

Title:	Electrical Machines and Applications
Level:	5
Credit value:	8
GLH:	50
Unique Reference Number:	H/651/4806
Sector Subject Area:	4.1 Engineering and Manufacturing
Aim:	The aim of this unit is to provide learners with theoretical knowledge and practical skills to understand, operate, and analyse DC generators, DC motors, AC circuits, transformers, and single-phase and three-phase induction motors, emphasizing their construction, principles of operation, and industrial applications.
Assessment Type:	The Assessment is internally set and internally assessed by the centres
Assessment Guidance:	The centre devises the assessment and they can use formative and summative assessments in their process. The summative assessment must outweigh the formative assessment to determine outcomes to the unit.

Learning outcomes

The learner will:

1. Be able to understand the properties and uses of electrical materials and components.

Delivery content:

The aim of this learning outcome is to provide learners with knowledge of electrical materials and their uses in machine construction and operation.

The learner must:

- 1.1: Describe the properties and uses of conducting materials, such as copper and aluminium.
- 1.2: Explain the properties and applications of insulating materials used in electrical engineering.
- 1.3: Identify different types of magnetic materials and their uses in electrical machines.

2. Be able to analyse the construction, working principles, and applications of DC machines.

Delivery content:

The aim of this learning outcome is to enable learners to analyse the construction, operation, and performance of DC machines.

The learner must:

- 2.1: Explain the construction and principles of operation of DC generators and motors.
- 2.2: Classify DC generators and motors and analyse their characteristics and applications.
- 2.3: Calculate back EMF, torque, and efficiency in DC machines.
- 2.4: Evaluate methods for speed control and starting of DC motors.
- 2.5: Explain the parallel operation of DC generators.

3. Be able to evaluate AC circuits and their characteristics, including power factor and Q-factor.

Delivery content:

The aim of this learning outcome is to equip learners with skills to evaluate the performance of AC circuits and calculate power and efficiency parameters.

The learner must:

- 3.1: Represent phasors mathematically and perform operations such as addition and multiplication.
- 3.2: Analyse AC series and parallel circuits containing resistance, inductance, and capacitance.
- 3.3: Calculate active, reactive, and apparent power in AC circuits.
- 3.4: Evaluate Q-factor and its significance in AC circuits.

4. Be able to understand the construction, operation, and testing of transformers.

Delivery content:

The aim of this learning outcome is to help learners understand and test transformers for industrial applications.

The learner must:

- 4.1: Explain the construction and principles of operation of single-phase transformers.
- 4.2: Derive the EMF equation and voltage transformation ratio of transformers.

<p>4.3: Analyse transformer losses and efficiency using open-circuit and short-circuit tests.</p> <p>4.4: Evaluate the parallel operation of transformers.</p> <p>4.5: Interpret phasor diagrams for transformers under load and no-load conditions.</p>
<p>5. Be able to analyse the working principles and industrial applications of three-phase and single-phase induction motors.</p>
<p>Delivery content:</p> <p>The aim of this learning outcome is to enable learners to analyse the principles and applications of three-phase and single-phase induction motors.</p> <p>The learner must:</p> <ul style="list-style-type: none">5.1: Describe the construction and operation of three-phase induction motors and their starting methods.5.2: Calculate synchronous speed, slip, and power factor for three-phase induction motors.5.3: Explain the principles and operation of single-phase induction motors, including capacitor and shaded pole types.5.4: Identify industrial applications of three-phase and single-phase induction motors.
<p>6. Be able to apply practical skills to operate, connect, and test electrical machines.</p>
<p>Delivery content:</p> <p>The aim of this learning outcome is to develop practical skills in connecting, operating, and testing electrical machines and setups.</p> <p>The learner must:</p> <ul style="list-style-type: none">6.1: Connect and operate DC generators and motors, including series, shunt, and compound motors.6.2: Perform short-circuit and open-circuit tests on transformers to determine losses and efficiency.6.3: Operate three-phase induction motors using DOL and star-delta starters.6.4: Test the speed control of DC motors using field and armature control methods.6.5: Construct a switchboard using common electrical components.

Scope of Training

The Scope of Training identifies areas that must be covered during the delivery of this unit. This is the minimum that is expected but tutors are expected to include other areas, knowledge of which will benefit their learners, based on location, types of work available and from the tutors own professional experience.

Electrical Materials

- Study the properties of conducting, insulating, and magnetic materials.
- Explore their applications in electrical machines.

DC Machines

- Analyse the construction and principles of DC generators and motors.
- Study their applications, efficiency, and methods of speed control.

AC Circuits

- Perform phasor operations and analyse AC circuits.
- Calculate power and Q-factor in series and parallel circuits.

Transformers

- Study transformer construction and phasor diagrams.
- Conduct open-circuit and short-circuit tests to evaluate efficiency and losses.

Induction Motors

- Explore the principles and operation of three-phase and single-phase induction motors.
- Calculate performance parameters like slip and power factor.

Practical Skills

- Operate, connect, and test electrical machines, including DC generators, motors, transformers, and induction motors.
- Construct switchboards and test electrical setups.