

B.Eng. (Chemical and Biomolecular Engineering) **Description of courses**

Year 1 courses

CH1002 Physics for Engineers (4 AU)

Electricity and magnetism. Geometrical and physical optics. Modern physics, covering photons, electrons and atoms, quantum mechanics and nuclear structure.

CH1004 Materials & Energy Balances (3 AU)

Unit conversion and process variables. Materials balances. Material balance for single and multi-component systems. Energy balances. Energy balance on reactive/Transient processes. Computer-aided balance calculations.

CH1005 Materials Science (3 AU)

Bonding between atoms. Building blocks of materials. Crystal defects and diffusion. Structural properties of materials. Functional properties of materials. Phases and microstructures. Applications to chemical engineering industries.

CH1006 Mathematics for Engineers A (3 AU)

First order differential equations. Second order differential equations. Sequences and series. Laplace transforms. Linear algebra. Matrix algebra. Partial differentiation.

CH1007 Mathematics for Engineers B (3 AU)

Partial differentiation. Multiple integrals. Vector integral calculus. Fourier series, integrals and transforms. Partial differential equations.

CH1011 Introduction to Programming (1 AU)

Self-learning course. Arithmetic operations. Logical operators and functions. Graphics. Arrays and matrices. Input and output. Modular and structured programming.

CH1020 Physical Chemistry (2 AU)

Equilibrium and non-equilibrium states. First law, second law, kinetics theory of gases. Molecular distributions. Active and passive transport. Reaction rates and mechanisms. Molecular spectroscopy. Measurement of kinetics.

CH1031 Biomolecular Engineering I (4 AU)

Molecular basis of living systems. Biophysics of proteins. Principles of metabolic engineering. Cellular systems and dynamics. Genetics basis of cellular systems.

CH2002 Organic Chemistry & Spectrophotometry (4 AU)

Intermediate organic chemistry course. Basic reactions of organic functional groups including alkenes, alkynes, alkyl halides, alcohols, ethers, amines, carbonyl groups and aromatic groups. Stereochemistry and spectroscopy.

CH2008 Thermodynamics (3 AU)

Thermodynamic properties and some basic concepts. Volumetric properties of pure fluids. First law of thermodynamics and its application in some common processes. 2nd law of thermodynamics and concepts of entropy. Third law of thermodynamics. Applications of thermodynamics in flow systems. Thermodynamic property relations for systems of constant compositions. Thermodynamic property relations for systems of variable compositions.

CH1701 Chemical & Biomolecular Engineering Laboratory 1 (1 AU)

The laboratory course aims to provide practical demonstrations and applications to reinforce theories and concepts taught in Biomolecular Engineering, Physical Chemistry, Physics and etc.

CH1702 Chemical & Biomolecular Engineering Laboratory 2 (1 AU)

This laboratory course provides practical demonstrations and applications in Physical Chemistry, Materials & Energy Balances, Biomolecular Engineering, and etc.

HW110 Effective Communication (2 AU)

The communication process. Intrapersonal and interpersonal communication. Oral and written communication.

Year 2 courses

CH2003 Fluid Systems (4 AU)

Macroscopic and microscopic fluid mechanics with emphasis on applications in chemical engineering and polymer processes. Mass, energy, and momentum balances. Fluid friction in pipes. Flow in chemical engineering equipment. Differential equations of fluid mechanics. Solution of viscous-flow problems. Laplace's equation for irrotational and porous medium flows. Boundary-layer and other nearly unidirectional flows. Turbulent flow. two-phase flow, and fluidization. Non-Newtonian fluids.

CH2004 Heat & Mass Transfer in Chemical & Biological Systems (4 AU)

Theories and applications of heat and mass transport phenomena, emphasizing their analogies and contrasts. Fourier's law. Steady and unsteady thermal conduction. Heat transfer coefficients. Heat exchangers. Condensation and boiling. Radiation, Kirchoff's law and view factors. Fick's law. Steady and unsteady diffusion. Mass transfer coefficients. Absorbers. Simultaneous heat and mass transfer.

CH2005 Biomolecular Engineering II (3 AU)

Biophysical basis of life. Metabolic pathway analysis: carbohydrate. Metabolism and catabolism. Biochemical signal transduction. Biochemical signal transduction on extracellular matrix. Biochemical system engineering.

CH2007 Computational Methods in Chemical Engineering (3 AU)

Use of numerical methods to solve problems in science and engineering, with emphasis on chemical engineering and biological systems. Linear and non-linear algebraic equations. Optimization. Least-squares regression and interpolation. Numerical differentiation and integration. Numerical solutions of ordinary differential equations (ODE).

CH2040 Chemical Engineering Unit Operations I (4 AU)

General principles & fundamental theories of separation by equilibrium and rate processes. Applications to evaporation, distillation, absorption, adsorption, extraction, leaching, etc.

CH3002 Chemical Reaction Engineering (4 AU)

Reaction rates and batch reactor. Continuous isothermal reactors - Single reaction. Continuous isothermal reactors - Multiple reactions. Nonisothermal reactors. Multiple steady states and transients. Mass transfer and catalytic reactor. Examples in chemical and biological processing. Nonideal reactors, bioreactors, environmental modeling. Reactions of solids. Chain reactions, combustion reactors and safety. Polymerization reactions and reactors. Multiphase reactors.

CH3003 Chemical Thermodynamics (3 AU)

Review of basic laws of thermodynamics and other concepts. Fundamental thermodynamic properties relations. Gibbs-Duhem equations and their applications. Molar and partial molar properties. Partial fugacity and fugacity coefficients in gaseous mixtures. The ideal solution and property change on mixing. Real gas mixtures. Fugacity and activity coefficient in liquid mixture. Excess properties and activity coefficients. Models of activity coefficients. Application of thermodynamics to physical processes. Application of thermodynamics to chemical and biochemical processes.

CH2701 Chemical & Biomolecular Engineering Laboratory 3 (2 AU)

This laboratory course aims to provide practical demonstrations and applications to reinforce theories and concepts taught in Organic Chemistry, Thermodynamics, Biomolecular Engineering II and Fluid Systems.

CH2702 Chemical & Biomolecular Engineering Laboratory 4 (2 AU)

This laboratory course aims to provide practical demonstrations and applications in Heat & Mass Transfer, Unit Operations, Biomolecular Engineering and etc.

HW210 Technical Communication (2 AU)

Principles of technical communication. Conveying technical information in writing and orally. Types of technical reports. Technical writing style.

Year 3 courses

CH1032 Biochemical Engineering (4 AU)

Principles of genetically engineered organisms. Genetic engineering techniques. Protein engineering. Enzyme kinetics and engineering. Microbial growth modeling and bioreactor. Protein design and optimization.

CH3001 Chemical & Biomedical Process Control & Dynamics (4 AU)

Modeling for control-input-output models. The transfer function. Stability analysis. Dynamic performance. Frequency response. Basic elements of feedback control. Stability analysis of closed-loop systems. Feedback control design. Multivariable systems – special cases.

CH3041 Chemical Engineering Unit Operations II (3 AU)

General principles of separation, particle technology and their applications. Crystallization, membrane processes, filtration and particle/colloid technologies. Recovery of products from pharma- & bio- processes.

CH4901 Engineers & Society (3 AU)

Evolution of modern Singapore. Technology and society. Ethics and professionalism. The environment.

CH3702 Chemical & Biomolecular Engineering Laboratory 5 (3 AU)

This laboratory course aims to provide practical demonstrations and applications to reinforce theories and concepts taught in Thermodynamics, Heat & Mass Transfer, Transport Processes, Chemical Reaction Engineering and Chemical Engineering Unit Operation.

HW310 Professional Communication (2 AU)

Interpersonal communication in professional settings. Intercultural communication. Negotiating skills. Job search skills. Professional oral presentations. Working effectively in a team.

Year 4 courses

CH3010 Modeling Chemical & Biological Systems (3 AU)

Process modeling principles. Conservation laws and constitutive relations. Dynamic lumped parameter systems. Approximation of dynamic models: linearization. Laplace transforms. Development of empirical models. Software issues.

CH4001 Chemical, Biological & Plant Safety (3 AU)

Toxicology. Toxicants release. Control and response from biological organisms. Industrial hygiene. Fire, explosion and prevention. Relief and design. Risk assessment and investigation. Case studies.

CH4701 Final Year Design Project (10 AU)

This is the capstone course which utilizes the fundamentals of chemical engineering (materials balances, energy balances, transport phenomena, thermodynamics, kinetics, separations, unit operations and safety) in the design and operation of chemical plants.

CH4902 Human Resource Management (3 AU)

Strategic human resource management. Human resource planning. Job analysis, job design and quality of work life. Recruiting human resource. Employee selection. Appraising and managing performance. Human resource development / career planning and development. Employee compensation and benefits. Industrial relations. Employee health and safety. International human resource management.