FAKULTI KEJURUTERAAN KIMIA & SUMBER ASLI
UNIVERSITI MALAYSIA PAHANG

<table>
<tr><td>1</td><td>Course Code and Name</td><td>BKC3463 Unit Operation I</td></tr>
<tr><td>2</td><td>Semester and Year Taught</td><td>Semester 1 Year 3</td></tr>
<tr><td>3</td><td>Program Level/Category</td><td>Degree / Separation Process</td></tr>
<tr><td>4</td><td>Unit</td><td>3 Credits</td></tr>
<tr><td>5</td><td>Prerequisite Course</td><td>BKF2343 Material &Energy Balance</td></tr>
<tr><td>6</td><td>Contact Hours</td><td>Lecture: 3 units (3 hours X 14 weeks)
Tutorial: 1 unit (1 hour X 14 weeks)
Laboratory: 0 unit (0 hour X 14 weeks)</td></tr>
<tr><td>7</td><td>Course Synopsis</td><td>The objective of this course is to provide students with concepts of separation processes in related chemical and petrochemical plants. This subject will emphasize various unit operations, namely evaporation, distillation, absorption and extraction. By completing this course, students will understand the basic mechanisms, principles, operations and basic design parameters of the selected unit operations in related chemical engineering field.</td></tr>
<tr><td>8</td><td>Course Outcomes</td><td>By the end of semester, students should be able to:
CO1 Explain, describe and interpret the concept and principles of evaporation, distillation, absorption and extraction processes
CO2 Apply knowledge of unit operation in the identification, formulation and solution of chemical engineering problems.
CO3 Basic design parameters associated with certain unit operations.</td></tr>
<tr><td>9</td><td>Assessment Methods</td><td>
<table>
<tr><td>Distribution (%)</td><td></td><td>CO1</td><td>CO2</td><td>CO3</td><td></td><td></td><td></td></tr>
<tr><td>Test 1</td><td>15 %</td><td></td><td>X</td><td>X</td><td></td><td></td><td></td></tr>
<tr><td>Test 2</td><td>15 %</td><td></td><td>X</td><td>X</td><td></td><td></td><td></td></tr>
<tr><td>Quizzes</td><td>5 %</td><td>X</td><td>X</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Assignments</td><td>10 %</td><td></td><td>X</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Project</td><td>15%</td><td>X</td><td>X</td><td>X</td><td></td><td></td><td></td></tr>
<tr><td>Final Examination</td><td>40 %</td><td></td><td>X</td><td>X</td><td></td><td></td><td></td></tr>
<tr><td>Total</td><td>100 %</td><td colspan="6"></td></tr>
</table>
</td></tr>
<tr><td>10</td><td>Learning References</td><td>

1. Geankoplis., “Transport Processes and Unit Operations”, 3th Ed., Prentice Hall, USA, 1995.
2. McCabe, Smith, “Unit Operations of Chemical Engineering”, 5th Ed., McGraw-Hill, Singapore, 1993.
3. Seader J.D & Henley, E.J, “Separation Process Principle”, 2nd Ed.,John Wiley & Sons, 2006.
4. Willian J. Thomson., “Introduction to Transport Phenomena”, Prentice Hall, USA, 2000.
5. Coulson & Richardson, “Particle Technology and Separation”, Processes Pergamon Press
6. Denise C. Prieve, “Unit Operation of Chemical Engineering”, Carnegie Mellon Univeristy
7. Robin Smith,”Chemical Process Design and Integration”, John Wiley & Sons, 2005.

</td></tr>
</table>

Chapter	Week	Topic	Topic Outcomes (TO)	Delivery Methods	Assessment						SLT		
					T01	T02	Q	A	P	FE	Contact Hour	Learning Hour	Total SLT
0	1	**Overview** Course Outline, Course Outcome, Assessment Methods and Programme Outcomes	• Define the CO, PO and assessment methods carried out throughout the semester	Lecture							3	0	3
1	1	**Overview of Separation Processes** • Purpose of Separation Process • Classification of Separation Processes • Mechanism of Separation Processes • Separation by Phase Addition or Creation • Separation by Barrier • Selection of Feasible Separation Processes	• Describe and explain the phenomena of separation processes	Lecture			X						
			• classify separation processes depending on its needs and physical properties of fluids	Lecture			X						
	2		• determining the suitable methods for separation processes	Lecture, Tutorial			X				4.5	5	9.5
2	3	**Evaporation** • Types of Evaporation Equipment and Operations Method • Overall Heat Transfer Coefficients in Evaporators • Calculation Methods for Single-Effect Evaporators • Calculation Methods for Multiple-Effect Evaporators • Condensers for Evaporators • Evaporations Using Vapor Recompression	• identify the types of evaporators and distinguish the suitable evaporator for certain operations	Lecture							3	3	6
			• Describe other specific types of evaporators that are used in certain industries	Lecture, Tutorial					X				
	4		• Solve material and energy balance for evaporator process	Lecture, Tutorial	X		X	X	X	X	4.5	8	12.5
			• Determine the basic design parameters for evaporator	Lecture, Tutorial	X				X	X			
3	5	**Distillation** • Vapor-Liquid Equilibrium Relations • Single-Stage Equilibrium Contact Stages • Simple Distillation Methods	• Describe the theoretical and principle of the mass transfer in Distillation	Lecture			X				3	3	6

Chapter	Week	Topic	Topic Outcomes (TO)	Delivery Methods	Assessment						SLT		
					T01	T02	Q	A	P	FE	Contact Hour	Learning Hour	Total SLT
	6	• Distillation with Reflux and McCabe-Thiele Method • Distillation and Absorption Tray Efficiencies • Fractional Distillation Using Enthalpy-Concentration Method (Poncon-Savarit) • Distillation of Multi-components Mixtures	• Identify types of distillation operations starting from the simple to the industrial application.	Lecture, Tutorial					X		4	4	8
	7		• Determine the operation conditions and the number of theoretical plates and stages needed in the distillation column design using McCabe-Thiele and Poncon-Savarit method	Lecture, Tutorial		X		X	X	X	5	10	15
			• Solve problem related to multicomponent distillation	Lecture, Tutorial			X	X					
4	8	**Absorption** • Types of Separation Process and Methods • Equilibrium Relations between Phases • Single and Multiple Equilibrium Contact Stages • Mass Transfer between Phases • Continuous Humidification Processes • Absorption in Plate and Packed Towers • Absorption of Concentrated Mixtures in Packed Towers • Estimation of Mass Transfer Coefficients for Packed Towers • Heat Effects and Temperature Variations in Absorption	• Explain the concept of equilibrium and mass transfer in absorption	Lecture, Tutorial			X				3	3	6
			• Explain and differentiate the relationship of humidification and the absorption operation	Lecture, Tutorial					X				
			• Solve problem related to single and multiple equilibrium contact stages.	Lecture, Tutorial			X						
	9		• Identify and describe the types of absorption columns	Lecture					X		4.5	8	12.5
			• Solve material and energy balance in various type of absorption column.	Lecture, Tutorial				X		X			
	10		• Determine the basic design parameters in absorption process.	Lecture, Tutorial					X	X	3	3	6
5	11	**Extraction** • Single-Stage Liquid-Liquid Extraction Processes	• Describe, explain and classify the types of extraction processes.	Lecture, Tutorial					X		4	4	8

Chapter	Week	Topic	Topic Outcomes (TO)	Delivery Methods	Assessment						SLT		
					T01	T02	Q	A	P	FE	Contact Hour	Learning Hour	Total SLT
		• Equipment Liquid-Liquid Extraction • Continuous Multistage Countercurrent Extraction	• Explain the basic principle of extraction (Liquid-Liquid and Solid-Liquid)	Lecture, Tutorial					X				
	12	• Introduction and Equipment for Liquid-Solid Leaching • Equilibrium Relations and Single Stage Leaching	• Determine the operation conditions and the number of stages needed in various extraction processes.	Lecture, Tutorial			X	X	X	X	5	10	15
	13	• Countercurrent Multistage Leaching • Properties of Pure Supercritical Fluids • Process Concept in Supercritical Fluid Extraction • Phase Equilibrium and Mass Transfer in Supercritical Fluid Extraction	• Explain the basic fundamental of supercritical fluids extraction process.	Lecture, Tutorial					X		4	4	8
	14	**Revision**	• Review the topics cover in the teaching plan • Pre-assessment the students understanding level								4	4	8

Remarks:

T01 = Test 1
T02 = Test 2
Q = Quiz
A = Assignment
P = Project
FE = Final Exam