BRANCH CAMPUS
MALAYSIAN INSTITUTE OF CHEMICAL AND
BIOENGINEERING TECHNOLOGY
(MICET)

PROGRAMME HANDBOOK

BACHELOR OF CHEMICAL ENGINEERING WITH HONOURS

CHEMICAL ENGINEERING SECTION

FOR INTAKE SEPTEMBER 2020

BACHELOR OF CHEMICAL ENGINEERING WITH HONOURS

Programme Educational Objectives:

After 3 – 5 years of graduation, the graduates are expected to become Chemical Engineers who are:

1. Competent to contribute towards the human capital in the national strategic industries.
2. Effective leaders with good communication and teamwork skills.
3. Able to advance themselves in industry or academia.
4. Practising professionalism with ethical, social and environmental responsibilities.
5. Capable of embarking on business and technopreneurial activities.

Programme Learning Outcomes:

1. **Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and chemical engineering to the solution of complex chemical engineering problems;
2. **Problem Analysis:** Identify, formulate, research literature and analyse complex chemical engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences;
3. **Design / Development of Solutions:** Design solutions for complex chemical engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations;
4. **Investigation:** Conduct investigation into complex problems using research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions;
5. **Modern Tool Usage:** Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex chemical engineering activities, with an understanding of limitations;
6. **The Engineer and Society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice;
7. **Environment and Sustainability:** Evaluate the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development;
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice;

9. **Communication:** Communicate effectively on complex chemical engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions;
10. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings;
11. **Life Long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change;
12. **Project Management and Finance:** Demonstrate knowledge and understanding of chemical engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Programme Structure:

Semester 1		
Code	Course Title	SLT Credit
CCB 10003	Mathematics for Engineers 1	3
CCB 10103	Analytical and Organic Chemistry	3
CCB 10201	Engineering Practice and Professionalism	1
CCB 10603	Fluid Mechanics	3
WEB 10302	Fundamental English	2
WEB 20202	Professional English 1	2
MPU 3123 / MPU 3143	Tamadun Islam dan Tamadun Asia / Bahasa Melayu Komunikasi 2	3
	Total SLT Credits:	17

Semester 2		
Code	Course Title	SLT Credit
CCB 10303	Physical Chemistry	3
CCB 10402	Chemical Engineering Laboratory 1	2
CCB 10702	Material Balance	2
CCB 11003	Mathematics for Engineers 2	3
CCB 21102	Fundamentals of Electrical and Electronics Engineering	2
MPU 3113 / MPU 3173	Hubungan Etnik / Pengajian Malaysia 3	3
MPU 34*2	Co-curriculum 2	2
	Total SLT Credits:	17

Semester 3		
Code	Course Title	SLT Credit
CCB 20003	Computer Programming for Engineers	3
CCB 20102	Introduction to Biochemical Engineering	2
CCB 20303	Process Heat Transfer	3
CCB 20702	Engineering Drawing	2
CCB 20803	Thermodynamics	3
CCB 21002	Energy Balance	2
	Foreign Language 1	1
	Total SLT Credits:	16

Semester 4		
Code	Course Title	SLT Credit
CCB 20202	Mass Transfer	2
CCB 20602	Reaction Engineering 1	2
CCB 21203	Statistics for Engineers	3
CCB 21302	Chemical Engineering Laboratory 2	2
CCB 21402	Materials Engineering	2
CCB 30003	Momentum Transfer	3
MPU 3333 / MPU 3343	Isu-isu Kontemporari Muslim di Malaysia / Culture and Lifestyle in Malaysia	3
	Total SLT Credits:	17

Semester 5		
Code	Course Title	SLT Credit
CCB 30103	Industrial Safety and Health	3
CCB 30403	Numerical Methods in Chemical Engineering	3
CCB 30502	Separation Processes 1	2
CCB 31403	Introduction to Environmental Engineering	3
CCB 31602	Reaction Engineering 2	2
WBB 20103 / MPU 3213	Technopreneurship / Bahasa Kebangsaan A	3
	Foreign Language 2	1
	Total SLT Credits:	17

Semester 6		
Code	Course Title	SLT Credit
CCB 30803	Process Control and Instrumentation	3
CCB 30903	Process Design and Economics	3
CCB 31102	Chemical Engineering Laboratory 3	2
CCB 31202	Separation Processes 2	2
CCB 31302	Particle Technology	2
CCB 31502	Process Analysis and Simulation	2
WEB 20302	Professional English 2	2
	Total SLT Credits:	16

Inter Semester (Between Semester 6 and 7)		
Code	Course Title	SLT Credit
CCB 49705	Industrial Training	5
	Total SLT Credits:	5

Semester 7		
Code	Course Title	SLT Credit
CCB 40003	Plant Design and Management System	3
CCB 40103	Design Project 1	3
CCB 40203	Renewable and Sustainable Energy Engineering	3
CCB 40402	Management and Marketing for Chemical Engineers	2
CCB 40602	Engineers in Society	2
CCB 49802	Engineering Final Year Project 1	2
CCB 4**02	Elective 1	2
	Total SLT Credits:	17

Semester 8		
Code	Course Title	SLT Credit
CCB 40304	Design Project 2	4
CCB 49904	Engineering Final Year Project 2	4
CCB 4**02	Elective 2	2
CCB 4**02	Elective 3	2
MPU 3242	Innovation Management	2
	Total SLT Credits:	14
	TOTAL CREDIT TO GRADUATE (TCG):	**136**

Electives (Process)		
Code	Course Title	SLT Credit
CCB 40502	Plant Utilities and Maintenance	2
CCB 41302	Petrochemicals and Petroleum Refining Technology	2
CCB 41402	Quality Assurance and Quality Control in Chemical Engineering	2

Electives (Environment)		
Code	Course Title	SLT Credit
CCB 40702	Solid and Hazardous Waste Management	2
CCB 40802	Air Pollution Control	2
CCB 40902	Wastewater Treatment Engineering	2

MPU Courses:

MPU Code	Course Code	Course Title	Note	SLT Credit
U1	MPU 3113	Hubungan Etnik	Local students	3
	MPU 3123	Tamadun Islam dan Tamadun Asia (TITAS)	Local students	3
	MPU 3143	Bahasa Melayu Komunikasi 2	International students	3
	MPU 3173	Pengajian Malaysia 3	International students	3
U2	MPU 3213	Bahasa Kebangsaan A ** If without a credit in Bahasa Melayu at SPM level or have not taken and passed Bahasa Kebangsaan A in previous level*	Local students	3
	MPU 3242	Innovation Management	All	2
U3	MPU 3333	Isu-isu Kontemporari Muslim di Malaysia	Local Muslim students	3
	MPU 3343	Culture and Lifestyle in Malaysia	Local Non-Muslim & International Students	3
U4	MPU 3412	Career Guidance 2	All (choose 1)	2
	MPU 3422	Community Service 2		
	MPU 3432	Culture 2		
	MPU 3442	Rakan Masjid 2		
	MPU 3452	Siswa-siswi Bomba dan Penyelamat 2		
	MPU 3462	Kor Siswa-siswi Pertahanan Awam 2		
	MPU 3472	Sports Management 2		
	MPU 3482	Personal Financial Management 2		
	MPU 3492	Askar Wataniah		

Conditions for Passing a Technical Course:

1. A student will pass a technical course in the Bachelor of Chemical Engineering with Honours if the student attains a minimum of 30% of the allocated marks in his final examination.

2. The student shall be awarded grade F if:

   2.1. he fails to fulfill the condition in 1 regardless of his attainment in his coursework, or
   2.2. he attempts only the final examination but does not have any coursework marks.

SUMMARY OF TECHNICAL COURSES

SEMESTER 1

Course Title	**Mathematics for Engineers 1**		Semester	1
Course Code	**CCB 10003**		SLT Credit	3
Pre-requisites	Nil			
Assessment Methods	Coursework	40 %	Final Examination	60 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Solve the systems of linear equations by using linear algebra method. (C3) 2. Apply the concept of complex numbers to convert the complex numbers in various forms. (C3) 3. Evaluate the scalar and vector products in engineering application. (C5) 4. Apply the rules of derivative in differentiating various functions and partial derivatives. (C3) 5. Apply appropriate methods in integrating various functions and multiple integral. (C3)			
Synopsis	This module offers a fundamental study of linear algebra: solving system of equations by using matrix methods such as Cramer's Rule, Gauss Elimination Method, Gauss Jordan Elimination Method and inverse matrix, as well as evaluating the eigenvalues and eigenvectors. A recall on Complex Numbers is provided as a pre-requisite to convert complex numbers in various forms. The concept of vectors and its properties which are related to the students' field are also provided. This course also provides the fundamental of multi-variable functions involving partial derivatives and multiple integrals.			
References	1. Stroud, K.A. and Dexter, J. (2013). Engineering Mathematics. (7th Ed). New York: Palgrave Macmillan.			

Course Title	**Analytical and Organic Chemistry**		Semester	1
Course Code	**CCB 10103**		SLT Credit	3
Pre-requisites	Nil			
Assessment Methods	Coursework	40 %	Final Examination	60 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Explain the principle, operation and industrial applications of analytical equipment. (C2) 2. Determine various functional groups and compounds in organic chemistry. (C4) 3. Propose reactions and mechanisms of organic compounds. (C4)			
Synopsis	This course provides students with an introduction into organic chemistry and the role of analytical techniques and tools used. The topics include the theory and applications of various analytical tools such as liquid chromatography, gas chromatography, infra-red spectroscopy and atomic absorption spectroscopy**.**			
References	1. Carey, F.A., Guiliano, R. (2013). *Organic Chemistry, 9th Edition*. McGraw-Hill. 2. Kellner, R., Widmer, H.M. (2004). Analytical Chemistry: A Modern Approach to Analytical Science. Willey VCH.			

Course Title	**Engineering Practice and Professionalism**		Semester	1
Course Code	**CCB 10201**		SLT Credit	1
Pre-requisites	Nil			
Assessment Methods	Coursework	100 %	Final Examination	0 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Explain ethics and responsibilities of an engineer. (A3) 2. Apply professional engineering practices in societal issues. (C3) 3. Demonstrate leadership and teamworking skills. (A3) 4. Discuss issues effectively in oral discussion and written report. (P2)			
Synopsis	The topics that will be covered in this course are introduction to the engineering profession, including different engineering fields, professional societies, engineering ethics and			

	responsibilities; engineering method and problem solving; critical thinking; leadership and team working; introductory error analysis and statistics; life-long learning skills; word processing, spread sheeting and graph plotting skills; oral presentations and technical report writing skills.
References	1. Baine. C. (2015). *Is there and Engineer Inside You?: A Comprehensive Guide to Career Decision in Engineering. (5th Ed.)* Bomany Publishing.

Course Title	**Fluid Mechanics**		Semester	1
Course Code	**CCB 10603**		SLT Credit	3
Pre-requisites	Nil			
Assessment Methods	Coursework	40 %	Final Examination	60 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Explain the properties and behaviour of fluids in both static and motion conditions. (C2) 2. Apply the principles of fluid mechanics in engineering application. (C3) 3. Analyse the engineering problems associated with fluid systems. (C4)			
Synopsis	This course will introduce the basic principles of fluid flow including the phenomena of fluid and theories related to fluid static, incompressible fluid and compressible fluid. Topics to be covered include fluid properties, pressure and fluid statics, mass, Bernoulli and energy equations and Fluid Kinematics.			
References	1. Cengel, Y.A. and Cimbala, J.M. (2013). *Fluid Mechanics Fundamentals and Applications, 3rd Edition*. McGraw-Hill Higher Education.			

SEMESTER 2

Course Title	**Physical Chemistry**		Semester	2
Course Code	**CCB 10303**		SLT Credit	3
Pre-requisites	Nil			
Assessment Methods	Coursework	40 %	Final Examination	60 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Explain the basic concepts of physical chemistry. (C2) 2. Apply the principles of physical chemistry to solve chemical engineering problems. (C3) 3. Analyze the principles of properties of gases, thermodynamics, equilibrium and chemical kinetics to solve chemical engineering problems. (C4)			
Synopsis	This course is designed to prepare engineering students with the knowledge in physical chemistry. It will highlight on the importance of knowledge in thermodynamics, equilibrium concepts and chemical kinetics in relation with chemical engineering. The concept can be used to explain and interpret observations relating to physical and chemical properties of matter. This course will create a better understanding on the application of physical chemistry in chemical engineering and its related application.			
References	1. Atkins, P. and De Paula, J. (2014). *Physical Chemistry, 10th Edition.* Oxford University Press.			

Course Title	**Chemical Engineering Laboratory 1**		Semester	2
Course Code	**CCB 10402**		SLT Credit	2
Pre-requisites	Nil			
Assessment Methods	Coursework	100 %	Final Examination	0 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Execute standard operating procedure for laboratory experiments. (C3) 2. Apply the knowledge acquired in previous mathematics, science and chemical engineering courses to analyze and interpret information acquired by operating process equipment. (C3) 3. Analyze the experimental data obtained from the conducted experiments. (C4) 4. Produce and present laboratory reports formatively. (P4)			

Synopsis	This course comprises all the experimental parts of the first year course. The laboratory experiments cover a range of topics related to analytical and organic chemistry, physical chemistry and fluid mechanics.
References	1. UniKL MICET (2015). *Chemical Engineering Laboratory 1 Manual, 2nd Edition*. UniKL MICET. 2. Yunus Cengel and John M. Cimbala (2013). *Fluid Mechanics: Fundamental & Application*. McGraw Hill. 3. Peter Atkins & Julio de Paula (2014). *Physical Chemistry, 10th Edition*. Oxford University Press.

Course Title	**Material Balance**		Semester	2
Course Code	**CCB 10702**		SLT Credit	2
Pre-requisites	Nil			
Assessment Methods	Coursework	40 %	Final Examination	60 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Determine the dimension of an equation and conversion of units. (C4) 2. Analyze the material balance of process streams, stream components and phase systems based on chemical process principles. (C4) 3. Apply computer software in solving material balance calculations. (C3)			
Synopsis	This course will introduce students to the knowledge and expertise in material balance related to the process industry. It begins with an introduction to engineering calculations, followed by applying methods used to carry out material balances over a range of equipment and processes encountered in industry. The course also covers the concepts of phase systems. In addition, it introduces students to the material balance calculations with the aid of computer software.			
References	1. Felder, R.M. and Rousseau, R.W. (1999). *Elementary of Chemical Process, 3rd Edition*. John Wiley & Sons. 2. Ghasem, N. and Henda, R. (2014). Principles of Chemical Engineering Processes, 2nd Edition. CRC Press			

Course Title	**Mathematics for Engineers 2**		Semester	2
Course Code	**CCB 11003**		SLT Credit	3
Pre-requisites	CCB 10003 Mathematics for Engineers 1			
Assessment Methods	Coursework	40 %	Final Examination	60 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Solve ordinary differential equations and partial differential equations' problems. (C3) 2. Apply Laplace transforms to solve differential equations problems. (C3) 3. Determine Fourier series of given functions. (C4)			
Synopsis	This course covers ordinary differential equations and partial differential equations. It also provides advanced level engineering mathematics such as Laplace transforms and Fourier series in solving various engineering problems.			
References	1. Stroud, K.A. and Dexter, J. (2013). Engineering Mathematics. (7th Ed). New York: Palgrave Macmillan.			

Course Title	**Fundamentals of Electrical and Electronics Engineering**		Semester	2
Course Code	**CCB 21102**		SLT Credit	2
Pre-requisites	Nil			
Assessment Methods	Coursework	40 %	Final Examination	60 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Describe basic concept of electricity, circuit theorems, electrical and electronics system, and electrical machines. (C2)			

	2. Apply fundamental principles of electrical and electronics to solve engineering problems. (C3)
Synopsis	This course provides fundamental knowledge in electrical technology such as basic concept of electricity, circuit theorem, simple ac and dc circuit analysis, electronic devices, magnetism, principle of single and three phase system, motor and transformer and their applications.
References	1. Edward Hughes. (2016). *Electrical and Electronic Technology, 12th. Edition*. Pearson. 2. Floyd and Buchla. (2014). *Electronics Fundamentals: A Systems Approach*. Pearson. 3. Stephen Umans. (2014). *Electric Machinery, 7th Edition*. McGraw-Hill.

SEMESTER 3

Course Title	**Computer Programming for Engineers**		Semester	3
Course Code	**CCB 20003**		SLT Credit	3
Pre-requisites	Nil			
Assessment Methods	Coursework	100 %	Final Examination	0 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Demonstrate the use of control structures (sequential, selection and iteration) in C++ language and MATLAB. (C3) 2. Construct computer programs to solve engineering problems using appropriate data types declaration, and appropriate commands to demonstrate the input, output, control structure, functions, File I/O and array statement. (C3) 3. Apply appropriate compiler and debugger tools to compile and debug program. (C3)			
Synopsis	This course introduces concepts and techniques for creating computational solutions to problems in engineering. Programming topics include Introduction to C++ Programming, selection and loop statements, functions, file input & output, structure data types, MATLAB programming, and using graphics in MATLAB. Good programming style and computational efficiency are emphasized.			
References	1. Cheng, H.H. (2010). *C for Engineers and Scientists: An Interpretive Approach*. McGraw Hill. 2. Valentine, B. H. D. (2010). *Essential MATLAB: For Engineers and Scientists*. Elsevier's Science & Technology.			

Course Title	**Introduction to Biochemical Engineering**		Semester	3
Course Code	**CCB 20102**		SLT Credit	2
Pre-requisites	Nil			
Assessment Methods	Coursework	40 %	Final Examination	60 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Identify the characterization of cells. (C2) 2. Analyze the kinetic parameters of the Michaelis-Menten Equation. (C4) 3. Explain the enzyme actions and enzyme immobilization technology. (C2) 4. Compare the design of bioreactors and product recovery strategies. (C4)			
Synopsis	This course covers the introduction of cell structures and different cell types, followed by the description of chemical elements of living cells. It also covers the explanation of enzyme-catalyzed reactions and kinetics, as well as the enzyme immobilization technology applied in the industrial processes. Students will also be introduced to the theories of microbial cell growth, design and analysis of bioreactors, and various product recovery operations.			
References	1. Syed Tanveer A.I. (2013). *Biochemical Engineering: Principles and Concepts, 3rd Edition*. PHI. 2. Bailey, J.E. and Ollis, D.F. (1986). *Biochemical Engineering Fundamentals, 2nd Edition*. McGraw-Hill Book Company.			

Course Title	**Process Heat Transfer**		Semester	3
Course Code	**CCB 20303**		SLT Credit	3
Pre-requisites	Nil			
Assessment Methods	Coursework	40 %	Final Examination	60 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Justify the concepts and laws related to heat transfer process. (C5) 2. Apply empirical correlations for heat transfer and determine the amount of heat transfer rates. (C3) 3. Examine engineering problems related to heat transfer. (C4)			
Synopsis	This course covers the basic principles of heat transfer. This course covers the three modes of heat transfer heat transfer through conduction, convection and radiation and the application of process heat transfer in industry such as in heat exchangers.			
References	1. Cengel, Y.A., Ghajar, A.J. (2015). *Heat and Mass Transfer: Fundamental & Application, 5th Edition*. McGraw-Hill. 2. Cengel, Y.A. (2014). *Heat and Mass Transfer, 5th Edition*. McGraw-Hill.			

Course Title	**Engineering Drawing**		Semester	3
Course Code	**CCB 20702**		SLT Credit	2
Pre-requisites	Nil			
Assessment Methods	Coursework	100 %	Final Examination	0 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Demonstrate the use of main conventions in engineering drawing. (C2) 2. Identify dimensional views from two-dimensional and three-dimensional objects. (C4) 3. Apply computer software for engineering drawing and process and instrumentation diagram. (C3)			
Synopsis	This course provides students with a basic foundation in technical engineering drawing as well as orthographic and isometric projections of object and chemical process drawing.			
References	1. R.K. Sinnott. (2009). *Chemical Engineering Design; Coulson and Richardson's. Chemical Engineering (Vol. 6)*. Butterworth Heinemann. 2. George Omura (2014), Mastering AutoCAD 2015 and AutoCAD LT 2015, SYBEX.			

Course Title	**Thermodynamics**		Semester	3
Course Code	**CCB 20803**		SLT Credit	3
Pre-requisites	Nil			
Assessment Methods	Coursework	40 %	Final Examination	60%
Course Outcomes	Upon completion of this course, students should be able to: 1. Analyze engineering problems based on thermodynamic laws and properties. (C4) 2. Evaluate the heat effects of chemical reactions and the performance of thermodynamic cycles. (C5) 3. Perform calculation on vapour-liquid phase equilibrium and solution thermodynamics. (C4)			
Synopsis	This course provides students with the foundation in chemical engineering thermodynamics. It covers the first and second laws of thermodynamics, the P-V-T behaviour of pure substances, ideal and non-ideal gases, heat effects, vapour-liquid equilibrium, phase rules, and solution thermodynamics.			
References	1. Cengel, Y.A. and Boles, M.A. (2014). *Thermodynamics: An Engineering Approach, 8th Edition*. McGraw-Hill. 2. Smith, J.M., Van Ness, H.C. and Abbott, M.M. (2005). *Introduction to Chemical Engineering Thermodynamics, 7th Edition*. McGraw-Hill.			

Course Title	**Energy Balance**		Semester	3
Course Code	**CCB 21002**		SLT Credit	2
Pre-requisites	CCB 10702 Material Balance			
Assessment Methods	Coursework	40 %	Final Examination	60 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Differentiate reactive and non-reactive processes based on chemical process principles. (C4) 2. Evaluate the overall energy balances for chemical engineering processes. (C5) 3. Apply computer software in solving material and energy balance calculations. (C3)			
Synopsis	This course will introduce students to the knowledge and expertise in energy balance related to the process industry. It begins with an introduction to energy balance and tables of thermodynamic, followed by applying methods used to carry out energy balances over a range of equipment and processes encountered in industry. In addition, it introduces students to the energy balance calculations with the aid of computer software.			
References	1. Felder, R.M. and Rousseau, R.W. (1999). *Elementary of Chemical Process, 3rd Edition*. John Wiley & Sons. 2. Ghasem, N. and Henda, R. (2014). *Principles of Chemical Engineering Processes, 2nd Edition*. CRC Press.			

SEMESTER 4

Course Title	**Mass Transfer**		Semester	4
Course Code	**CCB 20202**		SLT Credit	2
Pre-requisites	Nil			
Assessment Methods	Coursework	40 %	Final Examination	60 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Distinguish the principle of diffusion in steady state, unsteady state and convective mass transfer. (C4) 2. Evaluate diffusion coefficients in gas mixtures, liquid mixtures, electrolytes, biological solutes in liquid and solid. (C5) 3. Analyze mass transfer in turbulent and laminar flows. (C4) 4. Examine problems involving diffusion and mass transfer. (C4)			
Synopsis	This course will introduce the students to the theories of diffusion and mass transfer involving steady state and unsteady state mass transfer, interphase mass transfer and convective mass transfer.			
References	1. Geankoplis, C. J. (2003). *Transport Processes and Separation Process Principles, 4th Edition*. Prentice Hall. 2. Seader, J.D., Henley, E.J. and Roper, D.K. (2011). *Separation Process Principles, 3nd Edition*. John Wiley & Sons, Inc. 3. Nag, P.K. (2011). *Heat and Mass Transfer, 3rd Edition*. McGraw Hill Education (India) Private Limited			

Course Title	**Reaction Engineering 1**		Semester	4
Course Code	**CCB 20602**		SLT Credit	2
Pre-requisites	Nil			
Assessment Methods	Coursework	40 %	Final Examination	60 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Solve problems for batch and flow reactors based on fundamentals of reaction engineering. (C4) 2. Analyze rate data to determine kinetic constant and reaction order. (C4) 3. Perform preliminary design of isothermal and non-isothermal reactors. (C5)			
Synopsis	This course covers the basic concepts of reaction kinetics, conversion as well as the design of isothermal and non-isothermal batch and flow reactors. In addition, students will be exposed to data interpretation for batch and flow reactors.			

References	1. Fogler, H.S. (2016). *Elements of Chemical Reaction Engineering, 5th Edition*. Prentice-Hall International Series.

Course Title	**Statistics for Engineers**		Semester	4
Course Code	**CCB 21203**		SLT Credit	3
Pre-requisites	Nil			
Assessment Methods	Coursework	40 %	Final Examination	60%
Course Outcomes	Upon completion of this course, students should be able to: 1. Apply the fundamental concepts of probability and statistics in engineering. (C3) 2. Analyse engineering data using statistical methods in decision making. (C4) 3. Generate statistical solution using computer software. (C6) 4. Interpret the outcome from statistical software output with the statistical concept. (C5)			
Synopsis	This course covers the introduction to probability, probability distribution and sampling distribution, test of hypothesis, analysis of variance, linear regression and correlation and factorial design.			
References	1. Montgomery, D.C. and Runger, G.C. (2013). *Applied Statistics and Probability for Engineers, 6th Edition*. John Wiley & Son 2. Montgomery, D.C., Runger, G.C. and Hubele, N.F. (2010). *Engineering Statistics, 5th Edition*. John Wiley & Sons, Inc.			

Course Title	**Chemical Engineering Laboratory 2**		Semester	4
Course Code	**CCB 21302**		SLT Credit	2
Pre-requisites	CCB 10402 Chemical Engineering Laboratory 1			
Assessment Methods	Coursework	100 %	Final Examination	0 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Execute operating procedure for laboratory experiments. (C3) 2. Apply the knowledge acquired in previous mathematics, science and chemical engineering courses to conduct experiments by the operating process requirements. (C3) 3. Analyze the experimental data obtained from the conducted experiments. (C4) 4. Produce and present laboratory reports formatively. (P4)			
Synopsis	This course comprises all the experimental parts of the second year courses. The laboratory experiments cover a range of topics related to thermodynamics, mass transfer, process heat transfer and reaction engineering.			
References	1. UniKL MICET (2015). *Chemical Engineering Laboratory 2 Manual, 2nd Edition*. UniKL MICET.			

Course Title	**Materials Engineering**		Semester	4
Course Code	**CCB 21402**		SLT Credit	2
Pre-requisites	Nil			
Assessment Methods	Coursework	40 %	Final Examination	60%
Course Outcomes	Upon completion of this course, students should be able to: 1. Determine the stress and strain properties in material. (C4) 2. Discuss the atomic structure and interatomic bonding in materials. (C2) 3. Analyze the failure modes, corrosion and degradation of materials. (C4)			
Synopsis	This course provides students with a basic foundation in materials engineering as well as the fundamentals in atomic structure and interatomic bonding. The course covers the basic principles of corrosion and degradation of materials, mechanical properties of metals, modes of deformation and failure, thin shells under pressure and mechanical design of process equipment.			
References	1. R.K. Sinnott. (2009). *Chemical Engineering Design; Coulson and Richardson's. Chemical Engineering (Vol. 6)*. Butterworth Heinemann. 2. W. D. Callister & D. G. Rethwisch (2015), *Materials Science and Engineering Ninth Edition*, Wiley.			

Course Title	**Momentum Transfer**		Semester	4
Course Code	**CCB 30003**		SLT Credit	3
Pre-requisites	CCB 10603 Fluid Mechanics			
Assessment Methods	Coursework	40 %	Final Examination	60%
Course Outcomes	Upon completion of this course, students should be able to: 1. Apply the control volume analysis associated with fluid flow. (C3) 2. Evaluate the differential equations of mass and momentum conservation. (C5) 3. Analyze problems involving incompressible flow of Newtonian fluids using Navier-Stokes equation. (C4)			
Synopsis	This course introduces the phenomena of fluid and theories related to incompressible fluid. This course covers flow in pipes, differential analysis of fluid flow, approximate solutions of the Navier-Stokes and flow over bodies in chemical engineering.			
References	1. Cengel, Y.A. and Cimbala, J.M. (2013). *Fluid Mechanics Fundamentals and Applications, 3rd Edition*. McGraw-Hill Higher Education.			

SEMESTER 5

Course Title	**Industrial Safety and Health**		Semester	5
Course Code	**CCB 30103**		SLT Credit	3
Pre-requisites	Nil			
Assessment Methods	Coursework	40 %	Final Examination	60 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Demonstrate knowledge and understanding of the importance of safety in industry. (C3) 2. Identify different types of hazards and its' control. (C4) 3. Apply hazard identification and analysis in industrial safety. (C3) 4. Recognize relevant regulations in industrial safety and health. (C4)			
Synopsis	This course covers the introduction to industrial safety and health, hazards and risk assessment, chemical safety, hazard control measures and emergency planning, and industrial safety and health regulations.			
References	1. Crowl, D.A. and Louvar, J.F. (2011). *Chemical Process Safety Fundamentals with Applications, 3rd Edition*. Prentice Hall.			

Course Title	**Numerical Methods in Chemical Engineering**		Semester	5
Course Code	**CCB 30403**		SLT Credit	3
Pre-requisites	CCB 11003 Mathematics for Engineers 2			
Assessment Methods	Coursework	100 %	Final Examination	0 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Apply an appropriate numerical method for a particular problem of interpolation, integration, as well as for solving single nonlinear equations and linear systems of equations. (C3) 2. Solve engineering problems using numerical method. (C4) 3. Use software to solve numerical problems. (C3)			
Synopsis	This course is designed to provide students with a background in modern numerical methods. The topics covered are numerical linear algebra, numerical solution of ordinary and partial different equations, numerical methods for solving systems of non-linear equations and the introduction to optimization. Numerical computation software will be introduced in solving numerical problems.			
References	1. Chapra, S.C. (2012). *Applied Numerical Methods with MATLAB for Engineers and Scientist, 3rd Edition*. McGraw-Hill Education.			

Course Title	**Separation Processes 1**		Semester	5
Course Code	**CCB 30502**		SLT Credit	2
Pre-requisites	CCB 10702 Material Balance			
Assessment Methods	Coursework	40 %	Final Examination	60 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Apply fundamentals of phase equilibrium to estimate compositions in equilibrium in liquid/liquid and liquid/vapour separation units. (C3) 2. Differentiate the design fundamentals for separation processes. (C4) 3. Evaluate the number of equilibrium stages in absorption, distillation and liquid-liquid extraction processes. (C5)			
Synopsis	This course provides students with the various types of separation processes available in chemical engineering. The topics cover mass transfer and the design criteria of processes such as distillation, absorption, and liquid-liquid extraction.			
References	1. McCabe, W.L. Smith, J.C. and Harriott, P. (2014). *Unit Operations of Chemical Engineering, 7th Edition.* McGraw Hill. 2. Geankoplis, C.J. (2003). *Transport Processes and Unit Operations, 4th Edition*. Prentice Hall. 3. Seader, J.D., Henley, E.J. and Roper, D.K. (2011). *Separation Process Principles, 3nd Edition*. John Wiley & Sons, Inc.			

Course Title	**Introduction to Environmental Engineering**		Semester	5
Course Code	**CCB 31403**		SLT Credit	3
Pre-requisites	Nil			
Assessment Methods	Coursework	40 %	Final Examination	60 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Identify the impact of development on the environment and ecosystem. (C4) 2. Recommend the appropriate method or treatment system in solving environmental problems. (C5) 3. Practise the relevant legislation and decision making in environmental engineering. (C3)			
Synopsis	This course covers the current environmental issues as well as the importance of waste treatment systems including industrial wastewater and sludge treatment, control of air pollutants, solid waste and hazardous waste management and disposal method.			
References	1. Davis, M.L. and Cornwell, D.A. (2013). *Introduction to Environmental Engineering, 5th Edition*. McGraw Hill.			

Course Title	**Reaction Engineering 2**		Semester	5
Course Code	**CCB 31602**		SLT Credit	2
Pre-requisites	CCB 20602 Reaction Engineering 1			
Assessment Methods	Coursework	40 %	Final Examination	60 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Identify the properties of a catalyst and the steps in a catalytic reaction. (C4) 2. Calculate the conversion or catalyst weight for packed bed reactor. (C4) 3. Determine the effects of external and internal diffusions on the heterogeneous reactions. (C4)			
Synopsis	This course covers the basic concepts of heterogeneous catalytic reaction. Students will be exposed to the calculation of packed bed reactor. In addition, the topics also cover the effects of mass transfer (external and internal diffusions) on the overall rate of catalytic reaction.			
References	1. Fogler, H.S. (2016). *Elements of Chemical Reaction Engineering, 5th Edition*. Prentice-Hall International Series.			

SEMESTER 6

Course Title	**Process Control and Instrumentation**		Semester	6
Course Code	**CCB 30803**		SLT Credit	3
Pre-requisites	Nil			
Assessment Methods	Coursework	40 %	Final Examination	60 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Identify main components in the control system. (C4) 2. Differentiate the control strategies in the chemical process application. (C4) 3. Develop solutions based on the fundamental principles of process control and instrumentation in chemical processes. (C6)			
Synopsis	This course introduces the various aspects of fundamental process control and control strategies. Besides, this course also introduces the working principles of control system instrumentation and advanced process control.			
References	1. Seborg, D.E., Mellichamp, D.A., Edgar, T.F. and Doyle III, F.J. (2011). *Process Dynamics and Control, 3rd Edition.* John Wiley and Sons. 2. King M. (2011). *Process Control: A Practical Approach, 1st Edition*, Wiley.			

Course Title	**Process Design and Economics**		Semester	6
Course Code	**CCB 30903**		SLT Credit	3
Pre-requisites	Nil			
Assessment Methods	Coursework	40 %	Final Examination	60 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Apply the knowledge in preparing the flow sheet for process design. (C3) 2. Formulate the steps in process design and basic considerations in equipment design. (C5) 3. Justify the capital and manufacturing costs of a process design project. (C4)			
Synopsis	This course is first started with an introduction on how to define and begin a process design project, followed by the steps used in process design. It also covers the descriptions of flow sheet preparation and the basic concepts of process equipment design. In the second part of the course, it will introduce students to the important knowledge of economic and cost analysis of a process design project including capital and manufacturing costs estimation, economic optimization, and profitability analysis.			
References	1. Sinnott, R.K., Towler, G. (2015). Chemical engineering design, Volume 6, 5th *Edition.* Elsevier.			

Course Title	**Chemical Engineering Laboratory 3**		Semester	6
Course Code	**CCB 31102**		SLT Credit	2
Pre-requisites	CCB 21302 Chemical Engineering Laboratory 2			
Assessment Methods	Coursework	100 %	Final Examination	0 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Develop appropriate experimental procedures based on chemical engineering knowledge. (C6) 2. Execute the experimental procedures for laboratory experiments. (C3) 3. Analyze the experimental data obtained from the conducted experiments. (C4) 4. Produce and present laboratory reports formatively. (P4)			
Synopsis	This course comprises all the experimental parts of the third year courses. The laboratory experiments cover a range of topics related to separation processes, process control and instrumentation, and environmental engineering.			
References	1. UniKL MICET (2015). *Chemical Engineering Laboratory 3 Manual, 1st Edition*. UniKL MICET. 2. Seborg, D.E., Edgar, T.F. and Mellichamp, D.A. (2011). *Process Dynamics and Control, Third Edition, International Student Edition*, John Wiley and Sons. 3. McCabe, W.L. and Smith, J.C. (2005). *Unit Operations of Chemical Engineering, 7th*			

	Edition. McGraw Hill. 4. Thomas, A.H. (2007). *Measurement and Control Basics.* ISA Control Series.

Course Title	**Separation Processes 2**		Semester	6
Course Code	**CCB 31202**		SLT Credit	2
Pre-requisites	CCB 30502 Separation Processes 1			
Assessment Methods	Coursework	40 %	Final Examination	60 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Apply separation process principles to solve problems related to separation processes that involve a solid phase, barrier and solid agent. (C3) 2. Analyse separation operations including leaching, crystallization, evaporation, drying, membrane and adsorption processes. (C4) 3. Evaluate the equilibrium stage requirements for single and multistage counter-current in solid-liquid extraction. (C5)			
Synopsis	This course provides students with the various types of separation processes available in chemical engineering. The topics cover mass transfer and the design criteria of processes such as evaporation, drying, leaching, crystallization, adsorption, ion exchange, and membrane processes.			
References	1. McCabe, W.L. Smith, J.C. and Harriott, P. (2014). *Unit Operations of Chemical Engineering, 7th Edition.* McGraw Hill. 2. Geankoplis, C.J. (2003). *Transport Processes and Unit Operations, 4th Edition*. Prentice Hall. 3. Seader, J.D., Henley, E.J. and Roper, D.K. (2010). *Separation Process Principles, 3nd Edition*. John Wiley & Sons, Inc.			

Course Title	**Particle Technology**		Semester	6
Course Code	**CCB 31302**		SLT Credit	2
Pre-requisites	Nil			
Assessment Methods	Coursework	40 %	Final Examination	60 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Distinguish the methods used in particle size measurement and phenomenon involving slurry transport and colloids and fine particles. (C4) 2. Analyze for the problems involving separation and transport of particle in fluids (C4) 3. Determine the health effects of fine powders. (C4)			
Synopsis	This course provides students with a basic foundation in particle technology, which includes particle size analysis, pneumatic transport, separation of particles from a gas and health effects of fine powders.			
References	1. M. Rhodes (2008). *Introduction to particle technology*, 2nd Edition, Wiley. 2. Sunggyu, L., Kimberly, H.H. (2012). *Particle technology and Application*, CRC Press.			

Course Title	**Process Analysis and Simulation**		Semester	6
Course Code	**CCB 31502**		SLT Credit	2
Pre-requisites	CCB 10702 Material Balance CCB 21002 Energy Balance			
Assessment Methods	Coursework	100 %	Final Examination	0%
Course Outcomes	Upon completion of this course, students should be able to: 1. Apply knowledge of process analysis and simulation to the solution of chemical engineering problems. (C3) 2. Analyze the performance of chemical processes using principles of simulation. (C4) 3. Select the appropriate computer software for the analysis and simulation of various chemical processes. (C5)			

Synopsis	This course explains the basic concepts of process analysis and simulation in solving chemical engineering problems. This course covers introduction to simulation software, flowsheeting and model analysis tools, as well as the analysis and simulation of various chemical processes.
References	1. Gil Chaves, I.D., López, J.R.G., García Zapata, J.L., Leguizamón Robayo, A., Rodríguez Niño, G. (2016). *Process Analysis and Simulation in Chemical Engineering, 1st Edition*. Springer. 2. Felder, R.M. and Rousseau, R.W. (1999). *Elementary Principles of Chemical Processes, 3rd Edition*. John Wiley & Sons.

INTER SEMESTER 6 & 7

Course Title	**Industrial Training**		Semester	6 – 7
Course Code	**CCB 49705**		SLT Credit	5
Pre-requisites	Attained CGPA ≥ 2.00, gained 80 SLT credits			
Assessment Methods	Coursework	100 %	Final Examination	0 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Demonstrate the ability to work professionally with consideration on safety and health during the training. (C3) 2. Apply engineering knowledge in performing assigned task during the Industrial Training. (C3) 3. Follow responsibly assigned task with minimum supervision and in accordance to the quality required. (A3) 4. Appraise work experience gained on skills and knowledge during the Industrial Training in oral and writing. (P3)			
Synopsis	This course provides students a venue to apply their knowledge and skills acquired during their studies. Students will be placed for 10 weeks in relevant industry to expose with all aspects of working environment especially towards to be competent engineer. The experience is essential to ensure the student is ready to work after completing his/her study. The student is also required to compile the experience gained by writing a formal report and present the report adequately.			
References	1. UniKL INTRA Handbook (Edition 2017)			

SEMESTER 7

Course Title	**Plant Design and Management System**		Semester	7
Course Code	**CCB 40003**		SLT Credit	3
Pre-requisites	Nil			
Assessment Methods	Coursework	100 %	Final Examination	0 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Apply knowledge and tools of engineering and management system in chemical process plant. (C3) 2. Examine plant drawings and specification in the design of chemical plant. (C4) 3. Construct 3-Dimensional plant model for chemical engineering processes. (C6)			
Synopsis	This course provides students with knowledge in plant design and management system. This course covers a fundamental study on plant development and design. The design is enhanced using a 3D computers modeling of a process plant.			
References	1. Sinnott R.K. & Towler G., (2010), *Coulson and Richardsons Chemical Engineering Design, 5th Ed. (Vol. 6)*, Butterworth Heinemann. 2. Perry, R.H., and Green, D.W., (2008), *Perry's Chemical Engineers Handbook, 8th Edition*, McGraw-Hill. 3. Seider, W.D., Seader, J.D, and Lewin, D.R., (2009), *Product and Process Design Principles: Synthesis, Analysis and Evaluation, 3rd Edition*, Wiley 4. Towler G. & Sinnot R.K. (2012), *Chemical Engineering Design, Second Edition: Principles, Practice and Economics of Plant and Process Design*, Butterworth Heinemann			

Course Title	**Design Project 1**		Semester	7
Course Code	**CCB 40103**		SLT Credit	3
Pre-requisites	CCB 10702 Material Balance CCB 21002 Energy Balance			
Assessment Methods	Coursework	100 %	Final Examination	0 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Develop preliminary design of a chemical plant based on fundamentals and concepts in chemical engineering. (C6) 2. Practice of ethical consequences in design aspect and ethical behaviour in line with professional code of conduct requirement. (A5) 3. Evaluate the feasibility on technical and economic of a chemical plant. (C5) 4. Perform cost estimation of a chemical plant. (C4) 5. Produce and present reports for the plant design. (P4) 6. Develop 2D and 3D engineering drawings of a chemical plant. (C6) 7. Demonstrate team work skills to complete an assigned task with responsibility. (A3)			
Synopsis	This course introduces students to the principles of designing chemical processes and process equipment design. It includes the design problem, process selection, plant design consideration and material balance of the process.			
References	1. Sinnott R.K. & Towler G. (2010). *Coulson and Richardsons Chemical Engineering Design, 5th Ed. (Vol. 6)*. Butterworth Heinemann. 2. Kirk and Othmer. *Encylopedia of Chemical Technology,* 20th Edition.			

Course Title	**Renewable and Sustainable Energy Engineering**		Semester	7
Course Code	**CCB 40203**		SLT Credit	3
Pre-requisites	Nil			
Assessment Methods	Coursework	40 %	Final Examination	60 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Identify the conventional energy problems and various types of renewable energy sources. (C3) 2. Analyse the potential of renewable energy technologies in different contexts for sustainable development. (C4) 3. Perform the preliminary of heat integration design in a chemical processing plant (C4) 4. Optimize the process performance based on pinch analysis. (C5).			
Synopsis	This course will introduce students to the conventional energy problem and the potential of renewable energy sources such as solar power, wind energy, hydroelectric, wave and tidal power, geothermal energy and biomass energy. This course also provides students with a basic foundation in process heat integration based on Pinch Analysis principles. The course covers the introduction to process heat integration, pinch analysis and synthesis.			
References	1. Robin Smith (2005). *Chemical Process Design and Integration*, McGraw-Hill. 2. Welty, J. R., Wicks, C. E., Wilson, R. E., and Rorrer, G. (2014). *Fundamentals of Momentum, Heat, and Mass Transfer*, 6th edition, John Wiley & Sons. 3. Hinrichs, R.A. and Kleinbach, M. (2013). *Energy*: *Its Use and the Environment*, 5th *Edition*. Thomson Learning. 4. Kaltschmitt, M., Streicher, W., Wiese, A. (2007). *Renewable Energy Technology, Economics, and Environment*. Springer.			

Course Title	**Management and Marketing for Chemical Engineers**		Semester	7
Course Code	**CCB 40402**		SLT Credit	2
Pre-requisites	Nil			
Assessment Methods	Coursework	40 %	Final Examination	60 %
Course Outcomes	Upon completion of this course, students should be able to:			

	1. Explain the elements and principles of marketing relative to chemical engineering project and chemical commodities (C2) 2. Evaluate the concept and principles of management in identifying bottlenecks and restructuring the operation related to chemical industry. (C5) 3. Relate the interactions between the environment, technology and organizations in order to achieve high performance. (P4)
Synopsis	This course will expose the student to type of management practices and constrains. Students will be taught on management skills to run and improve an organization using proven tools. Students will also be exposed to the knowledge of marketing chemical engineering projects and chemical commodities.
References	1. Didner, P. (2014) *Global Content Marketing: How to Create Great Content, Reach More Customers, and Build a Worldwide Marketing Strategy that Works*. McGraw-Hill 2. Goldratt, E.M. and Cox, J. (2014). The Goal: A Process of On-going Improvement. McGraw-Hill.

Course Title	**Engineers in Society**		Semester	7
Course Code	**CCB 40602**		SLT Credit	2
Pre-requisites	CCB 10201 Engineering Practice and Professionalism			
Assessment Methods	Coursework	40 %	Final Examination	60 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Identify ethical and professionalism issues in engineering. (A4) 2. Evaluate the decisions related to contemporary issues from an engineering standpoint. (C4) 3. Demonstrate the knowledge and the ability to engage in independent lifelong learning. (C4)			
Synopsis	This course will cover topics on the link between engineers and society, ethical and professional practice, occupational safety, health and environment, intellectual property, project management, standards and quality.			
References	1. Baine. C. (2015). *Is there and Engineer Inside You?: A Comprehensive Guide to Career Decision in Engineering. (5th Ed.)* Bomany Publishing.			

Course Title	**Engineering Final Year Project 1**		Semester	7
Course Code	**CCB 49802**		SLT Credit	2
Pre-requisites	Gained minimum 90 of total SLT credits [Total SLT Credit = Cumulative Credits Gain (CCG) + Industrial Training (INTRA) + Credits Transfer (CT)]			
Assessment Methods	Coursework	100 %	Final Examination	0 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Demonstrate the abilities to plan and work effectively. (C3) 2. Analyse the research gap using the fundamental engineering theory. (C4) 3. Perform critical review of the research project. (C4) 4. Propose a specific research methodology to solve the research problem. (C5) 5. Evaluate the impact of engineering parameters to determine the engineering behavior of the system or equipment. (C5) 6. Apply suitable tools and techniques to analyse and solve complex engineering problem. (C3) 7. Produce a feasible project proposal. (P3) 8. Present and defend the project proposal effectively. (P3)			
Synopsis	This course comprises of research abstract, literature review, problem statement, objectives and appropriate methodology to enhance the student's abilities in solving complex engineering problems. Students present their proposals and produce proposal reports individually.			
References	1. UniKL Engineering Final Year Project (FYP) Handbook 2nd Edition (2017) 2. Leedy, P.D. & Ormrod, J.E. (2014). *Practical Research: Planning & Design.* Pearson-Prentice Hall.			

SEMESTER 8

Course Title	**Design Project 2**		Semester	8
Course Code	**CCB 40304**		SLT Credit	4
Pre-requisites	CCB 40103 Design Project 1			
Assessment Methods	Coursework	100 %	Final Examination	0 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Design a chemical engineering related plant. (C6) 2. Perform equipment design for a chemical plant. (C4) 3. Evaluate engineering economic analysis of a chemical plant. (C5) 4. Optimize chemical processes for the plant design. (C4) 5. Demonstrate knowledge and understanding of safety in chemical plant design. (C3) 6. Produce and present reports for the plant design. (P4) 7. Demonstrate team work skills to complete an assigned task with responsibility. (A3)			
Synopsis	This course introduces students to the principles of designing chemical processes and process equipment design. It includes the equipment selection, specification and design, material of construction, safety and loss prevention, and plant design costing and evaluation.			
References	1. Peters, M.S., Timmerhans, K.D. and West, R.E. (2003). *Plant Design and Economics for Chemical Engineers, 5th Edition.* McGraw-Hill. 2. Gavin Towler and Sinnott, R.K. (2012). *Chemical Engineering Design: Principles, Practice and Economics of Plant and Process Design, 2nd Edition.* Butterworth Heinemann.			

Course Title	**Engineering Final Year Project 2**		Semester	8
Course Code	**CCB 49904**		SLT Credit	4
Pre-requisites	CCB 49802 Engineering Final Year Project 1			
Assessment Methods	Coursework	100 %	Final Examination	0 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Analyse complex engineering problem using the fundamental engineering theory. (C4) 2. Manage the project to solve complex engineering problem. (C5) 3. Evaluate the impact of engineering parameters to determine the behavior of the system or equipment and to draw essential engineering findings. (C5) 4. Apply the project using appropriate techniques and tools. (C3) 5. Perform independent critical review and embed conclusion with recommendation for the research findings. (C4) 6. Produce a project report according to the specified standard format. (P4) 7. Present and defend the project effectively. (P4)			
Synopsis	This course will determine student ability to apply the engineering knowledge and practice. Students are required to conduct research analysis, discuss and interpret research findings, and draw conclusions and possible recommendation. Students are also required to present their project outcomes.			
References	1. UniKL Engineering Final Year Project (FYP) Handbook 2nd Edition (2017) 2. Leedy, P.D. & Ormrod, J.E. (2014). *Practical Research: Planning & Design.* Pearson-Prentice Hall.			

ELECTIVE 1 (PROCESS)

Course Title	**Plant Utilities and Maintenance**		Semester	7
Course Code	**CCB 40502**		SLT Credit	2
Pre-requisites	Nil			
Assessment Methods	Coursework	40 %	Final Examination	60 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Identify the basic principles and operation of supporting equipment or facilities in chemical processing plants. (C4) 2. Apply maintenance strategies in new and old plant including applying standard monitoring and critical analysis during plant operation and shutdown. (C3) 3. Distinguish the benefits of plant utilities and their safety aspects. (C2)			
Synopsis	This course gives an overview of the different types of plant utilities normally found in chemical processing plants, its description and safe operations. This course also covers the basic management principles and techniques in plant maintenance.			
References	1. Duncan Richardson. (2014). *Plant Equipment & Maintenance Engineering Handbook, 1st Edition*, McGraw-Hill. 2. Mobley, R. K. (2014). *Maintenance Engineering Handbook, 8th Edition*. McGraw-Hill.			

ELECTIVE 2 (PROCESS)

Course Title	**Petrochemicals and Petroleum Refining Technology**		Semester	8
Course Code	**CCB 41302**		SLT Credit	2
Pre-requisites	CCB 40502 Plant Utilities and Maintenance			
Assessment Methods	Coursework	40 %	Final Examination	60 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Recognize the processes involved in petroleum refining and natural gas processing. (C4) 2. Identify the characteristics of crude oil and petroleum products based on crude assays and Material Safety Data Sheet (MSDS). (C4) 3. Classify the natural gas and petrochemicals produced from various processes. (C4)			
Synopsis	The students will be able to understand the operations of downstream processing units of petroleum refining plant and natural gas treating processes. The student will learn about crude oil and petroleum products properties and specifications. The student will gain knowledge about the operation of petroleum refinery and natural gas processing units.			
References	1. Gary, J.H. and Handwerk, G.E. (2007). *Petroleum Refining: Technologies and Economics, 5th Edition*. Marcel Dekker, Inc.			

ELECTIVE 3 (PROCESS)

Course Title	**Quality Assurance and Quality Control in Chemical Engineering**		Semester	8
Course Code	**CCB 41402**		SLT Credit	2
Pre-requisites	CCB 40502 Plant Utilities and Maintenance			
Assessment Methods	Coursework	40 %	Final Examination	60 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Apply the basic concepts of quality improvement to solve quality problems. (C3) 2. Construct and explain the process outcome base on control charts to solve quality problems in conducting quality improvement activities. (C5) 3. Analyze the process outcome using process capability method to solve engineering problem. (C4)			
Synopsis	This course covers the concept of fundamental of quality, statistical process control, control charts for variables data, control charts for attributes data, process capability and time weighted			

	charts.
References	1. Montgomery, D.C. and Runger, G.C. (2013). *Statistical Quality Control: A Modern Introduction, 7th Edition.* John Wiley & Son, International Edition.

ELECTIVE 1 (ENVIRONMENT)

Course Title	**Solid and Hazardous Waste Management**		Semester	7
Course Code	**CCB 40702**		SLT Credit	2
Pre-requisites	Nil			
Assessment Methods	Coursework	40 %	Final Examination	60%
Course Outcomes	Upon completion of this course, students should be able to: 1. Describe the basic principles of waste management system including waste identification, characterization, collection, storage, processing, treatment and disposal of waste. (C2) 2. Analyse the processes of waste management including waste generation, handling and minimization techniques of solid and hazardous waste generated from municipal and industry. (C4) 3. Apply the suitable methods of solid and hazardous waste treatment, remediation and disposal. (C3) 4. Identify the potentials of waste in economic value. (C4)			
Synopsis	This course will introduce students to solid and hazardous waste management, emphasizing on waste accumulation, laws and regulations, generation rates, handling, storage and separation techniques. This course also introduces students to 3R's concepts, landfills design and operation especially thermal treatment system, site remediation and radioactive waste treatment system.			
References	1. Mackenzie, L., D. And David, A. C. (2013). *Introduction to Environmental Engineering, 5th Edition*. McGraw-Hill. 2. Bhatia, S.C. (2007). *Solid and Hazardous Waste Management*. New Delhi: Atlantic Publishers & Distributors.			

ELECTIVE 2 (ENVIRONMENT)

Course Title	**Air Pollution Control**		Semester	8
Course Code	**CCB 40802**		SLT Credit	2
Pre-requisites	CCB 40702 Solid and Hazardous Waste Management			
Assessment Methods	Coursework	40 %	Final Examination	60 %
Course Outcomes	Upon completion of this course, students should be able to: 1. Analyze the major sources and types of air pollution. (C4) 2. Recommend air pollution control designs and working principles for particulate and gaseous that complied acts and regulations. (C5) 3. Measure pollutant concentrations and emissions by using the pollutant dispersion model. (C5)			
Synopsis	This course covers air pollution and its control methods as well as the regulatory requirements for atmospheric pollutants. The air pollution control methods include particulates control and gas control.			
References	1. Noel de Nevers (2010). *Air Pollution Control Engineering.* McGraw-Hill. 2. Mackenzie Davis and David Cornwell (2012). *Introduction to Environmental Engineering, 5th Edition.* McGraw-Hill.			

ELECTIVE 3 (ENVIRONMENT)

<table>
<tr><td>Course Title</td><td colspan="2">Wastewater Treatment Engineering</td><td>Semester</td><td>8</td></tr>
<tr><td>Course Code</td><td colspan="2">CCB 40902</td><td>SLT Credit</td><td>2</td></tr>
<tr><td>Pre-requisites</td><td colspan="4">CCB 40702 Solid and Hazardous Waste Management</td></tr>
<tr><td>Assessment Methods</td><td>Coursework</td><td>40 %</td><td>Final Examination</td><td>60 %</td></tr>
<tr><td>Course Outcomes</td><td colspan="4">Upon completion of this course, students should be able to:

1. Identify water quality standards and wastewater characteristics used in the water quality determination. (C4)
2. Analyze the processes involved in physical, chemical and biological treatments of wastewater. (C4)
3. Propose effective wastewater treatment process. (C5)</td></tr>
<tr><td>Synopsis</td><td colspan="4">Topics to be discussed are water quality parameters, wastewater characteristic, water quality act and standardization, wastewater treatment principle and design.</td></tr>
<tr><td>References</td><td colspan="4">1. Metcalf & Eddy (2004). Wastewater Engineering: Treatment and Reuse, 4th Edition. McGraw-Hill.
2. Metcalf & Eddy, George Tchobanoglous, H. David Stensel, Ryujiro Tsuchihashi and Franklin Burton (2013). Wastewater Engineering: Treatment and Resource Recovery, 5th Edition. McGraw-Hill.</td></tr>
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