2016 Suite

OCR
Oxford Cambridge and RSA

Cambridge **TECHNICALS LEVEL 2**

Cambridge TECHNICALS 2016

ENGINEERING

Unit 4

Electrical, electronic engineering – operations and application

L/615/2134

Guided learning hours: 60

Version 1 September 2016

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LEVEL 2

UNIT 4: ELECTRICAL, ELECTRONIC ENGINEERING - OPERATIONS AND APPLICATION
L/615/2134

Guided learning hours: 60

Essential resources required for this unit: Circuit diagrams, electrical and electronic components and devices to construct circuits, interconnecting cables and connectors, hand tools (see specification), suitable PPE, test equipment (see specification)

This unit is internally assessed and externally moderated by OCR.

Unit aim

The aim of this unit is for learners to develop the knowledge, understanding and skills to be able to perform electrical operations safely.

Learners will develop knowledge and practical skills of:

- being able to work safely with electrical systems
- interpret circuit diagrams
- construct electronic circuits
- fault find electronic circuits.

TEACHING CONTENT

The unit content describes what has to be taught to ensure that learners are able to access the highest grade.

Anything which follows an i.e. details what must be taught as part of that area of content.

Anything which follows an e.g. is illustrative, it should be noted that where e.g. is used, learners must know and be able to apply relevant examples to their work though these do not need to be the same ones specified in the unit content.

Learning Outcome The Learner will:		Teaching Content The Learner must be taught:
1. Be able to work safely when undertaking electrical operations	1.1	current Health and Safety Executive standards (HSE) regulations and codes of practice relevant to performing electrical operations i.e. • the Electricity at Work Regulations • the Electrical Equipment (Safety) Regulations • Health & Safety at Work Act
	1.2	to follow safe working practises when undertaking electrical operations i.e. • produce and use safe work method statements for performing electrical operations • undertake risk assessments for electrical operations in accordance with HSE regulations • use appropriate Personal Protective Equipment (PPE)
	1.3	identify and reduce the risk of electrical hazards, i.e. • risks associated with working on live equipment i.e. o electrical isolation before testing o use of circuit protection (e.g. Residual Current Device (RCD), Magnetic Circuit Breaker (MCB)) • scheduled inspection of equipment (e.g. periodic/time based, usage/criterion based) • legal compliance i.e. o Portable Appliance Testing (PAT)
2. Be able to construct electronic circuits by interpreting circuit diagrams	2.1	to interpret circuit diagrams (i.e. schematic, block/ flow and complete circuit) i.e. circuit symbols i.e. • power source / power supply input • resistor fixed / variable (e.g. potentiometer) • capacitor non-polarised / polarised • switches and their contact arrangements • input devices (e.g. photodiode, phototransistor, LDR, thermistor, switch, microphone) • process devices (e.g. diode, transistor, logic gate, integrated circuit, microprocessor, microcontroller) • output devices (e.g. piezo-electric buzzer, lamp, light emitting diode, liquid crystal display, dot matrix display, relay, solenoid)

Learning Outcome The Learner will:		Teaching Content The Learner must be taught:
	2.2	connectors i.e. • connection terminal block • header • jack socket
	2.3	nets, nodes and labels i.e. • net (e.g. lines between component terminals) • nodes (e.g. junction where wires connect) • labels (e.g. identification of component name and value)
	2.4	voltage nodes on circuit diagrams (e.g. terminals connected to specific voltage level, terminals connected to ground/earth)
	2.5	use tools and equipment safely, i.e. • soldering iron • de-soldering tools • wire cutters • wire strippers • crimping tools • pliers • screwdrivers • allen keys / spanners • manual/PCB drills
	2.6	construct electronic circuit(s) i.e. • component assembly (e.g. static reduction, work holdings, heat sinks) • construction techniques, i.e. o use of heat sinks (e.g. delicate components) o soldering (e.g. preparation, type of solder, size of iron) o connecting i.e. ▪ components (e.g. bread board, PCB) ▪ plugs and sockets (e.g. type, current rating) ▪ cable assemblies (e.g. type, current rating)

Learning Outcome The Learner will:		Teaching Content The Learner must be taught:
3. Be able to test electronic circuits for functionality	3.1	electronic circuit functionality procedures, i.e. • data gathering i.e. o use of manuals, data sheets and functionality data o truth tables o expected values o flow chart • testing for functionality, i.e. o visual inspection o the half split method o six point diagnostic technique i.e. ▪ gather evidence (e.g. run tests to establish functionality/faults) ▪ analyse results (e.g. compare data and readings) ▪ identify and locate any fault(s) ▪ rectify any fault(s) ▪ determine and remove cause(s) (if appropriate) ▪ run a systems check (e.g. to check confirm functionality/ fault(s) have been removed)
	3.2	use appropriate test equipment, i.e. • for voltage, current, resistance and continuity i.e. o multimeter (volts, amps, ohms) o power supply unit o for frequency (e.g. signal generator, oscilloscope, logic probe)

GRADING CRITERIA

Learning Outcome	Pass	Merit	Distinction
The learner will:	The assessment criteria which are the pass requirements for this unit.	To achieve a merit the evidence must show that, in addition to the pass criteria, the candidate is able to:	To achieve a distinction the evidence must show that, in addition to the pass and merit criteria, the candidate is able to:
1. Be able to work safely when undertaking electrical operations	P1*: Describe the relevant aspects of Health and Safety regulations, standards and codes of practice to carry out electrical operations		
	P2*: Carry out a risk assessment when performing electrical operations to include a safe working method statement		
2. Be able to construct electronic circuits by interpreting circuit diagrams	P3*: Interpret a circuit diagram to plan for construction of an electronic circuit	M1*: Explain construction techniques used to construct electronic circuits	D1*: Evaluate the quality of circuit construction and circuit functionality
	P4: Safely use tools to construct a circuit		
	P5*: Construct a circuit from a circuit diagram using appropriate component assembly and construction techniques		
3. Be able to test electronic circuits for functionality	P6*: Use data to perform functionality checks on electronic circuit(s)	M2*: Explain test procedures used to establish functionality and/or rectification of faults found in an electronic circuit.	
	P7*: Use appropriate test equipment and follow procedures to confirm electronic circuit functionality, rectifying any faults found		

ASSESSMENT GUIDANCE

Feedback to learners: you can discuss work-in-progress towards summative assessment with learners to make sure it's being done in a planned and timely manner. It also provides an opportunity for you to check the authenticity of the work. You must intervene if you feel there's a health and safety risk.

Learners should use their own words when producing evidence of their knowledge and understanding. When learners use their own words it reduces the possibility of learners' work being identified as plagiarised. If a learner does use someone else's words and ideas in their work, they must acknowledge it, and this is done through referencing. Just quoting and referencing someone else's work will not show that the learner knows or understands it. It has to be clear in the work how the learner is using the material they have referenced to inform their thoughts, ideas or conclusions.

For more information about internal assessment, including feedback, authentication and plagiarism, see the centre handbook. Information about how to reference is in the OCR Guide to Referencing available on our website: http://www.ocr.org.uk/i-want-to/skills-guides/.

P1
Learners could produce a report or presentation (including detailed speaker notes) to describe the relevant aspects of current Health and Safety Executive standards (HSE) regulations and codes of practice relevant to performing electrical operations i.e.

- The Electricity at Work Regulations
- The Electrical Equipment (Safety) Regulations
- Health & Safety at Work Act

P2
Learners must identify any initial risks specifically related to electrical operations. They should demonstrate their understanding with particular reference to circuit protection, isolation and legal compliance.
A safe working method statement should set out the work activities in logical sequence, identify hazards and describe control measures. To produce a safe working method statement, learners should:

- describe the activity or task to be undertaken
- identify the resources and skills associated with the task
- assess and select control measures
- plan the activity so it can be completed efficiently and effectively.

Learners should produce a completed risk assessment, a safe working statement and a report that identifies any initial risks specifically related to electrical operations.

P3
Tutors must provide learners with a circuit diagram from which learners will extract information on circuit components and connections, circuit layout and construction information. The circuit diagram must not contain any annotations as it is a requirement that learners interpret this diagram independently. To meet this criterion circuit diagrams must contain a sufficient number and variation of components that are both passive (e.g. resistors and capacitors) and active (e.g. transistors, diodes and integrated circuits). The components should form the basis of an electronic circuit that has input, process and output devices. For this unit there is no requirement for learners to programme the processing device. However, this circuit construction could be used for the starting point for Unit 5 Engineering systems control – operations and application.

Learners must identify circuit component symbols (e.g. nets (interconnecting wires), nodes (points where wires join) and component labels. Learners must identify blocks (e.g. areas of a circuit diagram such as a power supply, microprocessor, and display) and signal flow) in order to interpret a circuit diagram. P3 is linked with P5 where learners must then construct an electronic circuit.

Evidence of interpretation could be in the form of an annotated circuit diagram and plan including descriptions of components, component values and specific assembly requirements.

P4 & P5
Learners must use appropriate tools and techniques to safely construct electrical/electronic circuits. Tutors should ensure that circuits allow learners to demonstrate a range of construction techniques. Evidence of circuit construction could be in the form of a documentary record (e.g. log) which must include circuit diagrams, procedures and photographs of construction taking place.

P6 & P7
Learners must safely use appropriate test equipment and follow procedures to undertake electronic circuit functionality testing procedures. Learners should, where possible, use the circuit that they have constructed in LO2; however, learners could be provided with suitable examples on which to test electronic circuits for functionality. If testing results in faults being discovered these must be rectified. Evidence must be in the form of a fully functioning circuit (e.g. the physical circuit or photographic evidence, supported by a detailed witness statement) and a documentary record (e.g. log book) of a range of tests for functionality compared against data, including any rectifications to faults found.

M1
Learners could produce a report or presentation (including detailed speaker notes) to explain construction techniques used to construct electronic circuits. This should explain;

- use of heat sinks
- soldering
- connecting

M2
Learners should be able to demonstrate that they have been able to test a circuit and show where expected electrical values such as volts, amps, resistance and continuity are compared against expected values. Evidence of functionality and fault rectification (if applicable) should follow a prescribed test procedure. This could be in the form of a written report or presentation (including detailed speaker notes).

D1
Learners should be able to compare the constructed circuit and its functionality, quality and accuracy of assembly against the circuit diagram and any specialised assembly techniques such as use of heat sinks. Evidence should be in the form of an assembly log or portfolio which contains annotated photographs of the circuit being constructed, tested and any fault rectifications made. The quality of the circuit construction should feature in this evaluation, with reference to how well the components have been assembled and methods used to connect them, such as soldering and wire connections.

*SYNOPTIC ASSESSMENT AND LINKS BETWEEN UNITS

Unit 4 is one of the synoptic units within the Certificate and Diploma qualifications. Please see section 6 of the centre handbook for more detail. We have indicated in this unit where these links are with an asterisk and provided more detail in the synoptic assessment grid below.

Synoptic assessment grid

This unit and specific LO	Related unit	Related LO	Assessment requirements
Unit 4 LO1 Be able to work safely when undertaking electrical operations	Unit 1	LO1 1.1, 1.2, 1.3, 1.4 LO5	• Learners must use their understanding of electrical systems from Unit 2 when identifying relevant health and safety procedures required when undertaking electrical operations. • Learners must use their understanding of electrical and electronic devices from Unit 2 and select safe options when undertaking electrical operations. • Learners must use their knowledge of Health and Safety practices and procedures required in an engineering workplace from Unit 3 and apply this to working safely when undertaking electrical operations. This should include preparation of the working environment. • Learners should use their experience of performing safe and efficient working procedures for product assembly and manufacture in Unit 7 to working safely when undertaking electrical operations.
	Unit 2	LO4	
	Unit 3	LO1 1.1, 1.2, 1.3 LO2 2.1	
	Unit 5	LO2 2.1, 2.2 LO4 4.1	
	Unit 7	LO2 2.1, 2.2	
	Unit 8	LO3 3.1, 3.2, 3.3, 3.4	
Unit 4 LO2 Be able to construct electronic circuits by interpreting circuit diagrams	Unit 1	LO1 1.1, 1.2, 1.3, 1.4 LO5	• Learners must use knowledge of SI units and their derivatives from Unit 1 to interpret circuit diagrams
	Unit 2	LO4	• Learners must use their understanding of electrical and electronic devices and select electrical resistors and electrical capacitors to construct the electronic circuit. They will also need to draw on understanding of cable types, switches, motors and circuit protection in order to construct the electronic circuit.

This unit and specific LO	Related unit	Related LO	Assessment requirements
	Unit 3	LO1 1.1, 1.2, 1.3 LO2 2.1	• Learners will recognise schematic diagrams of basic programmable devices in circuit from Unit 5 and must apply this knowledge where appropriate to interpreting circuit diagrams. • Safe working from Unit 7 should inform how students carry out their circuit construction. • Learners should apply their experience of performing maintenance operations in Unit 8 when they construct their electronic circuit. They should consider common maintenance issues and seek to avoid these at the construction stage.
	Unit 5	LO2 2.1, 2.2 LO4 4.1	
	Unit 7	LO2 2.1, 2.2	
	Unit 8	LO3 3.1, 3.2, 3.3, 3.4	
Unit 4 LO3 Be able to test electronic circuits for functionality	Unit 1	LO1 1.1, 1.2, 1.3, 1.4 LO5	• Learners must use knowledge of SI units and their derivatives from Unit 1 to testing circuit functionality. • Learners must use their understanding of electrical and electronic devices to inform their tests on electronic circuit functionality. • Learners will recognise schematic diagrams of basic programmable devices in circuit from Unit 5 and must apply this knowledge where appropriate to inform their tests on electronic circuit. • Safe working from Unit 7 should inform how students carry out their circuit construction. • Learners should apply their experience of performing maintenance operations in Unit 8 to their tests on electronic circuit functionality where appropriate.
	Unit 2	LO4	
	Unit 3	LO1 1.1, 1.2, 1.3 LO2 2.1	
	Unit 5	LO4 4.1	
	Unit 7	LO2 2.1, 2.2	
	Unit 8	LO3 3.1, 3.2, 3.3, 3.4	

MEANINGFUL EMPLOYER INVOLVEMENT - A REQUIREMENT FOR TECHNICAL CERTIFICATE QUALIFICATIONS

These qualifications have been designed to be recognised as Technical certificates in performance tables in England. It is a requirement of these qualifications for centres to secure employer involvement through delivery and/or assessment of these qualifications for every learner.

The minimum amount of employer involvement must relate to at least one or more of the elements of the mandatory content.

Eligible activities and suggestions/ideas that may help you in securing meaningful employer involvement for this unit are given in the table below.

Please refer to the Qualification Handbook for further information including a list of activities that are not considered to meet this requirement.

Meaningful employer involvement – eligible activities	Suggestion/ideas for centres when delivering this unit
1. Students undertake structured work-experience or work-placements that develop skills and knowledge relevant to the qualification.	Placements with electrical/electronic employer working with the electrical maintenance department or electrical/electronic manufacturing department, investigating production and maintenance techniques.
2. Students undertake project(s), exercises(s) and/or assessments/examination(s) set with input from industry practitioner(s).	Project set on inspection and test of electrical assembly using industry standard equipment, to determine if equipment is safe and functioning correctly.
3. Students take one or more units delivered or co-delivered by an industry practitioner(s). This could take the form of master classes or guest lectures.	Talks from practicing electrical/electronic engineers involved in manufacture, installation or test of electrical/electronic equipment.
4. Industry practitioners operating as 'expert witnesses' that contribute to the assessment of a student's work or practice, operating within a specified assessment framework. This may be a specific project(s), exercise(s) or examination(s), or all assessments for a qualification.	Input and review from practicing electrical/ electronic engineers relating to the adoption of correct working practices, assembly methods and fault-finding techniques.

You can find further information on employer involvement in the delivery of qualifications in the following documents:

- Employer involvement in the delivery and assessment of vocational qualifications
- DfE work experience guidance

To find out more
ocr.org.uk/engineering
or call our Customer Contact Centre on **02476 851509**

Alternatively, you can email us on **vocational.qualifications@ocr.org.uk**

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