

# Delivery Unit

<b>Learning Outcomes</b> The learner will:	<b>Assessment Criteria</b> The learner can:	<b>Delivery Advice</b> (not exhaustive):
<b>7. Understand electrical supply systems.</b>  <i>(This outcome is assessed by a graded written paper)</i>	<b>7.1 Describe how electricity is generated and transmitted for domestic and industrial/commercial consumption.</b>	Cover: <ul style="list-style-type: none"> <li>Power Stations, fossil fuels, hydro; nuclear.</li> <li>Super-grid and standard grid system, transformers, transmission voltages, distribution voltages, sub-stations, above and below ground distribution</li> </ul>
	<b>7.2 Specify the features and characteristics of a generation and transmission system.</b>	
	<b>7.3 State the basic operating principles of other sources of electricity.</b>	Other sources: batteries, cells or UPS systems, solar power (thermal and photovoltaic), wind energy, wave energy, micro hydro, combined heat and power (CHP) including micro CHP.
	<b>7.4 Describe the main characteristics of:</b> <ul style="list-style-type: none"> <li>single phase electrical supplies</li> <li>three phase electrical supplies</li> <li>three phase and neutral supplies</li> <li>sub-station transformers.</li> </ul>	Link to criteria 8.8. Also cover PME and PEN conductors.
	<b>7.5 Identify types of transformers.</b>	Such as: auto, current, voltage, isolating etc.
	<b>7.6 Describe the operating principles, applications and limitations of transformers.</b>	Operating principles, applications and limitations: <ul style="list-style-type: none"> <li>Iron loss, copper loss</li> <li>Relationship between current and voltage and primary and secondary windings</li> <li>Step up and step down transformers.</li> </ul>
	<b>7.7 Determine by calculation and measurement:</b> <ul style="list-style-type: none"> <li>primary and secondary voltages</li> <li>primary and secondary current</li> <li>kVA rating of a transformer.</li> </ul>	Criteria 7.7 is assessed by a centre marked practical (Transformers).

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<b>Learning Outcomes</b> The learner will:	<b>Assessment Criteria</b> The learner can:	<b>Delivery Advice</b> (not exhaustive):
<b>8. Understand how different electrical properties can affect electrical circuits, systems and equipment.</b>  <i>(This outcome is assessed by a graded written paper)</i>	<b>8.1 Explain the relationship between resistance, inductance, capacitance and impedance.</b>	Cover the relationship in simple RLC series; and parallel circuits. Cover the relevant phasor diagrams.
	<b>8.2 Determine electrical quantities in alternating current circuits.</b>	Electrical quantities: Resistance, inductance, Inductive reactance, capacitance, capacitive reactance; Impedance.
	<b>8.3 Explain the relationship between kW, kVAr, kVA and power factor.</b>	Cover the power triangle (and also the voltage and impedance triangle). Active/True Power (kW), Reactive Power kVAr); Apparent Power (kVA).  (Further note: in electrical engineering Active power is denoted by P, Apparent power by S, and reactive power Q. For further study on this topic and also complex numbers - please see L3 Engineering VRQs offered by EAL).
	<b>8.4 Calculate power factor.</b>	R/Z
	<b>8.5 Explain what is meant by power factor correction.</b>	Bringing the power factor closer to unity by reducing the undesirable effects of reactive power.
	<b>8.6 Specify methods of power factor correction.</b>	Local correction at load using a single capacitor, bulk correction using capacitor banks. Use of a synchronous motor (e.g. driving a fan).
	<b>8.7 Determine the neutral current in a three-phase and neutral supply and why systems should be balanced.</b>	Phase current can be added phasorially.
	<b>8.8 Calculate values of voltage and current in star and delta connected systems.</b>	This can link back to 7.4. Cover: Line and phase voltage; and line and phase current.

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<b>Learning Outcomes</b> The learner will:	<b>Assessment Criteria</b> The learner can:	<b>Delivery Advice</b> (not exhaustive):
<b>9. Understand the operating principles and applications of d.c. machines and a.c. motors.</b>  <i>(This outcome is assessed by a graded written paper)</i>	<b>9.1 State the basic types, applications and describe the operating principles of d.c. machines.</b>	A d.c. machine relates to motors and generators.  Cover the following: <ul style="list-style-type: none"> <li>• Series</li> <li>• Shunt</li> <li>• Compound.</li> </ul> Cover basic types circuit diagrams. Cover commutation and the principles of these machines. Cover fundamental calculations.
	<b>9.2 Describe the operating principles of a.c. motors.</b>	a.c. motors: <ul style="list-style-type: none"> <li>• Single phase a.c. motors (split phase, induction, capacitor start-induction run, capacitor start and run, capacitor start - capacitor run) , universal, synchronous).</li> <li>• Three phase a.c. motors (induction, wound-rotor, synchronous).</li> </ul>
	<b>9.3 State the basic types, applications and limitations of a.c. motors.</b>	
	<b>9.4 Describe the basic operating principles, limitations and applications of motor control.</b>	Cover the following methods: Direct-on-line, star-delta, rotor-resistance, soft-start, variable frequency.
<b>10. Understand the operating principles of electrical components.</b>  <i>(This outcome is assessed by a graded written paper)</i>	<b>10.1 Specify the main types and operating principles of electrical components.</b>	Cover: <ul style="list-style-type: none"> <li>• Relays</li> <li>• Solenoids</li> <li>• Over-current protection devices: Fuses (HRC, cartridge and re-wireable), Circuit-breakers, RCBOs; RCDs, AFDDs.</li> </ul>

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<b>Learning Outcomes</b> The learner will:	<b>Assessment Criteria</b> The learner can:	<b>Delivery Advice</b> (not exhaustive):
<b>11. Understand the principles and applications of electrical lighting systems.</b>  <i>(This outcome is assessed by a graded written paper)</i>	<b>11.1 Explain the basic principles of illumination and state the applications of:</b> <ul style="list-style-type: none"> <li>• inverse square law</li> <li>• cosine law</li> <li>• lumen method.</li> </ul>	Cover the relevant calculations.  For luminaires cover:  General Lighting Service (GLS): <ul style="list-style-type: none"> <li>• Tungsten</li> <li>• Halogen.</li> </ul>
	<b>11.2 Explain the operating principles, types, limitations and applications of luminaires.</b>	Discharge lighting: <ul style="list-style-type: none"> <li>• Low and high pressure mercury vapour</li> <li>• Low and high pressure sodium vapour</li> <li>• Metal halide</li> </ul> <ul style="list-style-type: none"> <li>• Energy saving (such as compact fluorescent lamps)</li> <li>• LED.</li> </ul>
<b>12.1 Understand the principles and applications of electrical heating.</b>  <i>(This outcome is assessed by a graded written paper)</i>	<b>12.1 Explain the basic principles of electrical space heating and electrical water heating.</b>	Electrical space and water heating appliances and components: <ul style="list-style-type: none"> <li>• Convection cycle</li> <li>• Conduction</li> <li>• Radiation</li> <li>• Immersion heaters</li> <li>• Storage heaters</li> <li>• Convector heaters</li> <li>• Under floor heating</li> <li>• Controls, timers and programmers for heating systems.</li> </ul>
	<b>12.2 Explain the operating principles, types, limitations and applications of electrical space and water heating appliances and components.</b>	