

## Unit 107

## Electrical and electronic engineering

### Unit summary

This unit is about the development of a thorough understanding of the principles of electrical and electronic systems including the analysis and performance of circuits. It also includes electrical/electronic measuring systems and analogue/digital communication systems.

### Aims

This unit aims to develop ac and dc electrical principles relating to circuits, transformers and rotating machines. It also aims to develop skills in the design of sequential logic circuits and the use of measuring and instrumentation techniques.

### Prerequisites

Complex numbers, Boolean algebra.

Electrical properties of materials, conduction processes, semiconductors, pn junctions, simple diode and transistor characteristics, field effect transistors, magnetic materials.

Charge, voltage, current, resistance (Ohms Law), capacitance, inductance.

Passive dc circuits, Kirchoff's Laws.

Direct current, alternating current, elementary treatment of power, electrical generators and rectification.

Electric and magnetic fields and basic principles of electromagnetism.

### Learning outcomes

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

- Perform basic calculations on the performance of ac and dc circuits and equipment
- Analyse the performance of diode circuits, transistor and operational-amplifier circuits
- Design combinational and sequential logic circuits
- Use measuring instruments and analyse instrumentation systems
- Understand A/D and D/A conversion and modulation

### 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.

### **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
- 2.2.2 Solve production problems with engineering solutions
- 3.1.1 Determine the installation requirements for engineering products or processes
- 3.1.2 Specify installation methods and procedures to achieve installation requirements
- 4.1.1 Determine the operational requirements of engineering products or processes
- 4.2.2 Solve operational problems with engineering solutions
- 6.2.1 Assure the quality of engineering products or processes
- 8.1.1 Maintain and develop own engineering expertise

## **Unit 107**

## **Electrical and electronic engineering**

### Outcome 1

Perform basic calculations on the performance of ac and dc circuits and equipment

#### **Knowledge requirements**

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

- 1 analyse ac and dc single phase circuits
- 2 recognise steady-state and transient responses in ac and dc circuits
- 3 apply network theorems to ac and dc circuits
- 4 undertake mesh and nodal analysis
- 5 determine power and power factors
- 6 determine resonance and Q-factor
- 7 analyse balanced three-phase systems
- 8 appraise the characteristics of transformers
- 9 appraise the characteristics of rotating machines

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### Outcome 2

Analyse the performance of diode circuits, transistor and operational-amplifier circuits

#### Knowledge requirements

##### The candidate knows how to:

- 1 employ diode circuits for
  - a rectification
  - b limiting
  - c clamping
- 2 assess power supplies for
  - a smoothing
  - b regulation
- 3 review transistor characteristics
- 4 ascertain small-signal parameters
- 5 develop amplifier circuit configurations
- 6 determine
  - a current and voltage gain
  - b input and output impedances
  - c matching
- 7 analyse feedback in amplifier circuits
- 8 design and analyse operational amplifier circuits
  - a operational-amplifier characteristics
  - b operational-amplifier applications
- 9 analyse oscillator circuits

## **Unit 107**

Outcome 3

## **Electrical and electronic engineering**

Design combinational and sequential logic circuits

### **Knowledge requirements**

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

- 1 design combinational and sequential logic circuits
- 2 recognise logic families
- 3 examine and appraise computer hardware components

## **Unit 107**

Outcome 4

## **Electrical and electronic engineering**

Use measuring instruments and analyse instrumentation systems

### **Knowledge requirements**

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

- 1 select and use a variety of measuring instruments appropriate to
  - a single-phase ac circuits
  - b three-phase ac circuits
  - c dc circuits
- 2 select a variety of measuring instruments appropriate to
  - a diode circuits
  - b transistor circuits

## **Unit 107**

Outcome 5

## **Electrical and electronic engineering**

Understand A/D and D/A conversion and modulation

### **Knowledge requirements**

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

- 1 convert analogue instrumentation readings to digital signals
- 2 convert digital signals to analogue readings
- 3 operate and interpret communication systems to include
  - a amplitude modulation
  - b frequency modulation
  - c bandwidth, sidebands and power

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### Recommended reading list

<b>Core texts</b>	<b>Author(s)</b>	<b>Publisher</b>	<b>ISBN</b>
Electrical Technology Chapters 3, 4, (5), (8), 9 - 15, 17 - 19, 21, 22, 26, 27, 32 - 34, 35, 37 - 39, 44 & 45	Hughes; revised by McKenzie	Longman Higher Education	0582226961
Electronic and Electrical Engineering	Warnes	Palgrave Macmillan	0333743113
Principles and Practice Chapters 1 - 4, 7 - 9, 13 - 16, 19 - 21, 23, 24 & 28			0333743113