2016 Suite

OCR
Oxford Cambridge and RSA

Cambridge **TECHNICALS LEVEL 3**

Cambridge TECHNICALS 2016

ENGINEERING

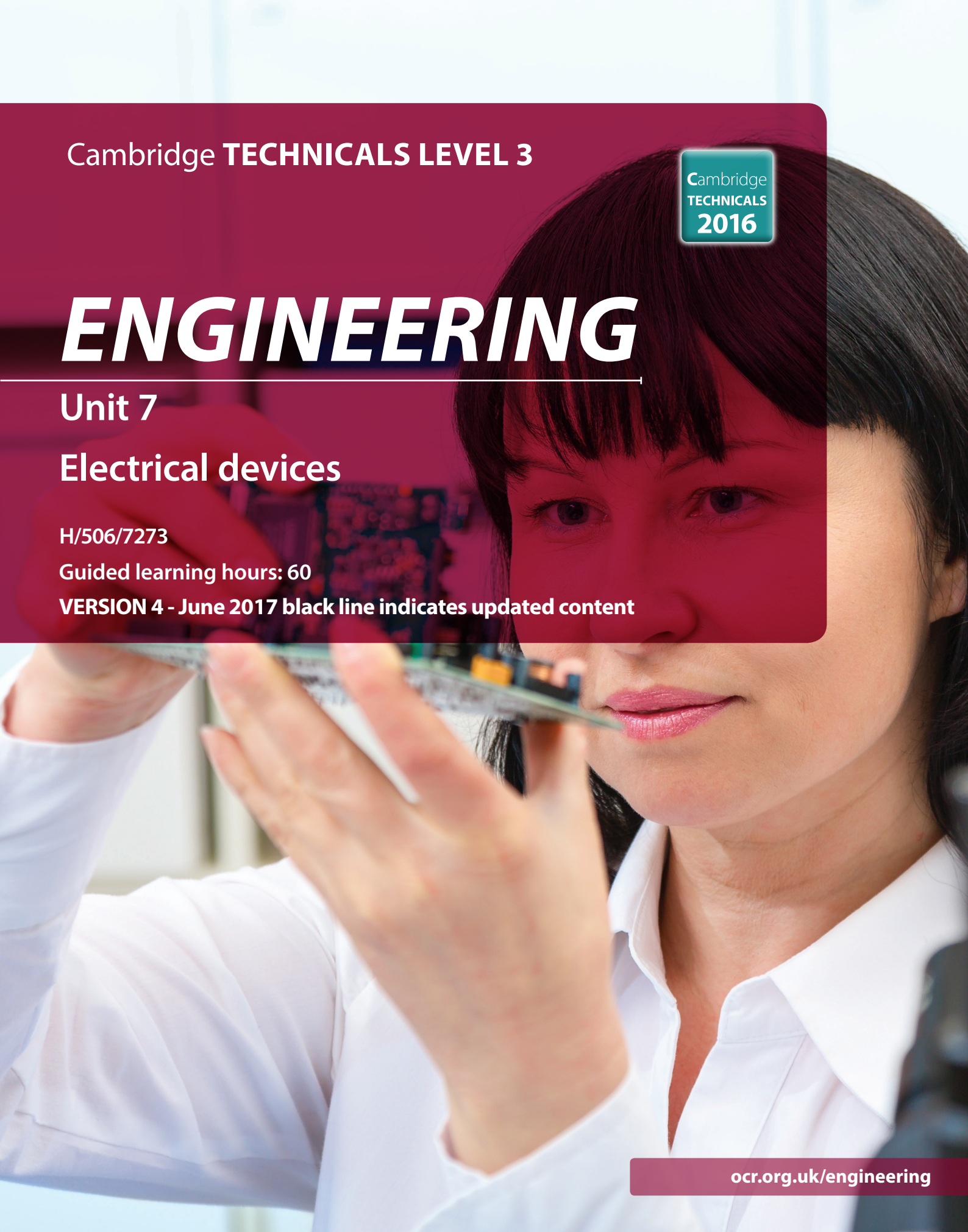
Unit 7

Electrical devices

H/506/7273

Guided learning hours: 60

VERSION 4 - June 2017 black line indicates updated content



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LEVEL 3

UNIT 7: ELECTRICAL DEVICES

H/506/7273

Guided learning hours: 60

Essential resources required for this unit: sensors and actuators for practical investigation

This unit is internally assessed and externally moderated by OCR.

UNIT AIM

Electrical devices in engineering companies are used for many purposes, from sensors and actuators used in robotic manufacture to programmable logic controllers (PLCs) which can control automated assembly lines.

The aim of this unit is for learners to develop knowledge and understanding of electrical devices including semi-conductor and programmable devices and sensors and actuators. They will also develop an understanding of their applications within electrical and electronic engineering companies.

Learners will also develop understanding of signal conditioning techniques and signal conversion devices, and on the use of smart and modern materials in electrical devices.

TEACHING CONTENT

The teaching content in every unit states what has to be taught to ensure that learners are able to access the highest grades.

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 in their work, although these do not need to be the same ones specified in the unit content.

For internally assessed units you need to ensure that any assignments you create, or any modifications you make to an assignment, do not expect the learner to do more than they have been taught, but they must enable them to access the full range of grades as described in the grading criteria.

Please note – if learners are completing this unit as part of the Extended Diploma qualification they will be required to complete the synoptic unit 25: Promoting continuous improvement. Before your learners complete the assessment of this unit, you must refer to the specification and model assignment requirements for unit 25, so if applicable you can ensure learners gather the appropriate feedback on their own performance and performance of the system, process or artefact that they may have produced in this unit.

Learning outcomes	Teaching content
The Learner will:	**Learners must be taught:**
1. Understand semi-conductor and programmable devices	1.1 application, function and operation of semi-conductor devices and circuits i.e. • thyristor • metal-oxide-semiconductor field-effect transistor MOSFET i.e. o voltage control o insulated gate bipolar transistor (IGBT) - single IGBT as a switch 1.2 application and function of programmable logic devices (PLDs) i.e. • programmable logic array (PLA) • programmable array logic (PAL) • field programmable gate array (FPGA) • static random access memory (SRAM) • electrically programmable read only memory (EPROM) • flash memory 1.3 internal architecture and typical system configurations (e.g. input ports, output ports, peripheral devices) for circuits using programmable devices i.e. • microprocessor • microcontroller • programmable interface controller (PIC) • programmable logic controller (PLC)
2. Understand electrical sensors and actuators	2.1 application, function and operation of electrical sensors used to measure a range of physical properties i.e. • light (e.g. photo-diode, phototransistor) • temperature (e.g. thermistor, thermocouple) • force/pressure (e.g. strain gauge, load cell) • position (e.g. optical encoder, linear variable differential transformer, hall effect sensor) • speed (e.g. tacho-generator, Doppler effect sensor) • flow (e.g. vane controlled potentiometer) • sound (e.g. microphone)

Learning outcomes	Teaching content
The Learner will:	**Learners must be taught:**
	2.2 application, function and operation of electrical actuators i.e. • electric linear actuator • electric rotary actuator • linear solenoid actuator
3. Understand how to use signal conditioning techniques and signal conversion devices	3.1 signal conditioning and interfacing i.e. • sensor output signal type i.e. o voltage o current (4-20mA current loop) • sensor calibration and scaling i.e. o use of sensor output calibration data o calculate voltage scaling using resistor potential divider or bridge circuits • filtering using operational amplifier (op-amp) circuits i.e. o low-pass filter o high-pass filter 3.2 function and operation of signal conversion devices i.e. • analogue to digital conversion • digital to analogue conversion • parallel to serial conversion • serial to parallel conversion 3.3 calculation of baud and bit rate for a serial data signal
4. Understand the application of smart and modern materials in electrical devices	4.1 application and operation of smart and modern materials in electrical devices i.e. • quantum tunnelling composite (QTC) • shape memory alloys (SMA) • electroluminescent (EL) materials i.e. o wire o panels o tape • electrochromic materials • conductive polymers • piezoelectric materials • electrostrictive materials • electrorheological (ER) fluids • thermoelectric materials • electro-optic materials

GRADING CRITERIA

LO	Pass	Merit	Distinction
	The assessment criteria 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. Understand semi-conductor and programmable devices	P1: Explain applications and functions of semi-conductors.	M1: Compare internal architecture and typical system configurations in programmable devices and systems.	D1: Analyse the operation of individual circuits containing a single thyristor, a single MOSFET and a single IGBT.
	P2: Explain applications and functions of programmable logic devices.		
2. Understand electrical sensors and actuators	P3: Identify applications and function of electrical sensors used to measure physical properties.	M2: Evaluate practically the operation of an electrical sensor and an electrical actuator.	
	P4: Explain applications and function of electrical actuators.		
3. Understand how to use signal conditioning techniques and signal conversion devices	P5: Describe sensor output signal types.	M3: Analyse the operation of analogue to digital and digital to analogue conversion devices.	D2: Evaluate the design of op-amp circuits for a high-pass and low-pass filter.
	P6: Calculate the value of resistors in a potential divider or bridge circuit to scale a sensor output voltage signal using sensor calibration data. **synoptic link to Unit 4 Principles of Electrical and Electronic Engineering*		

LO	Pass	Merit	Distinction
	P7: Explain the operation of serial to parallel and parallel to serial conversion devices. **Synoptic link to Unit 4 Principles of electrical and electronic engineering*		
	P8: Calculate baud and bit rate for a serial data signal.		
4. Understand the application of smart and modern materials in electrical devices	P9: Describe applications of smart and modern materials in electrical devices.	M4: Explain the operation of QTC in an electrical device and SMA in an electrical device.	

*SYNOPTIC ASSESSMENT AND LINKS BETWEEN UNITS

When learners are taking an assessment task, or series of tasks, for this unit they will have opportunities to draw on relevant, appropriate knowledge, understanding and skills that they will have developed through other units. We've identified those opportunities in the grading criteria. Learners should be encouraged to consider for themselves which skills/knowledge/understanding are most relevant to apply where we have placed an asterisk.

ASSESSMENT GUIDANCE

LO1: Understand semi-conductor and programmable devices
Learners should investigate the application and function of semiconductor and programmable devices. For M1 learners should focus on comparing the internal architecture and typical system configurations (e.g. inputs, outputs, peripherals) of programmable devices and systems. For D1 analysis of circuit operation is required for circuits containing a single thyristor, a single MOSFET and a single IGBT. Teachers might wish to supply suitable circuits for learners to analyse.

LO2: Understand electrical sensors and actuators
Learners should be able to explain the application and function of electrical sensors and actuators. For M2 a practical evaluation is required for a sensor and an actuator. Learners will require access to suitable sensors and actuators, and also appropriate equipment in order to evaluate these practically.

LO3: Understand how to use signal conditioning techniques and signal conversion devices
Learners should be able to explain sensor output signal types, and be able to explain and analyse signal conditioning, interfacing and filtering techniques.

LO4: Understand the application of smart and modern materials in electrical devices
Learners should be able to describe and explain the application of smart and modern materials in electrical devices.

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/.

MEANINGFUL EMPLOYER INVOLVEMENT - a requirement for the Foundation Diploma, Diploma and Extended Diploma (tech level) qualifications

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

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 engagement	Suggestion/ideas for centres when delivering this unit
1. Learners undertake structured work-experience or work-placements that develop skills and knowledge relevant to the qualification.	Placements with working with electrical/electronic engineering businesses, researching their use of electrical devices in the manufacture of products.
2. Learners undertake project(s), exercises(s) and/or assessments/examination(s) set with input from industry practitioner(s).	A task set by a practicing electrical engineer for learners to assess the use of electrical devices in a given business, e.g. electrical devices which use new and smart materials and how these have impacted on the business.
3. Learners 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.	Lecture from practicing electrical engineers involved in the manufacture of products which incorporate electrical devices. Content could include practical examples of how sensors, actuators and programmable devices are used in their own commercial engineering business.
4. Industry practitioners operating as 'expert witnesses' that contribute to the assessment of a learner'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.	Review from practicing electrical engineers of learners' knowledge of the use of electrical devices which use modern and smart materials in engineering business, focussing on a given example.

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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