COURSE MODULES

LEVEL1.1

Engineering Mathematics 1
Students will study mathematical subjects relevant to engineering applications. This module provides them with the necessary mathematical skills required in other engineering subjects. Topics include algebra, exponential and logarithmic functions, trigonometry, combination and permutation, plane analytical geometry, binomial expansion, determinants and matrices.

Introduction to Chemical & Biochemical Engineering
Students are introduced to basic chemical engineering concepts and applications, for example, units and dimensions, material balance calculations, reaction stoichiometry, reaction engineering, and fluid mechanics. Upon completion of this module, students will be able to undertake basic chemical engineering calculations. The module also provides hands-on practice of AutoCAD in engineering drafting to allow students to appreciate the use of computer software in the engineering field.

Organic & Biological Chemistry
This practical-oriented module is designed to give students an introduction to organic and biological chemistry. Students will be introduced to the chemistry of hydrocarbons, alcohols, amines, carboxylic acids and their derivatives. The structure, function and chemical reactions of carbohydrates, lipids, proteins, nucleic acids, enzymes and coenzymes are also covered.

LEVEL 1.2

Biomolecular Science
This module introduces students to cell biology, microorganisms and techniques in microbiology. Students will learn about cell structure, cell membrane, microbial growth and nutrition, cellular transport mechanisms, DNA replication, transcription and translation, mycology, virology and aseptic techniques.

Career & Professional Preparation I
This module is part of the Education and Career Guidance framework to provide students with the tools and resources necessary for their career and/ or further education. In this first module, students will undergo personal discovery and exploration of industry and career prospects. Students will learn how to plan and set achievable goals in preparation for their future. Students will also learn the importance of passion and professionalism, along with basic teamwork and interpersonal skills.

Engineering Mathematics 2
A continuation of the Engineering Mathematics 1 module, topics in this module include complex numbers, statistical techniques, differentiation, integration, further integration techniques and numerical methods for evaluating definite integrals. Emphasis is placed on their applications in solving engineering- related problems. A mathematical software package is also used to solve these problems.

Inorganic & Physical Chemistry
This module covers the principles of physical chemistry as well as the reactions and properties of inorganic compounds. Students will study the structure of matter, chemical bonding, chemical calculations, electrochemistry and redox reaction, chemical equilibria, ionic equilibria, chemical kinetics, thermochemistry, transition metal chemistry and chemistry of solutions, including acids and bases.

Thermodynamics
Students will study the fundamental concepts of thermodynamics and fluid mechanics. Topics include the first and second laws of thermodynamics, properties of liquids and vapours, non-flow processes and steady flow processes with steam and perfect gases. The concepts of pressure, pressure head, and pressure measurement will also be discussed.

COURSE CURRICULUM

Module Name	Credit Units
YEAR 1	
Level 1.1 (26.5 hours per week)	
Career & Professional Preparation I	1.5
Engineering Mathematics 1	6
Introduction to Chemical & Biochemical Engineering	5
Organic & Biological Chemistry	8
Innovation Toolkit ^	4
Sports & Wellness ^	2
Level 1.2 (27.5 hours per week)	
Biomolecular Science	4.5
Engineering Mathematics 2	6
Inorganic & Physical Chemistry	8
Thermodynamics	5
Critical Thinking and Communication ^	4

Notes:
^ For more details on Interdisciplinary Studies (IS) electives, please log on to www.np.edu.sg/is/

IS Modules
The School of Interdisciplinary Studies (IS) delivers a broad-based curriculum, which nurtures a new generation of professionals with multidisciplinary skills and an innovative and entrepreneurial spirit to meet the challenges of a knowledge economy. IS offers both prescribed modules and electives to challenge boundaries. Prescribed modules develop students' competencies in core areas such as Communication, Innovation and Enterprise, Culture and Communication, and Personal Mastery and Development, while elective modules provide insights into Arts and Humanities, Business, Design, and Science and Technology.

COURSE MODULES

LEVEL 2.1

Analytical Chemistry
This module teaches students some common separation and characterisation instruments and instrumental techniques used in the laboratory, as well as provide hands-on opportunity for them. These techniques include UV-visible spectrophotometry (UV-Vis), gas liquid chromatography (GLC), high performance liquid chromatography (HPLC) and Atomic Absorption Spectroscopy (AAS).

Biopharmaceutical Production
This module provides students with a working knowledge of all aspects of the manufacturing of biologics products. This module will cover various aspects of upstream and downstream manufacturing including media and buffer batching, cell banking, microbial and animal cell culture, bioreactor technology cell harvesting, chromatography, and fill and finish processes.

Career & Professional Preparation II
This module is part of the Education and Career Guidance framework to provide students with the tools and resources necessary for their further career and/or education. In this module, students will explore basic job search strategies,

practise writing effective resumes and cover letters, and learn interview skills. Students will also learn professional and intercultural communication skills to prepare them for a dynamic and diverse workplace.

Chemical Engineering Laboratory 2.1

This module integrates the practical aspects of Reaction Engineering and Transfer Processes - Fluid Flow modules. In addition, students will also explore basic electrical concepts for the determination of efficiency of common chemical engineering equipment, such as pumps and compressors.

Engineering Mathematics 3

Building upon the materials covered in the earlier two modules on engineering mathematics, this module provides students with an adequate knowledge of mathematics to solve problems encountered in their future work. Topics include vector algebra, first and second order differential equations and their applications, Laplace transform technique and its applications, and regression analysis. Students will also use a mathematical software package to solve these problems.

Reaction Engineering

Students will focus on reactor design principles. Topics include reactor kinetics, analysis of batch reactors, continuous stirred tank reactors and plug flow reactors. It also covers topics in material balance calculations as well as aspects of the design, construction and operation of chemical and biological reactors. Examples from the petrochemical, chemical, environmental and biotechnology industries are used to reinforce lecture materials.

Transfer Processes - Fluid Flow

Students are introduced to fluid dynamics in this module. Topics include energies of liquids in motion, flow in pipes, general principles of pumps and system characteristics compressors, and flow measurement.

LEVEL 2.2

Analysis of Chemical Engineering Processes

In this module, students will study the fundamental principles of flow diagram analysis, including both mass and energy balances, and the use of a process flow- sheeting package.

Chemical Engineering Laboratory 2.2

This module integrates the practical aspects of Environmental Technology and Transfer Processes - Heat and Mass modules.

Engineering Materials

In this module, students will study the properties of materials commonly used in industries and gain an understanding of the basic requirements to carry out the proper selection of materials. Topics include the classification of materials, properties of materials, metals, alloy and polymeric materials, corrosion and degradation of materials.

Environmental Technology

This module introduces students to environmental problems and their impact. Students will study the various methods, applications and equipment in solving and preventing environmental problems, specifically in the areas of air and water pollution, and the management of industrial wastes.

Occupational Health & Safety

This module gives students an understanding of biological, chemical and physical hazards, ergonomics, radiation, and management of dangerous and toxic goods. It also includes an overview of occupational health and safety legislation as part of a basic knowledge of industrial safety.

Transfer Processes - Heat & Mass

This module explores the mechanisms of heat transfer (conduction, convection and radiation), and introduces the importance of heat exchangers in chemical engineering processes. The fundamentals of mass transfer are also covered,

giving a deeper understanding of key chemical engineering processes such as evaporation and condensation, distillation, and other extraction and separation techniques.

COURSE CURRICULUM

Module Name	Credit Units
YEAR 2	
Level 2.1 (26 hours per week)	
Analytical Chemistry	3
Biopharmaceutical Production	5
Career and Professional Preparation II	2
Chemical Engineering Laboratory 2.1	3
Engineering Mathematics 3	4
Reaction Engineering	4
Transfer Processes – Fluid Flow	3
Interdisciplinary Studies (IS) elective ^	2
Level 2.2 (23.5 hours per week)	
Analysis of Chemical Engineering Processes	6.5
Chemical Engineering Laboratory 2.2	3
Engineering Materials	2
Environmental Technology	4
Occupational Health & Safety	2
Transfer Processes – Heat & Mass	4
Interdisciplinary Studies (IS) elective ^	2

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COURSE MODULES

LEVEL 3.1

GENERAL CHEMICAL ENGINEERING SPECIALISATION OPTION

Chemical Engineering Laboratories 3.1

This module integrates the practical aspects of Level 3.1 modules of Unit Operations, and Process Instrumentation & Control.

Industrial Chemical Processes

In this module, students will acquire a basic understanding of the chemical industry through comprehensive analyses of key chemical processes. The key manufacturing processes in the pharmaceutical industry are also covered. The module also highlights the importance and relevance of sustainability and green engineering in the chemical industry.

Petrochemical Technology

In this module, students are introduced to the petrochemical industry. Topics include an overview of the industry and its importance to Singapore and the region, its key products, raw materials, intermediate and product flows, economics of petrochemical processing and key petrochemical processes.

Process Engineering Design

Students will deal with process flow sheets, piping and instrumentation diagrams, process and mechanical design of equipment, cost and evaluation of projects, materials of construction, safety and loss prevention. A practical design project is used to reinforce theory.

Process Instrumentation & Control

This module gives students a broad introduction to the principles and applications of instruments in process industries such as instrumentation for temperature, flow, level and pressure measurements. Other topics include the fundamental concepts of feedback control, system dynamics and stability, PID control modes, controller tuning, multivariable control strategies, control valve sizing, and an introduction to digital control techniques and computer control of chemical processes.

Unit Operations

This module focuses on solvent extraction, crystallisation, drying, evaporation, distillation, digestion, absorption, adsorption and material handling as applied to unit operations in various sectors such as the petroleum, petrochemical, chemical and pharmaceutical industries.

GENERAL CHEMICAL ENGINEERING SPECIALISATION OPTION

Biopharmaceutical Quality Control

This module will introduce the functions of a quality control entity in a pharmaceutical and biopharmaceutical manufacturing facility, as well as the various raw material, in-process, product and stability testing methodologies and specifications.

Current Good Manufacturing Practice

Students will cover the US Food and Drug Administration's current Good Manufacturing Practice (GMP) regulations for pharmaceutical and related products. Various aspects, such as attributes of materials, labelling, materials in process, finished pharmaceuticals, manufacturing validation, quality control, personnel and facilities are covered.

Pharmaceutical Engineering Laboratories

This module integrates the practical aspects of Level 3.1 modules of Unit Operations, and Process Instrumentation & Control.

Process Engineering Design

Students will deal with process flow sheets, piping and instrumentation diagrams, process and mechanical design of equipment, cost and evaluation of projects, materials of construction, safety and loss prevention. A practical design project is used to reinforce theory.

Process Instrumentation & Control

This module gives students a broad introduction to the principles and applications of instruments in process industries such as instrumentation for temperature, level and pressure measurements. Other topics include the fundamental concepts of feedback control, system dynamics and stability, PID control modes, controller tuning, multivariable control strategies, control valve sizing, and an introduction to digital control techniques and computer control of chemical processes.

Unit Operations for Pharmaceutical Processes
This module covers topics such as solvent extraction, crystallisation, drying, evaporation, distillation, digestion, absorption, adsorption and material handling as applied to unit operations in various sectors such as the petroleum, petrochemical, chemical and pharmaceutical industries.

LEVEL 3.2

INDUSTRY TRACK
Industrial Internship
Students will do an internship and project which will give them opportunities to apply the knowledge acquired in classrooms to real-world work situations. They will be attached to companies in various industries such as the petrochemicals, specialty chemicals, and pharma- or biopharmaceutical sectors.

RESEARCH TRACK
Research Internship
Students will be introduced to basic research skills, which include literature review, laboratory safety, project management, and statistical analysis of laboratory data, followed by opportunities to undertake a scientific research project. The projects will be carried out in- house or at external research institutions, which include overseas institutions.

COURSE CURRICULUM

Module Name	Credit Units
YEAR 3	
Level 3.1 (28 hours per week)	
GENERAL CHEMICAL ENGINEERING SPECIALISATION OPTION	
Industrial Chemical Processes	1.5
Petrochemical Technology	1.5
Process Engineering Design	8
Process Instrumentation & Control	5
Unit Operations	5
Interdisciplinary Studies (IS) elective ^	2
World Issues: A Singapore Perspective ^	2
PHARMA & BIOPHARMACEUTICAL SPECIALISATION OPTION	
Biopharmaceutical Quality Control	1.5
Current Good Manufacturing Practice	1.5
Pharmaceutical Engineering Laboratories	3
Process Engineering Design	8
Process Instrumentation & Control	5
Unit Operations for Pharmaceutical Processes	5
Interdisciplinary Studies (IS) elective ^	2
World Issues: A Singapore Perspective ^	2
Level 3.2 (23.5 hours per week)	
INDUSTRY TRACK	
Industrial Internship	22

RESEARCH TRACK	
Research Internship	22

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