LONDON SOUTH BANK UNIVERSITY

unit guide

Principles of Separation & Reaction

Unit Leader: Dr Samuel Larkai

SCE-2-123

This unit guide is designed to help you structure your learning by providing an indicative structure and content for the unit. It is a guide and not a definitive statement of what you will be taught. We will try to follow this published schedule as far as possible, but there may be some variation as the unit develops and as we try to match the pace and content of our teaching to student needs.

Faculty of Engineering Science & The Built Environment

2007/2008

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UNIT SCE-2-123, PRINCIPLES OF SEPARATION & REACTION

Basic data

Level:	2	***Subject area:***	SAS1
Credit value	1	***Semester***	1
Class contact hours	Lectures: 48 Practicals: 18	***Student managed study hours***	84
Pre-requisites	Transfer Processes , Thermodynamics		
Unit leader	S Larkai	*Room:E244*	*Tel: 020 7815 7913*
			E-mail: larkais@lsbu.ac.uk
Other teachers	Richard Cadbury	Room B229	Tel: 020 7815 7925 Email: cadburrg@lsbu.ac.uk

Assessment

Element	*Description*	*Weighting*
Coursework	4 (four)laboratory reports and 1 (one)short test. NB: laboratory notebooks showing lab results and observations will also be assessed. (See separate instructions)	30%
Examination	2 hour unseen examination	70%

Short introduction to the unit

The separation processes part of the unit covers the basic concepts and principles underlying the physical separation of ideal binary liquid mixtures. It also covers the design of stage-wise and differential distillation and gas absorption processes for the separation of ideal binary mixtures.

The reactors part of the unit covers the basic principles of reaction equilibrium, reaction kinetics and reactor design.

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	of stages. Contact efficiency.	
9	***Simple Distillation Methods*** Flash distillation. Batch distillation. Steam distillation	Understand simple (batch) distillation methods and their applications
10- 11	***Gas Absorption*** Key feature of gas absorption. Equilibrium curve and operating line. Design of differential gas absorption concept of transfer unit and height of transfer unit. Development of design equations for differential gas absorption. Calculation of NTU and HTU	(i)understand the key features of gas absorption ii) understand the concept of transfer unit and how this is used in the design and analysis of differential gas absorption iii) know how to determine the height of differential column
12	***Review***	

Principles of Reaction

Topic	Content	Outcome Understand..., solve problems with...
1	**Introduction** Economic importance of reaction step. What constitutes a reactor?-different types. Safety, environment, sustainability. Aspects of reaction engineering: material and energy balances, equilibrium, kinetics, mechanism, catalysis, ideal reactor models, heat and mass transfer. Limitations of reactor modelling. Real reactors: development and engineering.	...importance of chemical reactors, and reaction engineering. ...what to expect on course, and key concepts.
2	**Reactor thermodynamics (1)** ΔH and its calculation.	
3	**Reactor thermodynamics (2)** Equilibrium and the free energy curve K and its relation to ΔG Le Chatelier's principle	...ΔG, ΔH, ΔS. ...Van't Hoff equation ...reaction equilibria ...real reactors, and the approach to equilibrium.
4	**Reaction kinetics** Reaction of order 0, 1, 2, 3. Rate constant k, rate equation, differential and integral forms. Arrhenius equation for k, and theoretical grounding for it.	...reaction order (esp 0 and 1). ...Arrhenius equation. ...effect of temperature on rate.
5	**Catalysis** Catalysis = money. Importance of catalysts in chemical processing, also vehicle emissions. Physical principles of catalysis. Homogeneous catalysis.	...key concepts of catalysis. ...activation energy. ...reaction mechanisms. ...Langmuir isotherm. ...examples of heterogeneous

Batch reactor studies

Residence time in stirred tanks

Plug flow reactor studies

(All laboratory sessions are located in Room E241)

Guidance Notes on Laboratory Practicals

A Attendance and Punctuality

Laboratory sessions are as indicated on the published class timetables. No student will be allowed into a lab session more than 15 minutes late. Please make sure you arrive for your lab sessions on time.

Reports will not be accepted from students who do not attend the relevant lab session, and students who miss a lab session without proof of mitigating circumstances will not be given further opportunity to do the lab study.

B Safety

You would all have received copies of the lab safety document when you enrolled. Make sure you are familiar with what the document says about lab safety.

Safety must be observed at all times. Please DO NOT do anything that may place your safety and that of other users of the lab at risk.

Ask for assistance if you are not sure about how to use or operate an apparatus or equipment. An experienced technician will be present at all lab sessions.

DO NOT attempt to repair any faults (mechanical, electrical etc). Bring any faults to the attention of the lab technician.

Do make sure to wear appropriate safety clothing whilst in attendance at lab sessions. These include lab coats and safety glasses where specified.

C Laboratory Reports

Refer to "Notes on Laboratory Reports" issued to all students at the start of the academic year. However note that assessment will be based on the following key points, which must therefore be covered in your reports.

- Summary

  must include brief statements on the following:

  i. Topic investigated and its significance in chemical engineering

  ii. Objectives of laboratory study

  iii. Equipment used

  iv. Key results

  v. Main conclusions

  vi. What you have learned from the lab study.

- Introduction

  i. Background, including theory and the importance of the topic investigated in chemical engineering.

  ii. Objectives of lab study (must be stated in introduction as well as summary)

- Experimental Equipment

  i. Drawing showing layout of equipment

  ii. Brief description indicating any special features, capacities, range, make and type (Do Not copy

- Students are reminded that the University has a policy on late submission of coursework, plagiarism, and on claiming for mitigating circumstances. These entail strict penalties for unauthorised late submissions and plagiarism.

A pass is required in **both** the coursework **and** the examination in order to pass the unit as a whole. A summary of the marks allocation is as follows:

	% of Unit Marks
Coursework	30%
Examination	70%
Total	100%

Recommended reading

Core reading

Unit Operations of Chemical Engineering, 5th ed., W.L. McCabe & J.C. Smith, McGraw-Hill,

1993.

Chemical Engineering, Vol. 2. 4th ed., J.M. Coulson & J. F. Richardson, Pergamon, 1991.

Mass Transfer in Engineering Practice, A. L. Lydersen, Wiley 1985.

Separation Process Principles, 2nd ed., J.D. Seader & Ernest J. Henley, John Wiley & Sons 2006.

Physical chemistry: Chemical principles: the quest for insight; P.Atkins, L.Jones. 3rd edition 2005; Freeman. *(Or earlier works by Atkins & Jones)*

Chemical reactors: Introduction to chemical reaction engineering and kinetics; R.Missen, C.Mims, B.Saville; 1999; Wiley.

Catalysis: Catalytic chemistry; B.C.Gates; 1992; Wiley

Concepts of modern catalysis and kinetics; I.Chorkendorff, W.Niemantsverdriet; 2003, Wiley.

Background reading

Mass Transfer Operations, 2nd ed., R. E. Treybal, McGraw-Hill, 1980.

Transport Processes and Unit Operations, 3rd ed., C. J. Geankopolis, Prentice-Hall, 1993.

Chemical Engineering Kinetics, 3rd ed., J.M. Smith, McGraw-Hill, 1981.

Chemical Reaction Engineering Kinetics, 3rd ed., O Levenspiel, Wiley 1999.

Optional reading

Mass Transfer, T.K. Sherwood et al., McGraw-Hill, 1975.

Principles of Unit Operations, A. S. Foust et al., Wiley, 1975