Twinning Engineering Programmes(TEP)

(Thammasat University and the University of Nottingham)

Chemical Engineering

(Revision 2004)

Chemical engineering is an applied engineering field covering broad ranges of technical knowledge beginning from basic engineering subjects, chemistry and applied chemistry including specialized major subjects such as material & energy balance, momentum, heat and mass transfer, etc. It studies how to improve the product quality and production process for the benefits of the manufacturers and users.

The recent industrial development in Thailand urges a large demand for chemical engineers. They can pursue their professional careers in a wide range of industrial area such as petroleum and petrochemical industries, pharmaceutical and food industries, consumer products manufacturing, plastic and chemical industries, fiber & textile manufacturing, building materials production, etc. as well as in the research and academic fields.

* This curriculum may be revised if necessary.

Curriculum Outline

Overall credits : 149 credits

Curriculum Outline	Total credits		
	TU	NU*	TOTAL
Total credit requirements	89	60	149
1. General Courses	45	3	48
1.1 Part I : General Basic Courses required by Thammasat University			
- Humanities	3	0	3
- Social Sciences	3	0	3
- Languages	9	0	9
- General Sciences and Mathematics	6	0	6
1.2 Part II : Engineering Sciences and Mathematics	24	3	27
2. Engineering Courses	44	51	95
2.1 Core Courses	14	0	14
2.2 Major Courses			
2.2.1 Compulsory Courses	30	45	78
2.2.2 Elective Courses**	0	6	6
3. Free Electives ***	0	6	6

Notes: *The numbers of credits shown for the table represent the credits counted at Thammasat University. The parenthetical numbers represent the credits counted at the University of Nottingham where 10 credits equivalents to 3 credits at Thammasat University.

** Elective Courses at the University of Nottingham

*** Select any courses offered by the University of Nottingham

* This curriculum may be revised if necessary.

Details of Curriculum

At Thammasat

1. Part I: General Basic Courses required by Thammasat University 45 credits

1.1 Part I Total 21 credits

1.1.1 Humanities

TU 110 Integrated Humanities (3 credits)

1.1.2 Social Sciences

TU 120 Integrated Social Sciences (3 credits)

1.1.3 Languages totally 7 courses

1 compulsory Thai course :

TH 160 * or TH 161 (3 credits)

* for foreigners or anyone who receives a permission from the Department of Thai

6 compulsory English courses :

EL 171 English Course II (3 credits)

EL 172 English Course III (3 credits)

**EL 214 Communicative English I

**EL 215 Communicative English II

**EL 314 Communicative English III

** Credits are not counted.

1.1.4 General Sciences and Mathematics

TU 130 Integrated Sciences and Technology (3 credits)

CN 208 Introductory Computer Programming (3 credits)

1.2 Part II Total 24 credits

Engineering Sciences and Mathematics 24 credits

MA 111 Fundamentals of Calculus (3 credits)

MA 112 Analytic Geometry and Applied Calculus (3 credits)

MA 131 Applied Linear Algebra (3 credits)

MA 214 Differential Equation (3 credits)

SC 124 Chemistry for Engineers (3 credits)

SC 133 Physics for Engineers I (3 credits)

SC 134 Physics for Engineers II (3 credits)

SC 174 Chemistry for Engineers Laboratory (1 credit)

SC 183 Physics for Engineers Laboratory I (1 credit)

SC 184 Physics for Engineers Laboratory II (1 credit)

2. Part II : Engineering Course 44 credits

2.1 Core Courses 14 credits

Student must complete totally 14 credits of core course below.

IE 121 IE 261 CE 100 CE 101

CE 202 ME 111

* This curriculum may be revised if necessary.

2.2 Major Courses 30 credits

Students must complete totally 30 credits below.

AE 202	AE 204	AE 205	AE 213
AE 233	AE 284	AE 285	AE 334
AE 351	AE 371	LE 209	

At NU

Total credit requirements at NU 60 credits

1. General Basic Courses:	3 credits
1. Engineering Courses :	51 credits
2. Free Electives :	6 credits

Note:

Per Council of Engineers' academic requirement for Engineering professional license, students are allowed to repeat courses specified by the Council of Engineers' regulation if they receive letter grades below C.

Course Planning

Year 1

Semester 1

Course Number	Title	Credit (lecture-lab-self study)	Prerequisite
CE 100	Ethics for Engineers	0(0-0-0)	-
CE 101	Introduction to Engineering Profession	2(2-0-4)	-
MA 111	Fundamentals of Calculus	3(3-0-6)	-
ME 111	Engineering Graphics	3(2-3-2)	-
IE 121	Engineering Materials I	3(3-0-6)	-
SC 133	Physics for Engineers I	3(3-0-6)	-
SC 183	Physics for Engineers Laboratory I	1(0-3-0)	Used to study and study together with SC 133
EL 171	English Course II	3(3-0-6)	-
TU 130	Integrated Sciences and Technology	3(3-0-6)	-
	Total	21(19-6-36)	

Semester 2

Course Number	Title	Credit (lecture-lab-self study)	Prerequisite
TH 161 Or TH 160*	Thai Usage I Or Thai Usage	3(3-0-6) 3(3-0-6)	-
EL 172	English Course III	3(3-0-6)	EL 171
SC 124	Chemistry for Engineers	3(3-0-6)	-
SC 174	Chemistry for Engineers Laboratory	1(0-3-6)	-
MA 112	Analytic Geometry and Applied Calculus	3(3-0-6)	MA 111
MA 131	Applied Linear Algebra	3(3-0-6)	-
SC 134	Physics for Engineering II	3(3-0-6)	Used to study SC 133
SC 184	Physics for Engineers Laboratory II	1(0-3-0)	Used to study and study together with SC 134
	Total	20(18-6-42)	

* This curriculum may be revised if necessary.

Year 2

Semester 1

Course Number	Title	Credits (lecture – lab – self study)	Prerequisite
AE 204	Physical and Analytical Chemistry	4(4-0-8)	-
AE 284	Chemistry Laboratory for Chemical Engineers I	1(0-3-0)	-
CN 208	Introductory Computer Programming	3(2-3-4)	-
CE 202	Engineering Mechanics - Statics	3(3-0-6)	SC 133
MA 214	Differential Equation	3(3-0-6)	MA 112
TU 110	Integrated Humanities	3(3-0-6)	-
IE 261	Engineering Statistics	3(3-0-6)	-
EL 214	Communicative English I	0(0-4-2)	EL 172
	Total	20(21-10-28)	

Semester 2

Course Number	Title	Credits (lecture – lab – self study)	Prerequisite
AE 213	Chemical Engineering Thermodynamics I	3(3-0-6)	-
AE 202	Organic Chemistry	3(3-0-6)	-
AE 205	Material and Energy Balances	3(3-0-6)	-
AE 233	Fluid Mechanics for Chemical Engineering	3(3-0-6)	MA 214
AE 285	Chemical Laboratory for Chemical Engineer II	1(0-3-0)	AE 284
LE 209	Introduction to Electrical Engineering	3(2-3-4)	-
TU 120	Integrated Social Sciences	3(3-0-6)	-
EL 215	Communicative English Course II	0(0-4-2)	EL 214 (or can be taken in the same semester as EL 214 or with the instructor's permission
	Total	19(17-10-36)	

* This curriculum may be revised if necessary.

Year 3

Semester 1

Course	Title	Credits (lecture – lab – self study)	
AE 334	Mass Transfer	3(3-0-6)	AE 205, MA 214
AE 351	Heat Transfer	3(3-0-6)	AE 233
AE 371	Chemical Process Engineering and Industrial Trips	3(3-0-6)	-
EL 314	Communicative English III	0(0-3-3)	EL 215 (or can be taken in the same semester as EL 215 or with the instructor's permission
	Total	9(9-3-21)	

* This curriculum may be revised if necessary.

Courses at University of Nottingham (Semesters 6-9)

Code	Subject	Credit*
	6th Semester	
H82SP1	Separation Processes 1	10
H82BOB	Basis of Biotechnology	10
H82CSY	Computer Systems	10
XXXXXX	Department Elective (from Options)	10
		40
	7th Semester	
HGBMPN	Probabilistic and Numerical Techniques	10
H82CPE	Chemical and Phase Equilibria	10
H82PLD	Plant Design	10
H8BEMA	Engineering Management and Accounting	10
XXXXXX	Department Elective (from Options)	10
XXXXXX	Free Elective	10
		60
	8th Semester	
H83CEL or	Chemical Engineering Lab or	10
H83MLP	MEng Laboratory Project	10
H83RED	Reactor Design	10
J13SEN	Safety Engineering	10
H83MCS	Multicomponent Separations	10
H83DPB or	Design Project BEng* or	10
H83RDP	MEng R+D Project *	
		50
	9th Semester	
H83DPB or	Design Project BEng (20)* or	20
H83RDP	MEng R+D Project (20)*	
H83PDC	Process Dynamics and Control	10
J1CPRM	Project Management	10
XXXXXX	Free Elective	10
		50

*10 Credits at University of Nottingham = 3 Credits at Thammasat University

* This curriculum may be revised if necessary.

Department options

Code	Subject	Credit*
	Options	
H8BINC	Interfacial Chemistry*	10
H8BENP	Environmental Protection*	10
H84FTE	Fuel Technology	10
J1CWWT	Waste and Waste Water Treatment	10
J14WAM	Waste Minimisation	10
J1CPPE	Petroleum Engineering	10
H84APC	Advance Process Control	10
H8CPS1	Process Simulation 1	10
H8BMPE	Particle Mechanics	10

* Option for Thammasat degree but required for Nottingham degree

* This curriculum may be revised if necessary.

Chemical Engineering

Course Description

Course Description of the university's general program

EL 171 English Course II 3(3-0-6)

Prerequisite: -

This intermediate course aims to develop the four English skills-listening, speaking, reading and writing. Students are required to have more practice in listening comprehension, reading various printed materials and writing short paragraphs.

EL 172 English Course I 3(3-0-6)

Prerequisite: EL 171

This advanced course aims to develop student's English skills. Students are required to have more practice in listening to news and dialogues, reading more complex passages, and writing various types of paragraphs.

EL 214 Communicative English I 0(0-4-2)

Prerequisite : EL 172

This intermediate course aims to give practice in the four English skills-listening, speaking, reading, and writing-through various communicative tasks, such as class discussion and group works. Students will be able to communicate and participate in class more effectively with speakers of English.

- Speaking: Improving linguistic features such as minimal pairs, problem sounds in English, and intonation.
- Writing: Learning components of an academic essay such as introduction and conclusion.
- Listening: Learning problems in listening for Thai learners such as difficult sounds for Thai students to catch and obstacles to listening comprehension.
- Reading: Learning vocabulary and phrases in different topics. Learning reading strategies such as skimming, scanning and getting the main idea.

Grading criteria: S (Satisfactory) or U (Unsatisfactory)

EL 215 Communicative English II 0(0-4-2)

Prerequisite: Learn together with or passed EL 214 or permission from Instructor

This advanced course aims to extend the linguistic and skills of the students to a level that is adequate for full participation in undergraduate studies and communication with speakers of English. Students will have to use their four English skills-listening, speaking, reading and writing-to accomplish various communicative tasks and group works in class.

- Speaking: Learning academic skills such as basics in giving presentation, summarising, and organising a speech.
- Writing: Learning techniques to better comprehend a lecture such as guessing meaning from context, making inferences and getting the main idea.
- Reading: Learning reading strategies such as speed reading and scanning. Practice reading longer passages and doing comprehension exercises.

Grading criteria: S (Satisfactory) or U (Unsatisfactory)

* This curriculum may be revised if necessary.

EL 314 Communicative English III **0(0-3-3)**

Prerequisite: Learn together with or passed EL 215 or permission from Instructor

This course aims to further prepare the students with study skills necessary to successfully participate in class. Students will learn various study skills through assignments, such as making reports, giving presentation, and taking notes. They will also have practice in the four English skills-listening, speaking, reading and writing-through academic tasks such as:

- Speaking: Giving presentation, doing seminar, and discussing in groups.
- Writing: Writing academic reports and essays.
- Listening: Listening to lectures and taking notes.
- Reading: Reading long academic documents and summarising the main points.

Grading criteria*:* S (Satisfactory) or U (Unsatisfactory)

TH 160 Thai Usage **3(3-0-6)**

Prerequisite: -

Study Thai language about alphabet, the sound system, the words and meaning, the structure of sentences. Also, the skills of listening, reading, and writing Thai. Emphasis is placed on encouraging effective communication skills.

TH 161 Thai Usage I **3(3-0-6)**

Prerequisite: -

The aim of the theoretical part of the course is to lead into the more important sections, namely the practical ones, and these in turn are designed to promote skills in reading, listening, writing and speaking. All these skills will be achieved through emphasizing the depth of knowledge, ideas, reasoning and development of sound critical faculty. Students will be encouraged to read and criticize various types of writing from a broad perspective. The teaching method with regard to reading,
listening, writing and speaking will be based on the principle of integration, with special emphasis on reading and writing.

TU 110 Integrated Humanities **3(3-0-6)**

Prerequisite: -

To study different aspects of man from the beginning till now, such as beliefs, intellectual developments and creativities. And how to survive in this changeable world with the problems that we are facing in this globalization technomania society through concentration on one's inner self.

TU 120 Integrated Social Sciences **3(3-0-6)**

Prerequisite: -

A study of the origin of social sciences in the modern world, the separation of social science from science, the acceptance of scientific paradigm for the explanation of social phenomenon. Analysis of significant disciplines, concepts and theories in social science by pointing out their strengths and weaknesses when applied to social problems. Analysis of current issues with the application of social theories so that each issue is understood from the individual perspective, group perspective and macro - social, national and world perspectives.

TU 130 Integrated Sciences and Technology **3(3-0-6)**

Prerequisite: -

A study of scientific concept, theory and rule concerning inorganic particle from the planetary level to particle level, and to molecule and atom levels, the interaction between atom and molecule, chemical and inorganic chemical reaction relating to biological condition of living things and the evolution of life on the planet. The exploring of basic concepts in science and technology that are pertinent to modern day living, important debates concerning the relationship between science and technology and the environment and society and their distinctive features as separate fields of knowledge.

MA 111 Fundamentals of Calculus 3(3-0-6)

Prerequisite: -

Review of the elementary number system and functions; Calculus of one variable functions; limit; continuity; the derivative and its applications; antiderivatives; techniques of integrations and its applications; series; Taylor's Theorem and its applications.

MA 112 Analytic Geometry and Applied Calculus 3(3-0-6)

Prerequisite: MA 111

Analytic geometry for Conic sections; second degree equations; vectors transformation of coordinates; polar coordinates and functions of Several variables; partial derivatives; multiple Integrals. scalar fields and vector fields; derivative of vector valued functions; Integration in the vector fields; Gauss's Theorem; Green's Theorem and Stoke's Theorem; Fourier and Laplace analysis and theirs applications.

MA 131 Applied Linear Algebra 3(3-0-6)

Prerequisite: -

Theorems of matrices; Hermitian matrices and unitrary matrices; LU-fractorizations; vector spaces; linear independence; dimensions; rank of matrices; applications of matrices for solving systems of linear equations; inverse of matrices; determinant; Cramer's Rule; Linear Transformations; inner product spaces; orthogonal complement and least square; eigenvalues; eigenvectors and its applications; diagonalizations of matrices; fundamentals concepts of tensor.

MA 214 Differential Equation 3(3-0-6)

Prerequisite: MA 112

First-order differential equations; second-order differential equations; homogeneous linear differential equations; nonhomogeneous linear differential equations; differential equations of higher order; series solution of linear differential equations; partial differential equations; the Laplace transform and Fourier transform; introduction to nonlinear differential equations; applications engineering problem solving.

SC 124 Chemistry for Engineers 3(3-0-6)

Prerequisite: -

Atomic Structure, Chemical Bonds, Gases, Solids, Liquid and Solutions, Chemical Equilibrium, Acids and Bases, Organic Chemistry, The Periodic Table, Transition Elements, Electrochemistry, Chemical Kinetics and Environmental Chemistry.

SC 133 Physics for Engineers I 3(3-0-6)

Prerequisite: -

Motion in one, two and three dimensions, motion and gravitation, work and energy, collides, rotational motion, equilibrium of rigid bodies, elasticity, fluids mechanics, harmonic oscillation, wave motions, sound and wave and applications, heat and kinetics theory, the 1st law and the 2nd of thermodynamics.

SC 134 Physics for Engineers II **3(3-0-6)**

Prerequisite: Used to study SC 133

Electric charge and electric field, Gauss' law electric potential, capacitors and dielectrics, magnetic induction and Faraday's law of induction, inductor, AC circuits, electromagnetic theorem and application, optics (lens and optical equipment, reflection, refraction, interference, diffraction and polarization), modern physics.

SC 174 Chemistry for Engineers Laboratory **1(0-3-0)**

Prerequisite: -

Practical work in support of SC 124

SC 183 Physics for Engineers Laboratory I **1(0-3-0)**

Prerequisite: Used to study and study together with SC 133

Practical work in support of SC 133

SC 184 Physics for Engineers Laboratory II **1(0-3-0)**

Prerequisite: Used to study and study together with SC 134

Practical work in support of SC 134

Major Courses

AE 202 Organic Chemistry **3(3-0-6)**

Prerequisite: -

Bonding in organic molecules. Classes and nomenclature of organic compounds. Characteristic reactions of organic compounds. Reaction mechanism. Stereochemistry. Resonance. Nucleophilic additions and substitutions. Elimination reactions. Electrophilic additions and substitutions.

AE 204 Physical and Analytical Chemistry **4(4-0-8)**

Prerequisite: -

Quantum chemistry. Principles and uses in selected analytical instrument such as thermal analysis instrument, chromatograph, X-ray related instrument, and instrument with spectroscopic method.

AE 205 Material and Energy Balances **3(3-0-6)**

Prerequisite: -

Chemical and physical process calculations. Material and energy balances applied to chemical process systems. Determination of thermodynamic properties needed for such calculations. Sources of data. Calculation procedures. Introductory thermochemistry.

AE 213 Chemical Engineering Thermodynamics I **3(3-0-6)**

Prerequisite: -

* This curriculum may be revised if necessary.

The first law of thermodynamics in closed systems. Ideal gas behavior. Properties of pure substances. Equation of state for ideal and real gas. Application of the first law to open systems. The second law of thermodynamics. Entropy. Carnot cycle. Heating and cooling systems. Application of thermodynamic equations.

AE 233 Fluid Mechanics for Chemical Engineering **3(3-0-6)**

Prerequisite: MA214

Mass, momentum, and energy balances on finite and differential systems. Flow characteristics in pipes, and porous media. Navier-Stroke equation. Bernoulli equation. Boundary layers. Non-Newtonian flow. Sedimentation and filtration.

AE 284 Chemistry Laboratory for Chemical Engineers I **1(0-3-0)**

Prerequisite: -

Selected topics in gravimetric analysis, volumetric analysis (including acid-base, precipitation, and oxidation-reduction titrations), and qualitative analysis. Experiment with analytical equipment.

AE 285 Chemistry Laboratory for Chemical Engineers II **1(0-3-0)**

Prerequisite: AE 284

Selected topic in organic synthesis and separation of organic compounds using processes such as crystallization, extraction, and distillation. Selected topics in physical chemistry such as thermodynamics (including enthalpy, equilibrium, and electrochemistry) and kinetics.

AE 334 Mass Transfer **3(3-0-6)**

Prerequisite: AE 205, MA 214

Fick's law. Steady diffusion. Mass transfer coefficients. Mass transfer equipment. Simultaneous heat and mass transfer. Mass transfer with reaction. Absorption, adsorption, humidifier, cooling tower, dryer, evaporator, fluidization, and membrane separation.

AE 351 Heat Transfer **3(3-0-6)**

Prerequisite: AE 233

Theories and applications of heat and mass transport phenomena, emphasizing their analogies and contrasts. Fourier's law. Steady thermal conduction. Heat transfer from extended surfaces. Heat transfer coefficients. Condensation and boiling. Radiation and Convection. Heat exchangers.

AE 371 Chemical Process Engineering and Industrial Trips **3(3-0-6)**

Prerequisite: -

Topics including various kinds of chemical process, raw material, energy, types of unit operations. Plant safety and environmental implications in process. Site visit industries to gain perspective knowledge of chemical process.

<u>Thammasat University's engineering courses that offered by other department</u>

CE 100 Ethics for Engineers **0**

(Participate activities organized by the faculty)

Prerequisite : -

* This curriculum may be revised if necessary.

Ethical issues relevant to the engineering profession. Potential impact of technology transfers and implementation with respect to society and its members. Potential problems that may arise are studied along with possible ways to prevent them from occurring and ways to deal with them once they occur.

CE 101 Introduction to Engineering Profession 2(2-0-4)

Prerequisite : -

Engineering profession, Role and responsibility, Engineering fields, Curriculum and courses in engineering, Problem solving in engineering, Mathematical and scientific tools, Tests and experiments, Engineers and society and environment, Computers in engineering.

IE 121 Engineering Materials I 3(3-0-6)

Prerequisite: -

Properties and structure of engineering materials such as metal, alloy, ceramics, plastics, rubber, wood and concrete. Phase diagram. Materials characteristics. Materials properties testing. Relation of microstructure and macrostructure with material properties. Manufacturing processes of materials. Effects of heat treatment on microstructure and properties of material.

IE 261 Engineering Statistics 3(3-0-6)

Prerequisite: -

Presenting and analyzing data. Probability theory. Statistics distribution. Sampling theory. Estimation theory. statistical inference. Hypothesis testing. Analysis of variance. Regression and correlation. Using statistical methods as the tool in engineering problem solving.

ME 111 Engineering Graphics 3(2-3-4)

Prerequisite: -

The significance of drawing. Instruments and their uses. Lining and lettering. Work preparation. Applied Geometry. Dimensioning and description. Orthographic projection. Pictorial drawing. Freehand sketching. Sectioning. Allowance and tolerance. Computer aided drawing for 2-D and 3-D objects.

ME 241 Mechanics of Fluids I 3(3-0-6)

Prerequisite :

Properties of fluids. Fluid statics. Buoyancy. Momentum equation. Energy equation. Moment of momentum equation and its application to turbomachinery. Kinematics of incompressible and non-viscous fluid flow. Dimensional analysis and dynamic similitude. Incompressible and viscous fluid flow. Control volume. Fluid measurement. Compressible flow.

CN 208 Introductory Computer Programming 3(3-0-6)

Prerequisite :

An introductory level to computer programming, intended primarily for Non-CN and Non-EE students. Number systems. Introduction to computer organizations. Algorithms and flowcharts. Approaches for solving problems using a computer. Fundamental concepts of a programming language: data types, operators, variables, constants and expressions. Control structures: sequence, decision,repetition. Subprograms. Composite data structures.

LE 209 Introduction to Electrical Engineering 3(3-0-6)

Prerequisite :

Basic D.C. and A.C. circuit analysis; voltage: current and power, transformers; introduction to electrical machinery; generators; motors and their uses; concepts of three-phase system; method of power transmission; introduction to some basic electrical instruments.

Course Description at NU

6th Semester

H82SP1 Separation Processes 1 10 Credits

Prerequisites: Competence in material and energy balances. Basic knowledge of fluid mechanics and heat transfer.

Corequisites: None.

Summary of Content: This module establishes the principles of mass transfer separation processes, with binary distillation, humidification and water cooling and drying being studied in detail.

H82BOB Basis of Biotechnology 10 Credits

Prerequisites: No prior knowledge of biology is assumed but GCSE in Maths and either Chemistry of Science is essential.

Corequisites: None.

Summary of Content: This module is a largely descriptive `primer' in microbiology and biochemistry, intended for students who know nothing of these subjects. Needed by all process engineers to understand the environmental effects of pollutants, and essential background for those thinking of specialising in the food, water, alcohol, pharmaceutical and other bio-industries.

H82CSY Computer Systems 10 Credits

Prerequisites: Keyboard skills.

Corequisites: H82SP1

Summary of Content: This module forms an introduction to computational techniques and computing. Students will gain experience in computer programming, engineering databases and steady-state and dynamic process simulation. Students will complete a series of coursework assignments. (Subject to change the computer packages currently in use are: Hysys process simulating, Excel Visual Basic programming, Matlab/Simulink dynamic simulation).

7th Semester

HGBMPN Probabilistic and Numerical Techniques 10 Credits

Prerequisites: Competence in the techniques of differential and integral calculus of one and several variables and knowledge of analytic solutions of ordinary differential equations to a level such as provided through modules HG2M03 or HGBM13 or HGBM14.

Corequsisites: None.

* This curriculum may be revised if necessary.

Summary of Content: The module is divided into two sections:

- Numerical techniques for ordinary differential equations.
- Probability theory and Introduction to statistical inference.

Problems in engineering may be formulated in terms of ODEs that cannot be solved analytically. This module studies the use of approximate methods that can be used to obtain numerical solutions to ODEs. Situation where there is a degree of uncertainly associated with quantities of engineering importance need to be analysed and quantified using data values. In this module the mathematical formulation of such problems in terms of probability theory is developed and related statistical techniques to utilise data values are introduced.

H82CPE Chemical and Phase Equilibria **10 Credits**

Prerequisites: Differential and integral calculus, including partial derivatives. A grounding in basic physical chemistry. Most A-level chemistry syllabuses meet this. H8AETD (Engineering Thermodynamics)

Corequisites: None.

Summary of Content: An introduction to Chemical Thermodynamics and its applications to chemical, vapour/liquid, liquid/liquid and solid/liquid equilibria. Correlation and prediction of data.

H82PLD Plant Design **10 Credits**

Prerequisites: Fundamentals of fluid mechanics, heat transfer, mass transfer and their application to process plant. Knowledge of mass and energy balances applied to processes.

Corequisites: None.

Summary of Content: This module introduces the elements of cost estimation and simple economic design. Ideas of process development and simple heat exchanger synthesis techniques are presented. To illustrate detailed design, some examples of the conversion of a process design to an engineered plant are considered.

H8BEMA: Engineering Management and Accounting **10 Credits**

Prerequisite: Satisfactory completion of a first year undergraduate course or equivalent in Engineering or Science.

Corequisites: None.

Summary of Content: The module introduces students to the role of the manager in a production setting relevant to the process and minerals industries. Topics covered include: management functions and skills; management organisation structures; introduction to motivation and leadership; management control; basics of accounting related to Profit and Loss Accounts; Cash Accounts and Balance Sheets; introduction to variance analysis.

8th Semester

* This curriculum may be revised if necessary.

H83CEL Chemical Engineering Laboratory **OR** **10 Credits**

Prerequisites: Familiarity with engineering laboratory procedures and instruments. Safety awareness. Use of library for literature searching.

Corequisites: H82SP1, H81FLM, H81HMT

Summary of Content: Literature search on a particular piece of Chemical Engineering equipment. Experimental study on the behaviour of that equipment.

OR

H83MLP M.Eng Laboratory Project **10 Credits**

Description : An experimental study of two contrasting pieces of pilot plant equipment to answer questions involved in full - scale plant design.

H83RED Reactor Design **10 Credits**

Prerequisites: A knowledge of the kinetics of homogeneous and heterogeneous reactions. A familiarity with heat and mass balances. A knowledge of heat and mass transfer. Differential and Integral Calculus.

Corequisites: None.

Summary of Content: The application of chemical kinetics and mass and heat balances to the design of batch and elementary flow reactors, with an introduction to non-ideal flow and heterogeneous reactors.

J13SEN Safety Engineering **10 Credits**

Prerequisites: None

Corequisites: None.

Summary of Content: This module introduces students to the general subject of safety engineering> It will present basic theory in the following areas:

- accident causation/cost of accident
- human factors/ergonomics in safety engineering
- engineering design of safe systems (including systems analysis, fail-safe design and factors of safety)
- hazard identification
- risk analysis (both qualitative and quantitative)
- incident/disaster response
- accident investigation
- safety management (systems, training, auditing)

- safety performance measurement
- health and safety legislation (basic concepts)

The module will present a number of case studies of safety engineering. Students will carry out a number of exercises in safety engineering related to a variety of industrial situations.

H83MCS Multicomponent Separations **10 Credits**

Prerequisites: H82SP1 (Separation Processes 1)

Corequisites: None.

Summary of Content: Multicomponent separation processes. Principles of design and distillation and absorption columns (including computer applications). Newer, less common separation methods. Adsorption and membranes.

H83DPB Design Project BEng **10 Credits**

Prerequisites: Knowledge of chemical engineering principles (mass and heat balances, equipment specification and sizing) equivalent to having completed two years of an accredited degree course in chemical engineering.

Corequisites: None.

Summary of Content: This is a group design project involving the preparation of heat and mass balances and flowsheets for a particular process scheme and the detailed design of certain important plant items. A study of the control, operational, safety, environmental and economic aspects will be included.

H83RDP MEng: Research and Development Project **10 Credits**

Prerequisites: A good grounding in chemical engineering at undergraduate level equivalent to completing two years of study.

Corequisites: None.

Summary of Content: A group project involving teams of 2/3 students. The groups undertake a research/development project in some areas of process engineering, chemical technology or environmental engineering. Most projects will involve experimental work although a few may be solely computer based.

9th Semester

H83DPB Design Project BEng (20)* **20 Credits**

Prerequisites: Knowledge of chemical engineering principles (mass and heat balances, equipment specification and sizing) equivalent to having completed two years of an accredited degree course in chemical engineering.

Corequisites: None.

* This curriculum may be revised if necessary.

Summary of Content: This is a group design project involving the preparation of heat and mass balances and flowsheets for a particular process scheme and the detailed design of certain important plant items. A study of the control, operational, safety, environmental and economic aspects will be included.

H83RDP MEng: Research and Development Project (20)* 20 Credits

Prerequisites: A good grounding in chemical engineering at undergraduate level equivalent to completing two years of study.

Corequisites: None.

Summary of Content: A group project involving teams of 2/3 students. The groups undertake a research/development project in some areas of process engineering, chemical technology or environmental engineering. Most projects will involve experimental work although a few may be solely computer based.

H83PDC Process Dynamics and Control 10 Credits

Prerequisites: Process Principles: Mass and energy balances. Fluid mechanics and heat transfer. Unit operations. Mathematics: Solution of ordinary differential equations (Classical and numerical solutions, Laplace Transform), Taylor series, Newton-Raphson iterative method, complex numbers. Computing: use of PC spreadsheets and dynamic simulation (e.g. using Matlab/Simulink).

Corequisites: None.

Summary of Content: This module provides an appreciation of the dynamic behaviour of processes and single loop controllers, the features and constraints on choice of conventional process control instruments and equipment and a basis for process analysis and design using dynamic process models and dynamic simulation.

J1CPRM Project Management 10 Credits

Prerequisites: None.

Corequisites: None.

Summary of Content: The module examines the application of quantitative and qualitative techniques in the planning and control of engineering projects. The special key features that define a project are explained together with key features of its organisation within overall company management. It reviews project planning procedures and the assessment of the impact of a project on a company's financial and managerial performance. Financial management techniques are explained including the role of financial reporting procedures and techniques to assess competing project bids. Critical path analysis as a tool for project control is examined. The module will be illustrated by the use of examples from industry.

Options

H8BINC Interfacial Chemistry 10 Credits

Prerequisites: Each student will be expected to have a good general knowledge of Chemistry to A-level standard or equivalent.

Corequisites: None.

* This curriculum may be revised if necessary.

Summary of Content: Surface tension and other surface phenomena. Capillary rise and depression. Micelles and surfactants. Adsorption and isotherms. Qualitative and quantitative aspects of catalysts. Overview of batch and continuous systems with relation to heterogeneous reactions.

H8BENP Environmental Protection **10 Credits**

Prerequisites: Knowledge of material and energy balances and separation processes as provided in the first year of a Chemical Engineering degree course.

Corequisites: H8BPME

Summary of Content: The module provides an introduction to: pollution prevention and control in the process industries; dispersion in watercourses and into the atmosphere from tall stacks; physical, chemical and biological treatment of aqueous effluents; physical and chemical treatment of gaseous effluents; disposal of sludges and solid wastes; noise measurement and noise reduction.

H84FTE Fuel Technology **10 Credits**

Prerequisites:

H8AETD	Engineering Thermodynamics
H81HMT	Heat and Mass Transfer
H81PEF	Process Engineering Fundamentals
H8BENP	Environmental Protection

Corequisites: None.

Summary of Content: The following topics are covered: - Fossil fuels, occurrence, use and world-wide availability. - Power generation using fossil fuels, conventional and advanced technologies. - Current issues in power generation using fossil fuels: emission problems and reduction technologies; greenhouse effect and abatement; co-firing of fossil fuels and biomass; carbon dioxide capture and sequestration.

J1CWWT Waste and Waste Water Treatment **10 Credits**

Target Students: Available to all Undergraduate Environmental Engineering students. Also available to non-SChEME students and study abroad students. Available to JYA/Erasmus students.

Prerequisites: Completion of Part 1 Environmental Engineering or equivalent.

Corequisites: None.

Summary of Content: The module will highlight the methods of waste and waste water treatment by methods other than landfill. Legislation will form the background to the module and for solid wastes topics such as incineration and composting will be

covered in detail. The disposal of nuclear waste will be dealt with as a special topic. Waste water treatment, including sewage treatment will also be covered in the module. The module will highlight current methods for waste treatment and will concentrate on the design specification for integrated treatment plants. Throughout the cost and environmental benefits of different plant specifications will be emphasised. Laboratory exercises related to water treatment and associated site visits will form an integral part of this module.

J14WAM Waste Minimisation **10 credits**

Target Students: No restrictions Available to JYA/Erasmus students.

Prerequisites: First three years of a science or engineering degree, or equivalent.

Corequisites: None.

Summary of Content: This module is concerned with developing an understanding of waste minimisation which will allow one to get involved with the implementation and monitoring of an effective waste minimisation programme. The module will include:

- Background - definitions; directive waste; minimising waste saves money; pollution prevention rather than cure.
- Benefits - environmental benefits; reduced costs; risk reduction; public relations
- Legal aspects - definitions of waste; legislation. Environmental Protection Act, 1990; civil liability; European Union developments; proposed taxes and directives.
- Methodology - management commitment; setting goals; the assessment phase; technical and economic evaluation; auditing; feedback of information; re-evaluation.
- Waste assessment - sources and collection of data, etc
- Techniques - good operating and design practice, etc
- Making it happen - overcoming barriers; making a decision.
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J1CPEE Petroleum Engineering **10 credits**

Prerequisites:

H81FLM Fluid Mechanics

H8AETD Engineering Thermodynamics

Corequisites: None.

Summary of Content: This module will develop the principles, methods and evaluation of rock drilling methods, and the principles and computational skills in reservoir evaluation and production. Case studies will be used to develop computation skills in well design, control and completion.

* This curriculum may be revised if necessary.

H84APC Advanced Process Control **10 credits**

Prerequisites: Mathematics: matrix algebra (e.g., matrix inverse, rank, eigenvalues/eigenvectors). Computing: use of PC spreadsheets and dynamic simulation (e.g. using Matlab/Simulink).

Corequisites: None.

Summary of Content: Starting from a basic knowledge of process control, this module develops insight into both control loop dynamic response and specifying control systems for complete process plant. Introductions to modern control theory and to the techniques of on-line computer process control are also provided.

H8CPS1: Process Simulation 1 **10 credits**

Prerequisites: A background in chemical engineering principles as would be obtained from the first 4 semesters of a chemical engineering degree.

Corequisites: None.

Summary of Content: This module is about steady-state process simulation by computer. Students will use a commercial package in a design environment and will develop an understanding of the benefits and drawbacks of such tools. Students will complete a series of assignments in their own time.

H8BMPE: Particle Mechanics **10 Credits**

Prerequisites: Fundamental understanding of fluid flow and simple ordinary differential equations.

Corequisites: None.

Summary of Content: Flow of fluids through beds of particles; simultaneous flow of gas and liquid through packed columns; dynamics of a single particle; terminal velocity; solid/liquid separation processes; solid/gas separation processes; centrifugal separations; particle size analysis; particle size reduction; drops and bubbles; fluidisation; conveying.