University of Strathclyde Engineering

MSc Process Technology and Management (Distance Learning)

COURSE OVERVIEW AND MODULE DESCRIPTIONS

Department of Chemical and Process Engineering

Note: The module descriptions in this booklet are intended as a guide, to assist students in choosing their optional modules and applicants on whether the course content fits their needs. Please be aware that although the general content and aim of the modules will remain the same, there may be changes to some content and assessment as the lecturer will be continually updating and developing the class. Modules may also become unavailable from time to time, either through staff changes, or lack of demand. Students should read this in conjunction with the current course regulations and student handbook.

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Year 1 Semester 1

Opportunity to exchange for Year 2 Semester 1 classes dependent on previous learning. Please refer to module descriptions.

- CP917 Process Design Principles
- CP964 Process Analysis in Chemical Engineering

Year 1 Semester 2

Year 1 Semester 2 classes will alternate each year

- CP931 Understanding Financial Information
- CP933 Project Management
- CP959 Advanced Process Design

Year 2 Semester 1

Choose 3 subjects. All will run every year.

- CP918 Safety Management Practices
- CP919 Programming and Optimisation
- CP921 Emerging Technologies
- CP925 Petrochemical Engineering
- CP955 Molecular Simulation in Chemical Engineering
- CP950 Modern Process Measurements

Year 2 Semester 2

- CP932 Managing People
- CP934 Business and Technology Strategy
- CP9xx Industrial and Environmental Engineering

Year 3 – CP936 Project

Year 1 Semester 1 CP917 Process Design Principles

Educational Aim

The focus of this module is on the principles of conceptual design and flowsheet development, which often represent the most difficult and challenging aspects of process design. The first stage is to define “design” and the associated terminology, and to show how this can be applied to both equipment and process selection. The second stage is to develop an appreciation of the hierarchical and structural methods of developing conceptual designs including the effective design of utility systems to reduce energy use.

Learning Outcomes

LO1 carry out a systematic approach to design selection according to the chosen assessment criteria

LO2 undertake a structured approach to designing the reaction, separation and recycle aspects of a flow sheet

LO3 employ “Pinch Technology” methods to the overall targeting of hot and cold utility requirements and to heat exchanger capital costs, which would then involve the design of a simple heat exchanger network (HEN)

LO4 apply a methodical approach to “retrofit” designs as well as to "new" designs (including understanding of the special features of batch processes)

Syllabus

The module will teach the following: terminology of design; hierarchy of process design: block flow diagrams (BFDs), process flow diagrams (PFDs); input-output structures of flowsheets; choice of reactors and separators; reaction, separation and recycle systems; hot and cold utility systems; energy utilisation to minimise utility and overall capital costs; retrofit design; batch process design.

Brief Description of Assessment

Assignment 1 (15%):	allow the student to demonstrate the application of the fundamental principles of design firstly to a simple piece of process equipment.
Assignment 2 (15%):	allow the student to apply the principles of design either to a past, current of future process in which they have an involvement.
Exam (70%):	This contains two sections. Section A (Process Analysis) consists of a number of questions based on a particular industrial process description and flowsheet. Section B (Process Synthesis) consists of a number of questions based on a process description including a schematic.

Year 1 Semester 1 CP964 Process Analysis in Chemical Engineering

Educational Aim

This module aims to:

- consolidate and enhance the student ability to understand and manipulate information in flow diagrams and stream tables
- provide the conceptual framework for design principles in chemical engineering
- build a comprehensive background for unsteady state processes

Learning Outcomes

LO1 Justify and discuss information extracted from flow diagrams using ASPEN-Plus or equivalent professional engineering package, appraising process behaviour

LO2 Identify and justify critical process parameters predicting their impact on the overall process

LO3 Identify paths for process optimisation accounting for operational constraints

LO4 Application of unsteady state balances in chemical engineering interpreting the dynamic system response

Syllabus

- The integral use of ASPEN-Plus or an equivalent professional engineering package as a tool for the simulation and optimisation of processes
- The chemical engineering conceptual framework for analysing flow diagrams and identifying critical parameters based on material and energy balances
- Logical reasoning to deal with sudden changes in the operational conditions focusing on damage limitation in relation to product quantity and quality requirements
- Logic behind process optimisation and its importance as a tool in decision-making
- Unsteady state material and energy balances for chemical engineering units and their relevance in the understanding of the dynamic response of the system under consideration.

Brief Description of Assessment

60% coursework and 40% project.

Year 1 Semester 2 CP931 Understanding Financial Information

Educational Aim

This module aims to provide students with an appreciation of how companies managed and report financial information.

Learning Outcomes

LO1 Read and interpret the financial reports that are published by companies and understand the links between the cash flow, expenditure and the profit reported;

LO2 Be aware of the implications of budgets and budgeting in order to exercise control within the organisation and understand the issues involved in determining the cost of a product or service;

LO3 Be familiar with the techniques that are used in the decision making process in respect of both short-term and capital investment decisions

Syllabus

- The nature and form of a company's financial statements;
- The interpretation of financial reports;
- Budgets and budgeting;
- The behaviour of costs and the implications for short-term decisions;
- Calculating the cost of products and services and an understanding of the cost allocation problem;
- Project evaluation techniques

Brief Description of Assessment

Students will be asked to demonstrate their understanding and analysis company financial information and be show how to use standard industry methods to assess company viability.

They will be able to calculate the fixed and variable cost for a new product introduction and assess the return investment using a number of techniques.

Year 1 Semester 2

CP933 Project Management

Educational Aim

This module aims to provide students with skills relating to the use of engineering practices in Project Management with particular respect to the effective and efficient use of resources.

Learning Outcomes

LO1 Demonstrate practical skills so that they are able to outline the scope of managing projects and the importance of completing projects on time, to an agreed quality and cost without excess use of resources

LO2 Gain intellectual skills so that they are able to demonstrate understanding of project network methods and demonstrate familiarity with industry standard project planning software

LO3 Develop an understanding of the inter-dependency between project estimating and project control and cost management

LO4 Understand the basis of contract law, the different types of contract and when they are used.

Syllabus

Introduction to Project management techniques and project control. Basic aspects of project teams; project scope of work; network related management techniques; project features; project constraints and resources; quality assurance and document control. Project networks: definition of events; activities and nodes; precedence networks and "activity on node" method; analysis of critical path. Procedural and Graphical presentation techniques that are used as industry standard planning packages. Introduction to Contract Law: formation of contract; validity; terms of the contract; breach of contract; agency; company contracts. Project Budgetary control including cash flow, financial borrowing and investment

Brief Description of Assessment

Group project and individual essay submission

Year 1 Semester 2 **CP959 Advanced Process Design**

Educational Aim

The focus of this module is on the wider implications of process design.

1st Stage: how batch and semi-batch processes are represented and described, including special factors when compared with continuous processes, start-up and shut-down procedures in continuous processes.

2nd Stage: provide appreciation of the broader context or macro level in which process design takes place, and in particular looking at the conceptual phase which stakes cognisance of geography, stakeholders, politics, access to infrastructure, economic drivers, logistics, legislation etc., as some of the factors which influence the major process design decisions. The second stage will also provide a framework for how major projects are executed from conceptual to detailed design.

3rd Stage: define chemical product design (CPD) and show the similarities/differences between CPD and process design.

Learning Outcomes

LO1 show an understanding of the structured approach to the design of batch and semi-batch processes

LO2 recognise the importance of wider implications, such as geographical location and stakeholder roles

LO3 appreciate linkage of “key principles”: green engineering, ethics, professionalism and sustainability

LO4 demonstrate knowledge and apply the principles of chemical product design

Syllabus

The module will teach the following: terminology of batch and semi-batch processes; design procedures for batch and semi-batch processes; consider case studies in which the geographical location is a key design factor; energy utilisation in batch and semi-batch processes; role of process simulators in process design; importance of project life-span; distinction between “commodity” chemical and chemical product.

Brief Description of Assessment

Assignment 1(15%):	based on designing a batch process from a process description.
Assignment 2 (15%):	based on a case study where a plant is to be constructed in another country. The students will be divided into groups of five, and each group will take a particular role.
Exam (70%):	3 sections: A - a batch process design, and questions to consider how such a process might be improved. B - a case study and invite commentary on factors such as ethics, sustainability and green engineering. C - the four-step procedure for chemical product design.

Year 2 Semester 1 **CP918 Safety Management Practices**

Educational Aim

This module aims to provide an advanced level exposure to the role of management and management systems in Safety and Loss Prevention.

Learning Outcomes

LO1 understand the concept of audit of systems/process/operations
LO2 be able to carry out advanced hazard identification exercises
LO3 be able to produce a simple safety case for a process plant

Syllabus

- An examination of some major incidents which have occurred over recent years and the breaches of the management systems in each case are explored
- Introduction to the role of managers in Safety and the Environment and the meaning of Managing for Safety
- Review of the general structure of Safety Management Systems and a general approach to Auditing Safety Management
- How to develop a Site Emergency Plan and the skills needed to Investigate Accidents
- The role of Human Factors in the process and the concept of Inherently Safety/Less Environmental Harmful Design
- A review of the legal structure in Britain and of some of the Major Acts and Regulations.

Brief Description of Assessment

Exam will use an industrial case study containing two compulsory questions on “a typical process safety incident where they will be asked to demonstrate how the use of safety management systems and the use of lessons learnt from other major incidents could have prevented it arising

Year 2 Semester 1 **CP919 Programming and Optimisation**

Educational Aim

This module aims to provide students with a fundamental understanding of scientific programming and in particular its application to optimisation in engineering applications.

Learning Outcomes

LO1 Develop algorithms to solve optimisation tasks

LO2 Present working Excel spreadsheets tackling optimisation tasks in a form suitable for other engineers to use

LO3 Understand and apply stochastic optimisation methods to more challenging process engineering

(UK SPEC suggests no more than 4 learning outcomes per module. Statements must be broad and be syllabus free and link in with the intended learning outcomes on the programme specifications).

Syllabus

- Getting started with Excel 2007 and the Visual Basic Editor
- Fundamentals of programming: if, do loops, arrays etc
- Algorithm development
- House-keeping: communicating with spreadsheets
- Stochastic searches in one dimension
- Local versus global maxima
- Constraints
- Optimisation in higher dimensions
- Engineering applications

Brief Description of Assessment

Coursework

Year 2 Semester 1 CP921 Emerging Technologies

Educational Aim

This course is an introduction to key research areas in the interface between Chemical Engineering and Chemistry that are of industrial importance in the medium term. It will include a range of advanced technologies that underpin the innovation, design and development of processes that are more efficient, cleaner and have a reduced impact on the environment.

Learning Outcomes

LO1 demonstrate knowledge in specific technological areas;
LO2 have gained an overview of how scientific and engineering research can translate into new industrial enterprise

Syllabus

The course will cover the new technological research areas of

- Nanotechnology
- Fuel cell development and application
- Micro-reactor development and process intensification
- Hydrogen storage and the hydrogen economy
- Biocatalysts and bioprocessing
- Advanced polymer and composite development
- And/or other subjects, dependent on current department staff specialisms

The course will be presented by a mixture of academic staff and industrialists together with researchers who specialise in the appropriate area(s). The course content is expected to change from year to year as new areas gain or reduce in importance.

Brief Description of Assessment

Group Work which will ask students to review 3 new technologies, their uses and value to the development of chemical engineering processes and products.

Year 2 Semester 1 CP925 Petrochemical Engineering

Educational Aim

This module aims to:

- introduce to the students the concepts of origin and formation of petroleum, types and quality of refinery feedstock and products
- provide detailed understanding of various sections of petroleum processing in refineries
- introduce refinery economics and planning
- introduce advanced topics in petrochemical engineering such as catalyst development desulphurisation, pollution control and hydrogen production.

Learning Outcomes

LO1 Recognise the origins of crude oil, its properties and refinery products.
LO2 Have an in-depth knowledge of refinery operations including distillation, cracking and residue processing.
LO3 Have an understanding of the economic aspects and planning of refineries.
LO4 Apply the understanding of various aspects of the course to advance topics such as catalyst development and pollution control.

Syllabus

• Origin, formation, composition and properties of petroleum / crude oil and refinery products
• Overview of refinery operations
• Separations by atmospheric and vacuum distillation
• Through case studies, petroleum processing by catalytic and hydro-cracking, hydrotreating, thermal treatment, alkylation, polymerisation.
• Blending and lube oils
• Progress on catalysts in refinery,
• Desulphurisation of diesel,
• Refinery related pollution control
• Hydrogen production and supply

Brief Description of Assessment

Coursework and exam.

Year 2 Semester 1

CP955: Molecular Simulation in Chemical Engineering

Educational Aim

i) how chemical engineering processes operate at a molecular scale and how the molecular scale eventually determines what happens at the process scale,
ii) the usefulness of Molecular Simulation in a chemical engineering context,
iii) the theoretical framework that underlies molecular simulations, thermodynamics and most of chemeng, namely basic statistical mechanics,
iv) molecular simulation conventions
v) transferable skills useful for obtaining measurements from simulations, analysing data, and communication of technical data and ideas.

Learning Outcomes

LO1 Understand the connection between the molecular scale and the process scale and how particular chemical engineering processes operate at a molecular scale
LO2 Understand the importance of entropy in chemical engineering, and its role in statistical mechanics and thermodynamics
LO3 Understand how typical molecular simulations work
LO4 take measurements from molecular simulations, and analyse and report data and technical ideas in written and oral communications

Syllabus

i) Introduction to molecular simulations, including typical molecular simulation conventions, such as periodic boundary conditions, pair potentials, potential and kinetic energy, local 'microscopic' density, and equilibration.
ii) An introduction to molecular dynamics simulation including the 'Velocity Verlet' integration algorithm, simulation thermostats, set-up a MD- simulation.
iii) Molecular modelling, including; when to use classical models of molecules (as opposed to quantum simulations), typical force-fields used for simulating molecules.
iv) Fundamental concepts in statistical mechanics: microstates and the fundamental postulate of statistical mechanics, the definition of entropy and free energy, the Boltzmann weight, standard ensembles and ensemble averages, link and difference between statistical mechanics & thermodynamics, the Maxwell-Boltzmann velocity distribution, the equipartition theorem, and the virial theorem.
v) How to use Etomica molecular dynamics applets.
vi) Fundamental aspects relevant to the etomica applet applications, including thermodynamic aspects of adsorption, osmosis, interfacial tension and surfactant adsorption.
vii) Data analysis, especially analysis of time-series and statistical error, including; ensemble averages, standard deviation, block averages, correlation in data, standard error, propagation of error, linear regression
viii) The role of entropy in 'driving' chemical engineering processes

Brief Description of Assessment

3 written assignments & 1 oral presentation (all based on use of 'etomica' online molecular dynamics applets) which will assess all learning outcomes.

Year 2 Semester 1 **CP950 Modern Process Measurements**

Educational Aim

We aim to provide students with a thorough understanding of the operating principles and capabilities of a number of advanced instrumentation techniques and to allow them to make quantitative assessments about the suitability of these tools for particular industrial or research applications.

Learning Outcomes

LO1 Understand enough atomic and molecular spectroscopy to be able to grasp the principles of some modern optical measurement techniques

LO2 Understand the operating principles and capabilities of a number of advanced measurement techniques

Syllabus

- Capabilities of optical measurement techniques
- Basic concepts, units and definitions
- Types of optical transitions; Planck's Law of black-body radiation; rates of spontaneous emission; Boltzmann population distribution; basics of atomic and molecular spectroscopy
- Principles of laser operation: Basic features of a laser; description of different types of light sources available for process measurements including diode lasers and supercontinuum devices
- Optical absorption concentration measurements: Beer-Lambert Law; limit of detection; limit of quantification; shot-noise limit; Resolving instruments for broadband spectroscopy: (i) Grating spectrometer; (ii) Prism spectrometer; (iii) Fourier transform spectrometer; Sensitive absorption measurements including cavity ring-down spectroscopy; Example applications: gas concentration measurements in process plants; atmospheric gas concentration measurements
- Laser-induced fluorescence: Basic principles; advantages / disadvantages compared to absorption spectroscopy; quenching; saturation; collection solid angle; limitations on spectral resolution; rate equations for 2-level system; Example applications: flame temperature measurement by two-line atomic fluorescence; flame imaging; study of nanoparticle synthesis in flames and plasmas
- Microscopy: Geometrical optics; magnification; spatial resolution; confocal microscopy; fluorescence microscopy; two-photon microscopy
- Light scattering: Static light scattering; small-angle light scattering; dynamic light scattering; structure factor; application to fractal aggregates

Brief Description of Assessment

Final exam in January

Year 2 Semester 2

CP932 Managing People

Educational Aim

This module aims to provide students with how the key aspects of Human Resource Management functions are addressed in organisations.

Learning Outcomes

LO1 Understanding of modern organisation structures and the behaviour of people within them
LO2 Be able to apply human resource management policies
LO3 Understand how to develop personal skills in organising and leading people at work

Syllabus

- Understanding organisations
- Corporate and national culture, mission and business strategy
- Technological innovation and work design: constraints and possibilities.
- Employee motivation, job satisfaction and morale
- Organisational communication and group dynamics
- Power, politics, conflict and the management of change
- Industrial relations and employee involvement and participation
- Leadership and management

Brief Description of Assessment

Students will be asked to demonstrate their understanding of how human resources policies can provide effective manpower planning and human capital management. They will be able to demonstrate the dynamics of performance review systems, the effectiveness of appraisal systems and develop their own personal development plan.

Year 2 Semester 2

CP934 Business and Technology Strategy

Educational Aim

This module aims to provide students with an appreciation of how companies develop their business strategy and the role that technology development plays in that process.

Learning Outcomes

LO1 Gain an overview of the competitive environment and wider external environment

LO2 Understand how technology development has influenced company's strategy

LO3 Be able to carry out analysis of technology strategic development using international strategy models

Syllabus

- Organisation, missions/vision/objectives, strategy, environments.
- Analysing the environments.
- The organisation, value chain, organisational structure and culture.
- Assessment of strategic options.
- Planning
- Implementation, success or failure.
- Models & Theory school overview

Brief Description of Assessment

Students will use industrial case studies to demonstrate how the use of strategy management models can aid the analysis of the external environment when developing technological markets. They will use lessons that companies learn from successful market introduction of technically advanced products & processes in completing their own analysis of a chosen company relevant to the chemical engineering industry.

Year 2 Semester 2 CPxx Industrial and Environmental Engineering

Educational Aim

This module aims to give the industry based student an overview of a systems based approach to engineering including multidisciplinary approaches to problem solving, continuous improvement, sustainability, ethics and environmental considerations.

Learning Outcomes

LO1 Consider engineering problems from a systems perspective
LO2 Evaluate various problem solving and improvement strategies
LO2 Understand the complexities of issues relating to ethics and sustainability, and be able to justify and defend different ethical positions.
LO4 Understand and describe the main environmental and legislative issues relating to chemical and process engineering related industries

Syllabus

- Engineering in multidisciplinary contexts
- Consideration of engineering problems from a systems perspective
- Continuous improvement and problem solving methodologies
- Philosophical background to ethics
- Ethical issues and dilemmas and how they relate to engineering
- Sustainability
- Environmental engineering in the chemical and process industries
- Environmental legislation relevant to the chemical and process industries

Brief Description of Assessment

60% coursework and 40% projects.

Year 3 CP936 Project

Educational Aim

The module extends across the various advanced chemical engineering and business/management subjects taught during previous years to consider an advanced technical issue and a business case, within the students' industrial workplace. This is the final assessment of MSc and MEng programmes and is only taken by students in their final year of these degrees.

Learning Outcomes

LO1 demonstrate an ability to work across subject boundaries in response to specific technical problems

LO2 have a critical awareness of how to develop a research model and have an ability to apply analytical and modelling tools and techniques appropriately to a specific research problem

LO3 Be able to present a business case in support of proposals generated by research

Syllabus

The module will teach the following:

- The application of core and advanced chemical engineering principles within a research setting

Brief Description of Assessment

Draft Project Submission and Presentation (not assessed but are required milestones to continue. Final Project Submission.