analyse important aspects related to power generation and conversion processes.

Outline Syllabus
- New technologies in the fields of additive manufacturing, energy storage and electric vehicles require novel materials such as advanced alloys. This module will introduce students to key metallurgical concepts for alloy design. Metallurgy comprises about 15% of UK economy. The concepts introduced here will provide students with the foundations to design novel materials to satisfy the demands of emerging and future technologies.
- Physical metallurgy: Steel alloys; transformations close to and far from equilibrium; aluminium alloys; nickel alloys; titanium alloys.
Advanced Alloy Design: Interstitial solutions in iron; microalloyed steels; low alloys steels; TRIP, TWIP and Q&P steels; precipitation hardening steels; alloy cast irons; properties and applications of titanium alloys; cast aluminium alloys; copper alloys; magnesium alloys; low melting point alloys.

- Ashby maps for materials selection.
- Thermokinetic modelling of advanced alloys: Model formulation; solution schemes; evaluation, sensitivity analysis, robustness. Performance/properties/microstructure/processing relationships and quantification using computer modelling.
- Industrial case studies: materials selection, materials life cycle and business impacts.

Assessment Proportions
- 60% Exam
- 40% Case Study

ENGR425: Nuclear safety and design

Terms Taught: Michaelmas Term Only
US credits: 4 semester credits
ECTS: 8 ECTS

Pre-requisites:
- This module is only available to Postgraduate Erasmus+ students from selected partners
- College-level Physics
- General awareness of nuclear energy an appreciation of the variety of reactor types

Module Description

The module enables students to become familiar with the basic principles of nuclear safety by studying several high-profile reactor, operational and material handling accidents. Students look at the causes of the accidents, both technical and human, their effect on legislation and regulation and the influence of the media on the nuclear industry. By the end of the module students will have the ability to understand the significance of the major regulatory issues associated with the civil nuclear industry, understand how regulation, legislation and international cooperation has arisen as the result of accidents and appreciate the affect of the media on a high profile industry and how this evidence of public opinion can affect the industry.

Educational Aims

The module aims to educate students in the importance of safety in the nuclear industry and how that is affected by design, regulation and the influence of the media. The module will cover the design of several reactor types as well as manufacturing and operational procedures. The students will also be educated to understand reactor operating principles and design in the production of electricity.

Outline Syllabus

On successful completion of this module students will be able to:
• demonstrate understanding of the significance of the major regulatory issues associated with the civil nuclear industry;

• demonstrate understanding of how regulation, legislation and international cooperation has arisen as the result of accidents;

• apply power and engineering aspects to reactor design;

• discuss the affect of the media on a high profile industry such as the nuclear industry and how this evidence of public opinion can affect the industry.

**Assessment Proportions**

- Coursework: 80%
- Exam: 20%

**ENGR426: Decommissioning Process and Technology**

**Terms Taught:** Lent Term Only  
**US credits:** 4 semester credits  
**ECTS:** 8 ECTS credits

**Pre-requisites:**

- This module is only available to Postgraduate Erasmus+ students from selected partners  
- College-level Physics  
- Some awareness of robotics is desirable but not essential

**Module Description**

This module addresses the strategies for effective nuclear decommissioning. Students are introduced to the range of size-reduction techniques for decommissioning, together with the concepts of hazardous waste management, minimisation, transport and disposal. Robotic and remote handling techniques are important aspects of decommissioning and a significant part of the module is devoted to the control and integration of robotic systems.

**Educational Aims**

The aim of this module is to further teach the students about the processes involved in Nuclear decommissioning in the UK. As part of this, the technology used in nuclear decommissioning is also discussed, but the current state of the art and the future plans. This is both in the form of what is being done by other groups as well as modules and a lab session enabling the students to build a basic robot themselves. The decommissioning waste management issue is also treated with an emphasis on waste treatment, the safety of the repository, and the safety assessment of the repository using laboratory and field data as well as natural analogue data.

**Outline Syllabus**

At the end of this module students should:

- Have knowledge of the range of cutting technologies available for demolition
- Understand the concepts of hazardous waste management, minimisation, transport and disposal
- Be aware of the range of robotic and remote handling techniques and have developed skills in their selection, integration, simulation and interfacing
- Know about equipment cleaning and surface decontamination
- Be aware of safety and legal issues in decommissioning
- Be exposed to techniques of decommissioning project management, assessment, costing and analysis
- Be able to understand waste management issues associated to decommissioning waste packages

Assessment Proportions
- Coursework: 67%
- Exam: 33%

ENGR429: Electrical Power Systems Analysis

Terms Taught: Michaelmas Term Only
US credits: 2 semester credits
ECTS: 4 ECTS credits

Pre-requisites:
- This module is only available to Postgraduate Erasmus+ students from selected partners
- College level Mathematics and Science
- BEng equivalent Electrical Engineering

Module Description
This module teaches about the complex structure of energy systems and places them in their physical, economic and environmental dimensions. The objective of the module is to provide students with comprehensive knowledge and understanding of complex energy systems, their control and modelling. The module splits into two large themes, big-picture modelling of energy transitions and their sociotechnical, political and economic implications; and detailed engineering modelling of modern power systems, both off-grid and on-grid, their optimal operation and network configurations.

Educational Aims
By the end of this module, students should:
- Be able to identify past energy transitions and describe their dynamics
- Be able to describe the key driving characteristics of past and current energy transitions
- Be able to model the technoeconomics of microgrids using specialised software
- Be able to model the power flow in grids using specialised software
- Develop an understanding of scientific principles of energy return on energy investment
- Develop an understanding of scientific principles and methodology of voltage and reactive power control, load flow, power system optimal dispatch and control of generation
Outline Syllabus

- Historical Energy Transitions
- Energy Resources and Society
- Energy Economics
- 100% Renewable Energy Scenarios
- Microgrid design principles
- Grid design & control
- Power flow analysis
- Network topologies
- Grid modelling

Assessment Proportions

- Coursework: 30%
- Exam: 70%

ENGR 421: Rapid Manufacturing

Terms Taught: Lent Term Only
US credits: 4 semester credits
ECTS: 8 ECTS credits

Pre-requisites:

- This module is only available to Postgraduate Erasmus+ students from selected partners
- BEng in Mechanical Engineering or equivalent
- Prior knowledge of mechanical design and manufacturing

Module Description

Manufacturing is a key component of engineering. The ability to design and manufacture, high quality, high value products, with short lead times, is essential for industries to be competitive in the modern "digital" age. This module will introduce the context of new product introduction and examine the technologies available to both shorten total lead times and increase confidence in the product. It will study, in detail, a range of rapid product development tools and technologies including specific process principles and engineering applications. Topics covered include, Concurrent Engineering, Rapid Prototyping, Rapid Tooling, Additive Manufacturing, Reverse Engineering, Virtual Prototyping and Responsive Manufacturing.

Educational Aims

Manufacturing is a key component of engineering. The ability to design and manufacture, high quality, high value products, with short lead times, is essential for industries to be competitive in the modern "digital" age. This module will introduce the context of new product introduction and examine the technologies available to both shorten total lead times and increase confidence in the product. It will study, in detail, a range of rapid product development tools and technologies including specific process principles and engineering applications. Topics covered include, Concurrent Engineering, Rapid Prototyping, Rapid Tooling, Additive Manufacturing, Reverse Engineering, Virtual Prototyping and Responsive Manufacturing.
Outline Syllabus
The module will introduce the context of new product introduction, examine the technologies available to both shorten total lead times and increase confidence in the product. It will also discuss factors influencing the correct choice of technologies. The module will study, in detail, a range of rapid product development tools and technologies including specific process principles and engineering applications. Topics covered include, Concurrent Engineering, Prototyping, Rapid Prototyping, Rapid Tooling, Additive Manufacturing, Reverse Engineering, Virtual Prototyping and Responsive Manufacturing.

Assessment Proportions

- 80% Exam
- 20% Case Study