2016 Suite

OCR
Oxford Cambridge and RSA

Cambridge **TECHNICALS LEVEL 3**

Cambridge TECHNICALS 2016

ENGINEERING

Unit 14

Automation control and robotics

A/506/7280

Guided learning hours: 60

VERSION 4 -June 2017 black line indicates updated content

LEVEL 3

UNIT 14: AUTOMATION CONTROL AND ROBOTICS

A/506/7280

Guided learning hours: 60

Essential resources required for this unit: none

This unit is internally assessed and externally moderated by OCR.

UNIT AIM

Many companies use automation control devices to run manufacturing, production and other processes such as power generation. These machines require specialist engineers to design, manufacture, operate and maintain them. Industrial robots are also increasingly commonly used in automation control systems.

The aim of this unit is for learners to develop knowledge and understanding of automation control systems in industry. They will develop understanding of control system theory and how this is implemented in automation control systems.

They will develop an understanding of how sensors and actuators are used in automation control systems, about industrial network systems including industrial communication standards (e.g. controller area network (CAN) bus), and the role of maintenance for automation control systems.

They will also gain an understanding of the application of robotics in automation control systems, including aspects of robotic operation.

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 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 control system theory in engineering	1.1 open loop control systems i.e. • open loop=no feedback • applications 1.2 closed loop control systems, i.e. • closed loop= feedback • applications 1.3 advantages and disadvantages of open loop and closed loop systems 1.4 functional representation of control systems using block diagrams, i.e.: • input and output • transfer function • feedback • summing points 1.5 the relationship of input to output including steady state error 1.6 feedback and performance in closed loop systems, i.e.: • time dependency • under damped • over damped 1.7 pulse width modulation and amplitude modulation as a means of control 1.8 advantages and disadvantages of analogue and digital control systems
2. Understand the implementation of control in automated systems	2.1 the application of embedded control systems, i.e. • microprocessors • Programmable Interface Controllers (PICs) • Programmable Logic Controllers (PLCs) 2.2 the basic architecture of a PLC (e.g. inputs, outputs, counters, timers, programming) 2.3 Analogue-to-Digital and Digital-to-Analogue (A-D and D-A) converters and their use in industrial control systems

Learning Outcomes	Teaching Content
The Learner will:	**Learners must be taught:**
3. Understand sensors and actuators used in automation control systems	3.1 the role of sensors and actuators in a control system (e.g. sensor detects an object's position on an assembly line; actuator controls movement of an arm to pick up the object) 3.2 types of sensors, i.e. • analogue • digital • active • passive 3.3 examples of sensors e.g. switches, proximity sensors, laser, vision systems 3.4 applications of sensors for measurement i.e • acoustic • biological • chemical • thermal • electrical • mechanical • optical • radiation 3.5 types of actuators, i.e. • linear • rotary 3.6 examples of actuators e.g. motors, solenoids, rams 3.7 applications of actuators which use different power sources i.e. • electrical • hydraulic • pneumatic
4. Know about industrial network systems	4.1 requirements of industrial network systems, i.e. • that individual parts of industrial plant need to communicate • data transmission (e.g. receive and transmit) 4.2 common industrial communication standards, i.e. • CAN bus • process field bus(profibus) • device net • supervisory control and data acquisition (scada) 4.3 application of human machine interfaces (HMI) and expert systems 4.4 network topologies, i.e. • physical topologies i.e. o star o ring o bus • logical topologies 4.5 data transmission speed (baud rate)

Learning outcomes	Teaching content
The Learner will:	**Learners must be taught:**
5. Know about maintenance in automation control systems	5.1 the need for maintenance in automation control systems 5.2 maintenance strategies in automation control systems, i.e. • traditional time interval maintenance • condition based maintenance 5.3 how machine parameters can be recorded over time 5.4 how Human Machine Interfaces (HMIs) can indicate maintenance issues 5.5 how statistical process control (SPC) is used to monitor process parameters 5.6 how expert systems can monitor, predict and report maintenance issues
6. Understand the application of robotics in automation control systems	6.1 characteristics of a robot, i.e. • fixed or mobile • re-programmable for specific tasks • able to manipulate and transport objects or tools 6.2 the difference between on-line and off-line robot programming 6.3 the interface of vision systems with robotics to perform tasks 6.4 aspects of robotic operation, i.e. • movements (e.g. sweep, shoulder, swivel, elbow extension) • arms (e.g. cartesian, cylindrical, polar) • joints (e.g. prismatic, revolute) • end effectors (e.g. tools, grippers) 6.5 application and operation of common types of industrial robot i.e. • Cartesian • SCARA • Articulated 2-10 axis • Cylindrical • Polar • Delta (flex picker) • Collaborative • Mobile (AGVs)

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 control system theory in engineering	P1: Produce block diagrams illustrating features of open and closed loop control systems.	M1: Analyse the advantages and disadvantages of open and closed loop control systems for specific applications.	D1: Evaluate how time and damping affect the performance of closed loop control systems.
	P2: Explain how feedback is used in closed loop control systems.		
	P3: Explain the difference between analogue and digital control systems.		
2. Understand the implementation of control in automated systems	P4: Explain the basic architecture of a PLC.	M2: Explain the use of A-D/D-A converters in an automated control system.	
	P5: Describe applications of different embedded control systems.		
3. Understand sensors and actuators used in automation control systems	P6: Explain the roles of sensors and actuators in automation control systems.	M3: Analyse why actuators which use different power sources are suitable for specific applications.	
	P7: Describe applications of different types of sensors and actuators in automation control systems.		

LO	Pass	Merit	Distinction
4. Know about industrial network systems	P8: Explain why industrial network systems have different requirements to domestic systems.	M4: Explain the operation of common industrial communication standards.	D2: Analyse the application of human machine interfaces (HMI) and expert systems in industrial network systems.
	P9: Describe how physical and logical topologies are used in industrial network systems.		
5. Know about maintenance in automation control systems	P10: Describe the difference between interval-based and condition-based maintenance in automation control systems.	M5: Analyse how HMI and expert systems record, predict and report maintenance issues.	
	P11 Explain how statistical process control (SPC) is used to monitor process parameters **Synoptic link - Unit 1 Mathematics for engineers*		
6. Understand the application of robotics in automation control systems	P12: Explain the characteristics of a robot and the difference between on-line and off-line robot programming.	M6: Analyse the application and operation of common types of industrial robot.	D3 Analyse how a vision system interfaces with robotics in a specific application.
	P13: Describe aspects of robotic operation in automation control systems.		

*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 control system theory in engineering
Learners should demonstrate understanding of control system theory including block diagrams, open and closed loop control and system performance. Teachers might provide learners with suitable examples to explain, analyse and evaluate.

LO2: Understand the implementation of control in automated systems
Learners should investigate embedded control systems employing a microprocessor, Programmable Interface Controller (PIC) and Programmable Logic Controller (PLC). Teachers might provide learners with suitable example systems to analyse.

LO3: Understand sensors and actuators used in automation control systems
Learners should investigate a range of sensors and actuators used in automation systems.

LO4: Know about industrial network systems
Learners should investigate industrial network systems, industrial communication standards, human machine interfaces (HMI) and expert systems.

LO5: Know about maintenance in automation control systems
Learners should investigate maintenance appropriate for automation control systems. P11 provides an opportunity to apply statistical techniques learnt in Unit 1.

LO6: Understand the application of robotics in automation control systems
Learners should investigate the application of robotics in automation control systems.

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 (this unit is a mandatory unit in the Automation, Systems and Control pathway).

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 an engineering firm working with the production/manufacturing engineering or maintenance department studying their use of automated control equipment such as robots.
2. Learners undertake project(s), exercises(s) and/or assessments/examination(s) set with input from industry practitioner(s).	A project investigating the how automated control systems are constructed, using industry standard components and design standards, to determine if/how the design of the automation control system is suitable for its given application.
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.	Demonstration from practicing robotics engineer involved in production automation, development and testing. Content to include examples of robots used, their characteristics and their applications within their 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 Production/Manufacturing/Maintenance engineers of the accuracy of learners' reports on the implementation of automated control systems as used in a modern engineering business.

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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