Swansea University
Prifysgol Abertawe

FACULTY OF SCIENCE AND ENGINEERING

UNDERGRADUATE STUDENT HANDBOOK

YEAR 3 (FHEQ LEVEL 6)

CHEMICAL ENGINEERING

DEGREE PROGRAMMES

SUBJECT SPECIFIC
PART TWO OF TWO
MODULE AND COURSE STRUCTURE
2023-24

DISCLAIMER

The Faculty of Science and Engineering has made all reasonable efforts to ensure that the information contained within this publication is accurate and up-to-date when published but can accept no responsibility for any errors or omissions.

The Faculty of Science and Engineering reserves the right to revise, alter or discontinue degree programmes or modules and to amend regulations and procedures at any time, but every effort will be made to notify interested parties.

It should be noted that not every module listed in this handbook may be available every year, and changes may be made to the details of the modules. You are advised to contact the Faculty of Science and Engineering directly if you require further information.

The 23-24 academic year begins on 25 September 2023

Full term dates can be found here

DATES OF 23-24 TERMS

25 September 2023 – 15 December 2023

8 January 2024 – 22 March 2024

15 April 2024 – 07 June 2024

SEMESTER 1

25 September 2023 – 29 January 2024

SEMESTER 2

29 January 2024 – 07 June 2024

SUMMER

10 June 2024 – 20 September 2024

IMPORTANT

Swansea University and the Faculty of Science of Engineering takes any form of **academic misconduct** very seriously. In order to maintain academic integrity and ensure that the quality of an Award from Swansea University is not diminished, it is important to ensure that all students are judged on their ability. No student should have an unfair advantage over another as a result of academic misconduct - whether this is in the form of **Plagiarism**, **Collusion** or **Commissioning**.

It is important that you are aware of the **guidelines** governing Academic Misconduct within the University/Faculty of Science and Engineering and the possible implications. The Faculty of Science and Engineering will not take intent into consideration and in relation to an allegation of academic misconduct - there can be no defence that the offence was committed unintentionally or accidentally.

Please ensure that you read the University webpages covering the topic – procedural guidance here and further information here. You should also read the Faculty Part One handbook fully, in particular the pages that concern Academic Misconduct/Academic Integrity.

Welcome to the Faculty of Science and Engineering!

Whether you are a new or a returning student, we could not be happier to be on this journey with you.

At Swansea University and in the Faculty of Science and Engineering, we believe in working in partnership with students. We work hard to break down barriers and value the contribution of everyone.

Our goal is an inclusive community where everyone is respected, and everyone's contributions are valued. Always feel free to talk to academic, technical and administrative staff, administrators - I'm sure you will find many friendly helping hands ready to assist you. And make the most of living and working alongside your fellow students.

During your time with us, please learn, create, collaborate, and most of all – enjoy yourself!

Professor David Smith
Pro-Vice-Chancellor and Executive Dean
Faculty of Science and Engineering

Faculty of Science and Engineering	
Interim Pro-Vice Chancellor/Interim Executive Dean	Professor Johann Sienz
Head of Operations	Mrs Ruth Bunting
Associate Dean – Student Learning and Experience (SLE)	Professor Laura Roberts
School of Engineering and Applied Sciences **Head of School: Professor Serena Margadonna**	
School Education Lead	Professor Simon Bott
Head of Chemical Engineering	Professor Enrico Andreoli
Chemical Engineering Programme Director	Dr Matt Barrow M.S.Barrow@swansea.ac.uk
Year 3 Coordinator	Dr Chris Phillips C.O.Phillips@swansea.ac.uk

STUDENT SUPPORT

The Faculty of Science and Engineering has two **Reception** areas - Engineering Central (Bay Campus) and Wallace 223c (Singleton Park Campus).

Standard Reception opening hours are Monday-Friday 8.30am-4pm.

The **Student Support Team** provides dedicated and professional support to all students in the Faculty of Science and Engineering. Should you require assistance, have any questions, be unsure what to do or are experiencing difficulties with your studies or in your personal life, our team can offer direct help and advice, plus signpost you to further sources of support within the University. There are lots of ways to get information and contact the team:

Email: studentsupport-scienceengineering@swansea.ac.uk (Monday–Friday, 9am–5pm)

Call: +44 (0) 1792 295514 (Monday-Friday, 10am–12pm, 2–4pm).

Zoom: By appointment. Students can email, and if appropriate we will share a link to our Zoom calendar for students to select a date/time to meet.

The current student **webpages** also contain useful information and links to other resources:

https://myuni.swansea.ac.uk/fse/

READING LISTS

Reading lists for each module are available on the course Canvas page and are also accessible via http://ifindreading.swan.ac.uk/. We've removed reading lists from the 23-24 handbooks to ensure that you have access to the most up-to-date versions.
We do not expect you to purchase textbooks, unless it is a specified key text for the course.

THE DIFFERENCE BETWEEN COMPULSORY AND CORE MODULES

Compulsory modules must be **pursued** by a student.

Core modules must not only be **pursued**, but also **passed** before a student can proceed to the next level of study or qualify for an award. Failures in core modules must be redeemed.

Further information can be found under "Modular Terminology" on the following link - https://myuni.swansea.ac.uk/academic-life/academic-regulations/taught-guidance/essential-info-taught-students/your-programme-explained/

Year 3 (FHEQ Level 6) 2023/24
Chemical Engineering

BEng Chemical Engineering[H831,H835]
BEng Chemical Engineering with a Year Abroad[H800]
BEng Chemical Engineering with a Year in Industry[H832]
MEng Chemical Engineering[H801]
MEng Chemical Engineering with a Year Abroad[H802]

Semester 1 Modules	Semester 2 Modules
EG-304 **Safety and Loss Prevention** **10 Credits** **Dr YK Ju-Nam** **CORE**	**EG-307** **Particulate Systems** **10 Credits** **Dr P Bertoncello** **CORE**
EG-337 **Reactor Design II** **10 Credits** **Prof DL Oatley-Radcliffe** **CORE**	**EGA323** **Energy and Low Carbon Technologies** **10 Credits** **Dr P Bertoncello** **CORE**
EG-338 **Separation Processes II** **10 Credits** **Prof C Tizaoui** **CORE**	**EGZ300** **Environmental Engineering Practice** **10 Credits** **Dr SJI Shearan/Ms S Walsh** **CORE**
EG-339 **Process Equipment Design** **10 Credits** **Ms S Walsh** **CORE**	
EGA332 **Process Equipment Selection and Control** **10 Credits** **Dr CO Phillips** **CORE**	
EG-386 **Engineering Management** **10 Credits** **Dr JM Courtney/Prof AR Barron/Dr M Evans** **CORE**	
EGA326 **Chemical Engineering Design Project** **30 Credits** **Dr P Esteban** **CORE**	
Total 120 Credits	

Year 3 (FHEQ Level 6) 2023/24
Chemical Engineering
MEng Chemical Engineering with a Year in Industry[H890]

Semester 1 Modules	Semester 2 Modules
EG-304 **Safety and Loss Prevention** **10 Credits** **Dr YK Ju-Nam** **CORE**	**EG-307** **Particulate Systems** **10 Credits** **Dr P Bertoncello** **CORE**
EG-337 **Reactor Design II** **10 Credits** **Prof DL Oatley-Radcliffe** **CORE**	**EGA323** **Energy and Low Carbon Technologies** **10 Credits** **Dr P Bertoncello** **CORE**
EG-338 **Separation Processes II** **10 Credits** **Prof C Tizaoui** **CORE**	**EGZ300** **Environmental Engineering Practice** **10 Credits** **Dr SJI Shearan/Ms S Walsh** **CORE**
EG-339 **Process Equipment Design** **10 Credits** **Ms S Walsh** **CORE**	
EGA332 **Process Equipment Selection and Control** **10 Credits** **Dr CO Phillips** **CORE**	
EG-233 **Placement Preparation: Engineering Industrial Year** **0 Credits** **Prof GTM Bunting/Dr SA Rolland/Dr V Samaras**	
EG-386 **Engineering Management** **10 Credits** **Dr JM Courtney/Prof AR Barron/Dr M Evans** **CORE**	
EGA326 **Chemical Engineering Design Project** **30 Credits** **Dr P Esteban** **CORE**	
Total 120 Credits	

EG-233 Placement Preparation: Engineering Industrial Year

Credits: 0 Session: 2023/24 September-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof GTM Bunting, Dr SA Rolland, Dr V Samaras

Format: 11 hours consisting of a mix of seminars and workshops. 11 one hour drop-in advice sessions. Review of CV and cover letter.
Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

Delivery Method: All Programmes will employ a blended approach to delivery using the Canvas Digital Learning Platform for live and self-directed online activity, with live and self-directed on-campus activities each week. Students may also have the opportunity to engage with online versions of sessions delivered on-campus

This module is delivered through directed and self-directed learning, careers resources, interactive workshops, reflective learning practice and drop-in advice sessions. The module is delivered on the Bay Campus.

Module Aims: This generic cross-disciplinary module is for all students who have enrolled (or transferred) onto the Engineering Year in Industry scheme. The module focuses on the underpinning and fundamental requisites required to gain, enter and progress effectively through an industrial placement. Learners will be introduced to a) sourcing placements, CV writing and application techniques; (b) interview techniques - how to pitch yourself and be successful; (c) workplace fundamentals and IP awareness, behaviours and expectations; (d) key employability skills; getting the most from your Industrial Placement; and (e) health and safety in the workplace.

Module Content:
The module will focus on the key requirements to gain and be successful whilst on a placement. Directed and self-directed activity will address the following topics;

1) Engineering Industrial Placements - what they are, how to search and how to apply.
2) CV writing, cover letters and application processes.
3) Assessment centres, interview techniques and mock interviews.
4) Recognising and developing employability skills.
5) Reflecting and maximising the placement experience.
6) One to one meeting with careers and employability staff.
7) Health and safety in the workplace.

Intended Learning Outcomes:
Technical Outcomes
By the end of this module, students will:
- Know how to find and apply for placements, create a CV and complete a placement application.
- Understand the interview process and gain interview experience.
- Discuss and share what is expected within the workplace including behavioural and professional conduct.
- Identify personal employability skills and how these will be used in a workplace setting.

Accreditation Outcomes (AHEP)
EL5b Awareness of relevant legal requirements governing engineering activities, including personnel, health & safety, contracts, intellectual property rights, product safety and liability issues
EL6b Knowledge and understanding of risk issues, including health & safety, environmental and commercial risk,

Assessment: Placements (100%)

Assessment Description:
Students are required to attend the health and safety lecture. Students who do not attend and have no valid reason will not be permitted to continue on an Engineering Industrial Placement Year programme of study.

Moderation approach to main assessment: Not applicable

Assessment Feedback:
N/A: students will however be able to discuss and seek feedback/advice on their search for an industrial placement, during the drop-in sessions.

Failure Redemption:
Successful completion of this module depends upon attendance at, and engagement with, the health and safety lecture. Therefore there will normally be no opportunity to redeem failure. However, special provision will be made for students with extenuating or special circumstances.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

This module is only available for students enrolled on the Engineering Year in Industry scheme.

EG-304 Safety and Loss Prevention

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules: EG-220; EG-230

Co-requisite Modules:

Lecturer(s): Dr YK Ju-Nam

Format: Lectures 25 hours
HAZOP 4 hours
Directed private study 75 hours
Contact Hours will be delivered through a blend of live activities online and on-campus.

Delivery Method: All Programmes will employ a blended approach to delivery using the Canvas Digital Learning Platform for live and self-directed online activity, with live and self-directed on-campus activities each week. Students may also have the opportunity to engage with online versions of sessions delivered on-campus.

Module Aims: This module aims to provide a basic knowledge of the technical issues underlying safety and loss prevention on process plant, introducing risk and hazard assessment together with the legal framework of obligations for organizations and individuals.

Module Content:
The module consists of topic lectures combined with case studies introduced by video footage; technical problems with solution methods and practical HAZOP & Risk Assessment exercises.
Specific topics covered are:
• Fires and Explosions; flammability of gases liquids and solids; ignition sources; electrical and hazardous area classification [5].
• HAZOP assessment [4]
• Inherent Safety [2]
• Toxic Releases [2]
• Hazard and Risk Assessment Methods [5]
• Management Issues, Emergency Planning and the legal framework [3]

Intended Learning Outcomes:
After completing this module students are expected to:

• Evaluate specific hazards associated to hazardous materials and their usage

• Identify potential sources of hazards and risk of major accident events using a range of techniques

• Assess hazards and risks from process control system failures

• Assess the impact of human factors in process operations and design

• Explain how process safety management systems are implemented and operated in industry

Assessment: Examination 1 (90%)
Group Work - Coursework (10%)
Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: A HAZOP or risk assessment exercise (this coursework is conducted and assessed in groups), and an end of year examination.

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback: Marked HAZOP exercise and final examination

Failure Redemption:
Year 3 BEng - BEng students are only permitted to redeem a failure as per University regulations for final year students. If you are eligible for a resit examination this will take the form of a 100% supplementary exam in August.

Year 3 MEng - MEng students are only permitted to redeem a failure as per University regulations for YR3 - YR4 progressing students. If you are eligible for a resit examination this will the form of a 100% supplementary exam in August.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

Available to visiting and exchange students.

This module operates with a zero tolerance penalty policy for late submission of all coursework and continuous assessment.

EG-307 Particulate Systems

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr P Bertoncello

Format: Lectures 20 hours;
Example classes/tutorials 5 hours;
Preparation for assessment; 25 hours
Reading/Private study: 50 hours

Delivery Method: On-campus lectures and tutorials.

Module Aims: This module aims at presenting the fundamental aspects of transport mechanisms of particles (suspended in fluids) and to illustrate the properties and external conditions that influence the flow of fluids through packed beds, the separation of multiphase systems, separation across phase boundaries in a variety of industrial situations.

Module Content:

• Motion of particles in a fluid: drag forces, terminal falling velocities; accelerating motion of a particle in the gravitational field; motion of a sphere in the Stokes' law region; motion of particles in a centrifugal field [2].
• Flow of fluids through granulat Beds and packed columns: Darcy's law and permeability; Carman-Kozeny equation; streamline and turbulent flow [2].
• Sedimentation: sedimentation of fine particles; the thickener; sedimentation of coarse particles [2].
• Fluidisation: general behaviour of gas/solids and liquid/solids systems; effect of fluid velocity on pressure gradient & pressure drop; minimum fluidising velocity; fluidising beds [3].
• Liquid filtration: introduction, theory; relation between thickness of cake and volume of filtrate; compressible & incompressible cakes [4].
• Centrifugation: introduction, theory; sedimentation of a centrifugal field; Filtration with centrifugation [4]
• Crystallisation: introduction, theory and fundamentals; solubility and saturation; crystal nucleation; crystal growth; crystal yield; crystallisation from solutions; fractional crystallisation [3].

Intended Learning Outcomes:

After completing this module, the student should be able to demonstrate knowledge and understanding of the following:

(1) Motion of particles through granular beds and sedimentation: calculation of terminal falling and settling velocities of solid particles under different fluid dynamic conditions;
(2) Fluidisation. Derive expression for minimum fluidising velocity under streamline and turbulent conditions; Evaluation of mass flow rate of flow under fluidisation and transport conditions;
(3) Principles and operations of separation of particles from fluids: sedimentation, centrifugation, liquid filtration and crystallisation;
(4) Solutions of practical problems. Typical examples include estimation of minimum area of a thickener; calculation of pressure drop and filtration rate; estimation of the number of filter press frames and their size required to filter a given amount of a slurry; calculation of crystal yield.

Assessment: Examination 1 (80%)
Coursework 1 (20%)

Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: 80% final exam
20% coursework

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback:

Examples questions will be solved in class with related solutions placed on Canvas.

Failure Redemption:

Year 3 BEng : BEng students are only permitted to redeem a failure as per University regulations for final year students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Year 3 MEng : MEng students are only permitted to redeem a failure as per University regulations for YR3 - YR4 progressing students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

Not available to visiting and exchange students.
This module operates with a zero tolerance penalty policy for late submission of all coursework and continuous assessment.
Notes, worked examples and past papers for this module can be found on Canvas.

EG-337 Reactor Design II

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules: EG-204

Co-requisite Modules:

Lecturer(s): Prof DL Oatley-Radcliffe

Format: Lectures 20 hours; Example classes 10 hours; Directed private study 70 hours
Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

Delivery Method: All Programmes will employ a blended approach to delivery using the Canvas Digital Learning Platform for live and self-directed online activity, with live and self-directed on-campus activities each week. Students may also have the opportunity to engage with online versions of sessions delivered on-campus

Notional lectures will be available online and asynchronously via the VLE. These will be supported by assigned reading and alternative online resources where appropriate. Online synchronous worked examples classes and drop in sessions will be scheduled to support student learning. Students will be expected to follow the scheduled workload of learning materials.

Module Aims:
This module continues to develop the concepts studied in the Level 2 Reactor Design Course (EG-204). The engineering design of reaction vessels will be considered for chemical reaction systems that involve simultaneous reaction with mass transfer limitations in the fluid phase and the solid phase matrix that contain a chemical catalyst. Mathematical modelling of the kinetic rate equations therefore incorporates the concept of a mass transfer limitation effectiveness factor for the solid phase matrix, whilst the fluid mechanics is used to determine the fluid phase transfer limitations. The kinetic rate models are used to develop Design Performance Equations for industrial reaction systems based on the fixed bed catalytic reactor. Other reaction systems are discussed as industrial examples.

Module Content: Reactor design concepts including catalysts in heterogeneous systems. Graphical representation and determination of chemical kinetic model parameters. Modelling of catalytic deactivation mechanisms and fluid phase mass transfer limitations in gas-solid catalytic tubular reactors.

Non-Catalytic Gas-Solid Reactions. Case problems. A detailed study of the Shrinking Core model. Gas-Solid Catalytic Reactions. Reactions on catalyst surfaces. Kinetics of heterogeneously catalysed reactions. Diffusion and reactions in porous catalysts.External Mass Transfer. Surface Phenomena and Reaction. Design of Gas-Solid Catalytic Reactors. Packed Bed Reactors.

Diffusion into a porous catalyst particle; modelling of the simultaneous mass transfer and catalytic chemical reaction in the solid phase matrix particle.

Design of industrial packed bed catalytic reactors; configurations for either non-isothermal adiabatic or heat transfer operation with a one dimensional model using dimensional correlations of the fluid mechanics in case studies.

Intended Learning Outcomes: On completion, students should have:

1. Knowledge and understanding of kinetic rate models and how these apply to reactor design, the concept of chemisorption and models of solid surface catalysed reactions including more complex systems such as non-catalytic gas-solid reactions.
2. An ability to analyse chemical reactor performance where mass transfer limitations occur (assessed by the mass transfer effectiveness factor), catalytic packed bed reactor engineering and geometry, fluid flow and the relationship between Reynolds No. and pressure drop.
3. The ability to design chemical reactors for a novel duty; using the dimensionless design performance equations, knowledge of the rate limiting step and Damkohler number for evaluating capacity and performance of industrial scale systems.

Assessment:	Examination 1 (80%) Coursework 1 (5%) Coursework 2 (5%) Coursework 3 (5%) Coursework 4 (5%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description: Examination 1: End of year examination accounting for 80% of the total mark.

Coursework 1-4: A series of typical questions relevant to topic areas (numerical calculations on various topics delivered throughout the course): 20%

Examination: Students who fail the primary exam will receive an examination in order to redeem this failure. Success will be treated as a threshold pass in-line with Faculty guidelines.

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback: Formal summative Exam feedback will be given via exam results and the exam feedback form.

Formative feedback will be given via example classes and discussion.

Failure Redemption: Year 3 BEng : BEng students are only permitted to redeem a failure as per University regulations for final year students. If you are eligible for a resit examination, this will take the form of an Examination in order to redeem the failure. Success will be treated as a threshold pass in-line with Faculty guidelines.

Year 3 MEng : MEng students are only permitted to redeem a failure as per University regulations for YR3 - YR4 progressing students. If you are eligible for a resit examination, this will take the form of an Examination in order to redeem the failure. Success will be treated as a threshold pass in-line with Faculty guidelines.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

Available to visiting and exchange students.
This module operates with a zero tolerance penalty policy for late submission of all coursework and continuous assessment.
Lecture slides are provided with worked examples via the VLE.

EG-338 Separation Processes II

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules: EG-200

Co-requisite Modules:

Lecturer(s): Prof C Tizaoui

Format: Lectures 20 hours
example classes 10 hours
Directed private study 70 hours

Delivery Method: On-campus lectures and example classes. Module materials are available at Canvas. Assessment: January Assessment (2 h exam) 80% and one Canvas test 20%.

Module Aims: This module builds on years 1 and 2 studies of traditional separation processes, extending these to multi-component systems. Short-cut methods are described. The importance of non-ideal behaviour is highlighted in descriptions of azeotropic and extractive distillation. The discussion of absorption is extended to include chemical reactions, and basic knowledge of adsorption and ion exchange separation processes is covered in this module.

Module Content: •Vapour liquid equilibrium for multi-component systems [1]
•Single stage flash vaporisation [2]
•Multi-component continuous fractionation and short cut methods for calculating column operating conditions [4]
•Multi-component distillation: rigorous solution methods [2]
•Column efficiencies and tray design [2]
•Extractive and azeotropic distillation [1]
•Multi-component gas absorption [4]
•Adsorption and ion exchange processes [4]

Intended Learning Outcomes: After completing this module, students should be able to:
• Demonstrate knowledge and understanding of VLE relationships and use DePriester charts to determine k-values.
• Calculate the composition of mixtures and their dew and bubble points.
• Analyse practical operation of multicomponent equilibrium flash units.
• Apply and evaluate short cut and rigorous methods for the design of multi-component distillation columns and solve difficult separations (azeotropic and extractive distillation).
• Design multi-component absorption columns.
• Demonstrate knowledge and understanding of adsorption and ion exchange processes.
• Select and apply chemical engineering principles to design problems and to select and apply common separation equipment.

Assessment: Examination 1 (80%)
Coursework 1 (20%)
Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: January Assessment 80% and one Canvas test 20%
Resit: Assessment (100%)

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback: Exam result and exam general feedback forms common across Faculty . Assignment feedback will be given by individual written comments and personal discussion and assignment mark.

Failure Redemption: Year 3 BEng : BEng students are only permitted to redeem a failure as per University regulations for final year students. If you are eligible for a resit examination this will take the form of a 100% supplementary assessment.
Year 3 MEng : MEng students are only permitted to redeem a failure as per University regulations for YR3 - YR4 progressing students. If you are eligible for a resit examination, this will take the form of a 100% supplementary assessment.

Additional Notes: We will make every effort to engage with students where changes are necessary and any changes will be communicated to students, as soon as possible. Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

Available to visiting and exchange students.
This module operates with a zero tolerance penalty policy for late submission of all coursework and continuous assessment.

EG-339 Process Equipment Design

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Ms S Walsh

Format: Contact hours - 25 hours (20 in-person lectures + 5 examples classes)
Directed private study - 80 hours

Delivery Method: Module will be delivered via in-person lectures and examples classes. Supplementary information may be available via the Canvas Digital Learning Platform.

Module Aims: The general aims of this module are to analyse manufacturing equipment and processes for the purpose of design and scale-up. The module will focus on aspects of process engineering design for the majority of equipment but will provide examples of detailed design and mechanical design in some cases. In all cases, industrial standards, best practice and safety will be at the heart of any design process to ensure the finalised designs will be reliable and robust, economically viable, safe and sustainable. Areas of design considered will include strength of materials, mechanical design, specification of stirred tanks including aseptic/sterile equipment design for regulation and control of chemical and biological reactions. Heterogeneous systems, in particular, the inter-phase mass transfer of nearly insoluble gases. Heat transfer through jackets, coils, electrical heaters.

Module Content: Equipment Design:
> Objectives of process equipment design. Understanding the design process. Commissioning and validation.
> Strength of Materials.
> Pressure Vessel Specification.
> Mass transfer issues: aeration and oxygen supply to fermenter design. The concept of limiting resistance for mass transfer - development of two film theory. Correlations for mass transfer coefficients. Bubble dynamics and determination of mass transfer coefficient.
> Scale up of fermenters: Oxygen transfer rates. Power and Reynolds numbers. Mixing characteristics. Bubble hold up. Other factors to consider, such as heat transfer.
> Batch processing: The concept of the batch process. Design and scale-up of batch processes. Processing methodologies and cycle time analysis.
> Sterilisation (gas/air): Practical methods for air sterilisation. Filtration. Design examples.

Intended Learning Outcomes: Upon completion of this module students should be able to:
• Design process equipment with reference to process requirements, safety and relevant industrial standards.
• Write validation and commissioning procedures.
• Perform scale-up calculations.
• Analyse the suitability of existing equipment to meet new process requirements.

Assessment: Examination 1 (80%)
Coursework 1 (20%)
Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Examination:
One end of module examination accounting for 80% of the total mark

Coursework:
One assessed coursework requiring numerical calculations/interpretation/design accounting for 20% of the total mark.

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback: Exam feedback will be provided via examination feedback forms and written feedback will also be available for coursework items. Feedback on learning and comprehension will be accessible through office hours.

Failure Redemption: A Supplementary Assessment (resembling traditional Exam Paper style) will be provided for students entitled to resit the module - provision of the Supplementary Assessment will be according to the usual rules governing Progression or Completion of studies.

Additional Notes: Delivery of both teaching and assessment will be on-campus.

Available to visiting and exchange students.
This module operates with a zero tolerance penalty policy for late submission of all coursework and continuous assessment.

EG-386 Engineering Management

Credits: 10 Session: 2023/24 September-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr JM Courtney, Prof AR Barron, Dr M Evans

Format: Core Lectures 20 hours
Discipline Specific Lectures 10 hours
Private Study 70 hours
Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

Delivery Method: All Programmes will employ a blended approach to delivery using the Canvas Digital Learning Platform for live and self-directed online activity, with live and self-directed on-campus activities each week. Students may also have the opportunity to engage with online versions of sessions delivered on-campus

Series of lectures, discipline-specific sections will cover the first 3 weeks and core components will follow.

Important - Careers Services Support lectures will take place in TB1 but formal assessment marks will be released in TB2. Please be aware that this is compulsory and will appear on the TB1 timetable.

One individual assignment for the discipline-specific component (30%) and two canvas-based electronic examinations (65% (2 x 32.5%)) for the core component, plus 5% careers services assessment .

Module Aims: The goal of this course is to provide the skills for science and engineering to meet the challenges of their future careers, whether they be in academia, industry, or as an entrepreneur. Irrespective of future careers engineers will be involved in projects and an awareness of the factors that enable a successful project is important for all team members. It should be recognized that the topics included in the course are not limited to scientists and engineers, they are useful for people in any careers. This course is not aimed at making you a certified project manager, but to provide the skills that will allow you to be a more effective project team member and also when you are dragged screaming and kicking into the role of accidental project manager.

With respect to human resources, the course will cover the basic concept of entrepreneurship before breaking down the essential elements of a business plan. The course will give the more entrepreneurial students guidance about how to go about commercialising their ideas and the less entrepreneurial students an understanding of what makes some of their colleagues tick. The learn by example approach adopted for this module guides the student through the complexities of financial and human resource management and encourages students to develop their own business plans. Students will also be introduced to the subject area of ethics within business. This module will also provide support on careers services with students creating CVs and Linked-In accounts.

Module Content: Pre-component
Careers Services Support - CV and Linked-In account

Section A. Programme Specific Component
There are four programme specific components:
•Civil, Chemical (including Environmental), Mechanical and Aerospace/Materials/Electrical/Medical Engineering.
•Chemical Engineering - Lectures on project appraisal in the chemical industries.
•Mechanical and Aerospace - Lectures on manufacturing processes and producing costing worksheets for specific processes.
•Materials/Electrical/Medical Engineering - Lectures on modelling, simulating and then optimising manufacturing products and processes.

Section B. Core Component
Project Management
• What is a Project?
Definition of a project and the stages within a project; project characteristics;
• Project Stakeholders
Who is involved in a project? The Politics of a project
• What is Project management and a Project manager?
Areas of expertise; what makes a successful project manager; triple constraint; standards and knowledge; management knowledge and skills
• Project Life Cycle
Initiation, planning, execution and closure; Project charter; Objectives and Scope; Project planning; Scope; Requirements; Work breakdown structure; network diagram; resource planning; Contract type; Risk management

• Entrepreneurship: Team building & Finance / Business Start-ups / The Business Plan including:
Team building and Entrepreneurial Finance.
Risk and Reward. How to set up a new company.
How to write a business plan.

Intended Learning Outcomes:
Technical Outcomes
Upon completion of the module the student should be aware of:
- Some of the "tools" that assist in the efficient use of financial & human resources in manufacturing;
- Writing a project plan
- How to determine if a project is a success
- Legal, human and economic aspects of entrepreneurship;

Accreditation Outcomes (AHEP)
- Knowledge of relevant legal and contractual issues (P5)
- Apply their skills in problem-solving, communication, working with others, information retrieval, and the effective use of general IT facilities (G1)
- Understanding of, and the ability to work in, different roles within an engineering team (P11)
- Knowledge and understanding of risk issues, including health & safety, environmental and commercial risk, and of risk assessment and risk management techniques (EL6)
- Work with information that may be incomplete or uncertain and quantify the effect of this on the design (D3B).
-Awareness of relevant legal requirements governing engineering activities, including personnel, health & safety, contracts, intellectual property rights, product safety, and liability issue (EL5)
- Understanding of appropriate codes of practice and industry standards (P6)
- Awareness of quality issues and their application to continuous improvement (P7)

Assessment:	Coursework 1 (3%) Assignment 1 (30%) Examination 1 (65%) Coursework 2 (2%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description:
The core component is assessed via two 1 hour canvas-based electronic examinations. (Equally weighted and contributing 65% to the module grade).

The program specific components are assessed through one piece of coursework that is program specific (contributing 30% to the module grade).

There will also be a 5% component on Careers Support that will be completed in TB1 - 3% for completion of 5 specified units of the 'career development course' and 2% for CV (which will be assessed using 'VMOCK').

This module is assessed by a combination of examination and continual assessment. In order to pass the module students must achieve a minimum of 30% in the examination component, and a minimum of 40% overall for the module. If students do not meet the exam and module requirements they will receive a QF outcome and will be required to take a supplementary assessment in this module, even if their module mark is above 40%.

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback:
Students will receive feedback on their coursework, together with a model answer, within three weeks of submission.
Feedback for the examination will be released via the exam feedback form.

Failure Redemption:
Year 3 BEng : BEng students are only permitted to redeem a failure as per University regulations for final year students. If you are eligible for a resit examination this will take the form of 100% supplementary examination.

Year 3 MEng : MEng students are only permitted to redeem a failure as per University regulations for YR3 - YR4 progressing students. If you are eligible for a resit examination this will take the form of 100% supplementary examination.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

Penalty for late submission of work: ZERO TOLERANCE.

The module is available to exchange students.

Notes and worked examples can be found on Canvas.

EGA323 Energy and Low Carbon Technologies

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr P Bertoncello

Format: Lectures 20 hours;
Example classes/tutorials 5 hours;
Preparation for assessment; 25 hours
Reading/Private study: 50 hours

Delivery Method: On campus lectures and tutorials.

Module Aims: This module aims to present fundamental aspects of energy generation using low carbon technologies.

The module will describe the following:
• Description of the concept of "Hydrogen economy"; Hydrogen generation and purification; Power To Gas;
• Energy generation using fuel cells: Proton exchange fuel cells (PEMs), solid oxide fuel cells (SOFCs), molten carbonate fuel cells (MCFCs), phosphoric acid fuel cells (PAFCs), alkaline fuel cells (AFCs); methanol fuel cells (MeFCs).
• Solar energy generation: Silicon-based photovoltaic cells, Gratzel and Organic photovoltaic cells; Perovskite solar cells;
• Definition and description of batteries: Rechargeable batteries: Li-ion, Li-ion polymer, Na-ion, Na-air, and NiMH batteries;
• Supercapacitors as energy generators. Wind and Tidal Energy generation; Geothermal Energy.

Module Content:
Introduction
Introduction to energy generation using organic and inorganic materials. Theory and Principles.
Hydrogen generation: general description of current industrial processes for hydrogen generation and related environmental implications; Power to Gas
Fuel cells: Introduction and principles of fuel cells. Definition of efficiency. Description of proton exchnage fuel cells (PEMs), solid oxide fuel cells (SOFCs), molten carbonate fuel cells (MCFCs), phosphoric acid fuel cells (PAFCs), alkaline (AFCs) fuel cells, methanol fuel cells (MeFCs). Case studies.
Solar energy generation: Theory and principles. Energy generation using inorganic and organic materials. Energy storage. Case studies.
Rechargeable batteries: Principles and theory. Introduction to Li-ion, Li-ion polymer and NiMH batteries. Supercapacitors. Case studies.
Other renewables: Wind, Tidal and Geothermal Energy: Theory and engineering aspects.

Intended Learning Outcomes:
After completing this module students should be able to apply fundamental chemical engineering knowledge to the area of energy generation; Gather, review and interpret technical information from a variety of sources; Analyse, interpret and question published research. Specifically:
(1) Understand, describe,and assess the methods for the generation and purification of hydrogen;
(2) Evaluate and analyse the characteristics and properties of fuel cells and their applications;
(3) Describe and critically evaluate the theory and principles at the basis of design of modern batteries and supercapacitors; Evaluate and assess efficiency, and the concept of charge/discharges and number of cycles; Compare and analyse the performances of various batteries (Li metal, Li-ion, NIMH, NiCd, Na-air);
(4) Describe the theory and principles at the basis of photovoltaic cells; Identify, and analyse the characteristics of various photovoltaic cells and compare their efficiency;
(5) Describe and appraise the generation of energy using other renewable sources (Wind, Tidal, Geothermal).

Assessment: Examination 1 (80%)
Coursework 2 (20%)
Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: 80% final exam
20% coursework. The coursework will be an essay on a topic related to renewables chosen by the student. The essay will be submitted in Turnitin for plagiarism check.

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback: There is no assessed work. Model answer to past exams will be placed in Canvas.

Failure Redemption:
Year 3 BEng : BEng students are only permitted to redeem a failure as per University regulations for final year students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Year 3 MEng : MEng students are only permitted to redeem a failure as per University regulations for YR3 - YR4 progressing students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

Available to visiting and exchange students.
This module operates with a zero tolerance penalty policy for late submission of all coursework and continuous assessment.
Notes, worked examples and past papers for this module can be found on Canvas.

EGA326 Chemical Engineering Design Project

Credits: 30 Session: 2023/24 September-June

Pre-requisite Modules: EG-200; EG-204; EG-206; EG-210

Co-requisite Modules: EG-304; EG-337; EG-338; EG-339; EGA332

Lecturer(s): Dr P Esteban

Format: 40 hours tutorials (An initial project brief in one lecture, then a series of tutorial sessions designed to answer questions and give guidance on further progress). Directed private study 260 hours.
Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

Delivery Method: All Programmes will employ a blended approach to delivery using the Canvas Digital Learning Platform for live and self-directed online activity, with live and self-directed on-campus activities each week. Students may also have the opportunity to engage with online versions of sessions delivered on-campus

Live face to face lectures in lecture theatre.

Module Aims: This module aims to give students experience in handling a complex and integrated engineering process design. This task will require, and so reinforce, the material taught throughout the undergraduate course and an additional amount of material from directed private study. The module provides transferable skills related to working in a team environment on a major project.

Module Content:

The project involves preparation of:

• A feasibility study and evaluation of alternative process available to meet the design specification and choose, with justification, the most appropriate one;
• A full material balance of the entire proposed process plant;
• Sufficient energy balances to define process operational conditions and service requirements;
• A detailed process Flow Diagram, (PFD), and an Equipment Schedule Listing;
• An approximate sizing of all major items of process equipment in that section of the process plant allocated to an individual member of the design team, and the mechanical design of one major unit in that section of the process plant;
• A review of safety and loss prevention, including HAZOP/HAZAN and the Dow Fire and Explosion Index of at least one major unit by each individual member of the design team with reference to health and safety and the use of globally competitive engineering designs;
• An Environmental Impact Assessment by each individual member of the design team of their allocated section of the proposed process plant, placing the findings into the context of the entire process plant operations;
• An estimation of capital and operating costs by each individual member of the design team for their allocated section of the process plant, placing these costings into the context of the entire process plant economics.
• Produce a comprehensive design report.
• Maintain project management information and tools throughout the duration of the project.

Intended Learning Outcomes:

After completing this module a student should be able to demonstrate a knowledge and skill in the area of:

• Concept design of a chemical or biological processing facility.
• Detailed design of at least one major item of equipment.
• Sustainability of the selected design, including safety.
• Professional transferable skills.

Assessment: Report (50%)
Group Work - Project (50%)

Assessment Description: Each TEAM (or individual) is required to submit a series of Tasks for assessment.
The activity/nature of each task will be clearly defined in the module guidelines and explained in depth in the introductory lectures and companion lectures during the TB1 and 2 period.
Examples of the tasks involved include:
Task 1 - Initial Group Report (Process route selection, PFD, M&E Balances)
Task 2- Individual Peer Review
Task 3- Individual Unit Design
Task 4- Group Design Presentation
Task 5- Individual Peer Review
Task 6- Individual Final Design Report
Task 7- Final Group Design Report
Task 8- Group Poster Presentation
Task 9- Individual Peer Review
Deadlines will be issued for each task and failure to achieve the deadline will result in a loss of marks as the Faculty of Science and Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment. Therefore, any assessments submitted after the submission date will be awarded a mark of zero.
Engagement in the design project is essential in order for students to effectively participate in the team activities and to benefit from the wider learning outcomes. Team tutor meetings will be used to discuss technical issues and to assist in time management of the work activities. A portion of the final grade is allocated to engagement as measured by the team tutor and is based on consistent effort and attendance at tutor design sessions.
A peer review process will take place after each of the group tasks and the results will contribute towards the final mark.

Attendance of the module synchronous sessions is COMPULSORY for this module and is monitored; this is to ensure that information is consistently delivered to all teams.

Overall, EGA326 module marking is split into 50% for Individual design elements and 50% for Group design elements. Students must pass the Individual (task 6) element by 40% to be eligible for the module group mark element.

Failure to pass the individual design element (task 6) by 40% will mean failure of the module (QF).

Failure redemption: The group components of this module are NOT REDEEMABLE via new supplementary coursework. However, the individual component is redeemable via a supplementary coursework.

The supplementary mechanism in EGA326 will entail the student attempting a “new” individual unit operation design. This supplementary coursework will be capped at 40% (i.e. 0.4 x 50 individual module marks).

Where a student has passed the individual supplementary coursework, the student will also then be eligible for the module group mark accrued during the course of the team project i.e. their group component mark will then be added to their individual capped mark to determine the final module mark.

It should be noted that a student who attempts to redeem failure in the individual component may still fail the module if their group mark is too low.

Moderation approach to main assessment: Moderation by sampling of the cohort

Assessment Feedback: Assessment Feedback: Informal continuous feedback will be provided during tutorials and the lecture class. Formal feedback will be provided during the detailed design presentation and following completion of the final design report in line with standard Faculty of Science and Engineering protocols. No marks other than the final module mark will be directly issued to students.

Failure Redemption: Failure redemption: The group components of this module are NOT REDEEMABLE via new supplementary coursework. However, the individual component is redeemable via a supplementary coursework.

The supplementary mechanism in EGA326 will entail the student attempting a ¿new¿ individual unit operation design. This supplementary coursework will be capped at 40% (i.e. 0.4 x 50 individual module marks).
Where a student has passed the individual supplementary coursework, the student will also then be eligible for the module group mark accrued during the course of the team project i.e. their group component mark will then be added to their individual capped mark to determine the final module mark.

It should be noted that a student who attempts to redeem failure in the individual component may still fail the module if their group mark is too low.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

NOT directly available to visiting and exchange students. Attendance on this module is COMPULSORY and monitored.

Deadlines will be issued for each task and failure to achieve the deadline will result in a loss of marks as the Faculty of Science and Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment. Therefore any assessments submitted after the submission date will be awarded a mark of zero.

Plagiarism will be dealt with via the standard Faculty rules. However, due to the nature of the work involved in this module students are expected to quote design standards, books and other literature sources. Where this is the case, accurate referencing is mandatory.

EGA332 Process Equipment Selection and Control

Credits: 10 Session: 2023/24 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr CO Phillips

Format: Typically 20 hours of Lectures and 5 hours examples delivered in person. Additional directed activities via Canvas.

Delivery Method: On campus lectures and examples incorporated

Module Aims: The module also builds upon topics covered in EG-206 (Instrumentation, Measurement and Control) and will focus on two distinct areas:
(1) Ancillaries to main process equipment, with emphasis on pump selection, line sizing, pressure drop calculation, control of flowrate, pressure relief calculations and utilities.
(2) Quantitative aspects of process control including numerical methods for defining control loops and their components as well as control loop design for P&IDs using rules based and numerical approaches.

Module Content: Selection:

Pumps and line sizing: What type of pump for what duty e.g. centrifugal vs positive displacement etc. Sizing and selection of pumps, which includes producing system curves, using pump laws, calculating NPSH, controlling flow by variable pump speed, control valves or orifice plates. How to size control valves. Line sizing.

Pressure relief calculations: How to determine why and when pressure relief devices are required, different types of pressure devices, how to size pressure relief devices and associated equipment.

Utilities and P&ID's Steam, water, air, nitrogen supply and distribution design. Elements of hot oil system design. Reading and interpreting P&ID's.

Control:

Incentives for control, control loops and PID control.

Process dynamics, Laplace transforms and transfer functions.

Stability and control loop tuning.

Control system design.

Intended Learning Outcomes: After completing this module students should be able to:

Select process equipment with reference to specific process requirements, process operation and safety.
Develop specifications for pump, pipework and pressure relief systems.
Specify a basic control strategy for elements of a chemical plant and explain strategies for control loop tuning.
Analyse the dynamics of a process subject to a control system using transfer functions.

Assessment: Examination (100%)
Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Assessment in January (100%)

Moderation approach to main assessment: Moderation of the entire cohort as Check or Audit

Assessment Feedback: Exam result and exam general feedback forms common across Faculty.
Optional exercise feedback will be given via marks, individual written comments and model answers.

Failure Redemption:
Year 3 BEng : BEng students are only permitted to redeem a failure as per University regulations for final year students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Year 3 MEng : MEng students are only permitted to redeem a failure as per University regulations for YR3 - YR4 progressing students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Additional Notes: Material will be delivered via in person lectures and examples classes, with additional directed activities using Canvas.

The module will be 100% exam.

This module is NOT available for visiting students.

This module operates with a zero tolerance penalty policy for late submission of all coursework and continuous assessment.

EGZ300 Environmental Engineering Practice

Credits: 10 Session: 2023/24 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr SJI Shearan, Ms S Walsh

Format: Lectures: 25 hours
Directed private study: 75 hours.

Delivery Method: One lecture hour will be dedicated to the presentation of the piece of equipment or technique employed for purification purposes together with the relevant equations and methodology to solve problems. A second lecture will focus on verification problems (design and process parameters are given), while the third one on design problems (design and process parameters are unknown and they require fixing some degrees of freedom). The same pattern will repeat each week.

Module Aims: Environmental impact of industrial processes is at the corner stone of process engineering. All the industrial processes are subjected to strict environmental regulations, including those on emissions and pollution. Therefore, the design of a chemical plant cannot be based on process considerations only, but it requires detailed environmental considerations. In may cases, actually, environmental considerations are those that drive the design of a specific process or unit operation. Without a quantification of the environmental impact, no productive process can be run.

This class will introduce the student to the environmental pollution caused by industrial and every day life activities. We will present practical procedures to reduce pollutant (solid and gaseous) contained in industrial process streams down to the legislation level. Students will also learn how to quantify the emissions by using the IChemE sustainability metrics.

Module Content: 1. Introduction to the module. Learning outcomes. Exam and Assignments structure. [1]

2. IChemE metrics to quantify the environmental impact of an industrial process. [3]

3. Sedimentation chambers. [3]

4. Cyclone separators. [3]

5. Electrostatic precipitators. [2]

6. Pieces of Equipment in Series and Parallel. [1]

7. Procedures for CO_2 and H_2S purification. [3]

8. Procedures for SO_2 purification. [3]

9. Procedure for NO_x purification. [3]

10. Design of an industrial system for the purification of gas streams from solid and gaseous pollutants [3]

Intended Learning Outcomes: At the end of this module students will be able to:

(i) Analyse and quantify the impact of industrial processes on the environment.
(ii) Design a purification plant to fulfil environmental legislations.

Assessment: Examination 1 (100%)
Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: 2.5-hour closed book exam to be completed in-person during the exam session. The formula sheet comprehensive of all the required graphs and numerical expressions is provided.

Moderation approach to main assessment: Not applicable

Assessment Feedback: General final feedback will be provided after formal ratification of the assessment results.

Failure Redemption: Year 3 BEng : BEng students are only permitted to redeem a failure as per University regulations for final year students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Year 3 MEng : MEng students are only permitted to redeem a failure as per University regulations for YR3 - YR4 progressing students. If you are eligible for a resit examination this will take the form of a 100% supplementary examination.

Resit: Examination 100%
2.5-hour closed book exam to be completed in-person during the exam session. The formula sheet comprehensive of all the required graphs and numerical expressions is provided.

Additional Notes: Not available to visiting and exchange students.