

**Unit summary**

This unit is about the physical bases of separation processes involving gas absorption, distillation, liquid extraction, fluid-solid systems and other common methods.

**Aims**

The unit aims to equip the candidate with the expertise required in the selection, design and evaluation of industrial separation processes.

**Prerequisites**

It is expected that candidates will have a working knowledge of the materials in the four compulsory papers of the Certificate examination.

**Learning outcomes**

There are **five** outcomes to this unit. The candidate will be able to:

- Understand and analyse gas absorption/ desorption (stripping)
- Understand and analyse distillation
- Understand and analyse liquid-liquid extraction
- Understand and analyse various fluid-solid separation processes
- Understand other specified separation process

**Guided learning hours**

It is recommended that 300 hours should be allocated for this unit. 120 of those hours are actual taught hours. This may be on a full time or part time basis.

**Key Skills**

This unit contributes towards the Key Skills in the following areas:

## N4.1

Develop a strategy for using application of number skills over an extended period of time.

## N4.2

Monitor progress and adapt your strategy, as necessary, to achieve the quality of outcomes required in work involving:

- deductive and inferential reasoning;
- algebraic manipulation.

## N4.3

Evaluate your overall strategy and present the outcomes from your work, including use of charts, diagrams and graphs to illustrate complex data.

## PS4.1

Develop a strategy for using skills in problem solving over an extended period of time.

PS4.2

Monitor progress and adapt your strategy, as necessary, to achieve the quality of outcomes required when tackling **one** complex problem with at least three options.

PS4.3

Evaluate your overall strategy and present the outcomes from your work using a variety of methods

### **Occupational Standards**

This unit has been mapped to the following National Occupational Standards:

- 1.1.1 Identify the requirements of clients for engineering products or processes
- 1.1.2 Produce specifications for engineering products or processes
- 1.4.1 Establish a design brief for engineering products or processes
- 1.4.2 Develop a strategy for the design process
- 1.4.3 Create designs for engineering products or processes
- 1.4.4 Evaluate designs for engineering products or processes
- 2.1.1 Determine the production requirements of engineering products and processes
- 4.1.1 Determine the operational requirements of engineering products or processes
- 4.3.1 Monitor operational processes
- 6.1.1 Analyse the risks arising from engineering products and processes
- 6.2.1 Assure the quality of engineering products or processes
- 8.1.1 Maintain and develop own engineering expertise

## **Unit 205**

## **Separation processes in chemical engineering**

### Outcome 1

Understand and analyse gas absorption/  
desorption (stripping)

#### **Knowledge requirements**

##### **The candidate knows how to:**

- 1 interpret ideal and non-ideal gas-liquid equilibrium data
- 2 evaluate the mass transfer requirements of absorption and stripping columns using
  - a transfer unit method
  - b theoretical plate method
- 3 assess and correlate/predict efficiency of plate and packed columns
- 4 assess fluid mechanics related to the design of plate and packed columns
- 5 assess methods used for economic optimization of design

**Knowledge requirements**

**The candidate knows how to:**

- 1 analyse, predict and correlate vapour-liquid equilibrium data
  - a binary
  - b ternary
  - c multi-component
- 2 describe and analyse steady-state distillation including the fundamentals of stagewise continuous distillation processes applied to
  - a binary mixtures
  - b multi-component mixtures
- 3 solve problems involving varying molal overflow
- 4 describe and analyse flash distillation
- 5 assess
  - a vacuum distillation
  - b steam distillation
- 6 describe and analyse batch distillation
  - a with and without hold-up
  - b time to reach equilibrium
- 7 assess and correlate/predict efficiency of plate and packed columns
- 8 assess and optimise the design of distillation equipment
- 9 assess methods used for economic optimization of design

## Unit 205

## Separation processes in chemical engineering

### Outcome 3

### Understand and analyse liquid-liquid extraction

#### Knowledge requirements

#### The candidate knows how to:

- 1 determine and represent phase equilibria in immiscible/partially miscible liquid-liquid systems
- 2 select solvents
- 3 calculate the equilibrium stage requirements in batch and in continuous co-current and counter-current extractions
- 4 apply the transfer unit method of column design
- 5 assess counter-current extraction with reflux
- 6 assess fluid mechanics in columns and mixer settlers
- 7 assess and correlate/predict efficiency of plate and packed column rate data
- 8 assess the design of liquid-liquid-extraction equipment
- 9 analyse economic optimization methods of design

## Unit 205

## Separation processes in chemical engineering

### Outcome 4

Understand and analyse various fluid-solid separation processes

#### Knowledge requirements

##### The candidate knows how to:

- 1 analyse leaching
  - a use of equilibrium data
  - b equilibrium stage calculations in co-current and counter-current leaching
  - c rate of leaching
  - d leaching equipment design
- 2 analyse fluid solids separation processes
  - a sedimentation and thickening
  - b flotation
  - c filtration equation
  - d filtration equipment types
- 3 understand the general principles of precipitation and crystallisation
  - a process fundamentals
  - b equipment selection

## Unit 205

## Separation processes in chemical engineering

### Outcome 5

Understand other specified separation process

#### **Knowledge requirements**

##### **The candidate knows how to:**

- 1 understand the general principles of
  - a membrane separation processes
  - b absorption
  - c ion exchange
- 2 make an informal choice of process for a specific separation requirement

## Unit 205 Separation processes in chemical engineering

### Recommended reading list

<b>Core texts</b>	<b>Author(s)</b>	<b>Publisher</b>	<b>ISBN</b>
Chemical Engineering Particle Technology and Separation Processes, Vol 2	Coulson, Richardson	Butterworth-Heinemann	0750629428
Chemical Engineering, Vol 6	Coulson, Richardson, Sinnott	Pergamon Press	0080229700
Mass Transfer Operations	Treybal	McGraw Hill	0070666156
Principles of Unit Operations	Foust, Wenzel, Crump, Maus	John Wiley	0471047872
Unit Operations of Chemical Engineering	McCabe, Smith, Harriott	McGraw Hill	0070448442
<b>Other useful texts</b>			
Gas Purification Processes for Air Pollution Control	Kohl, Nielsen	Gulf Publishing Co	0884152200
Perry's Chemical Engineer's Handbook	Perry, Green	McGraw Hill	0071159827
Liquid Extraction	Treybal	McGraw Hill	
Mass Transfer	Sherwood, Pigford, Wilke	McGraw Hill	
Principles of Chemical Separations with Environmental Applications	Nobel, Terry	Cambridge University	
Separation Processes	Judson King	McGraw Hill	