Cambridge NATIONALS LEVEL 1/2

SYSTEMS CONTROL IN ENGINEERING

R115 Engineering applications of computers

J833/J843

Schemes of work

Version 1

CONTENTS

INTRODUCTION

This teaching resource, which we've developed with Nationals Engineering teachers, contains two types of schemes of work.

- A **longer term** plan which covers the whole academic year over three terms and suggests the order in which each Learning Outcome (LO) could be taught. Links to other units and LOs within Nationals Engineering are also shown.

- A **medium term** plan which also covers the whole academic year over three terms and suggests the order in which each LO could taught but also provides classroom activities and any links to other resources which might be useful. We've also included 'Have they got it?' linking to activities other LOs in this unit and/or other units and LOs within Nationals Engineering. This includes performing practical activities by which learners confirm their understanding.

Link to qualification

https://www.ocr.org.uk/qualifications/cambridge-nationals/systems-control-in-engineering-level-1-2-award-certificate-j833-j843/

See our range of planning and teaching resources on the link below (including delivery guides, project approaches, teaching activities, teacher guides and resources lists).
https://www.ocr.org.uk/qualifications/cambridge-nationals/systems-control-in-engineering-level-1-2-award-certificate-j833-j843/planning-and-teaching/

See our range of assessment resources on the link below (including past paper, mark schemes, examiners' reports, candidate exemplars and set assignments).
https://www.ocr.org.uk/qualifications/cambridge-nationals/systems-control-in-engineering-level-1-2-award-certificate-j833-j843/assessment/

Scheme of work (longer term plan – academic year)

	Learning Outcome	Topic area/theme (from R115 specification)	Links to other Cambridge Nationals Engineering units and LOs
Autumn Term	**LO1**	Computers in the design of new products – part 1.	**R107 LO3** – Be able to use Computer Aided Design (CAD) software and techniques to produce and communicate design proposals. **R109 LO4** – Understand the impact of modern technologies on engineering production. **R111 LO2** – Be able to interpret information from Computer Aided Design (CAD) to manufacture components on CNC equipment.
	LO1	Computers in the design of new products – part 2.	**R107 LO3** – Be able to use Computer Aided Design (CAD) software and techniques to produce and communicate design proposals. **R109 LO4** – Understand the impact of modern technologies on engineering production. **R111 LO2** – Be able to interpret information from Computer Aided Design (CAD) to manufacture components on CNC equipment.
	LO1	Computers in manufacturing – part 1.	**R111 LO4** – Know about applications of computer control processes used to manufacture products.
	LO1	Computers in manufacturing – part 2.	**R111 LO4** – Know about applications of computer control processes used to manufacture products.
	LO1	Computers in manufacturing – part 3.	**R111 LO4** – Know about applications of computer control processes used to manufacture products.
	LO1	Computers in automation and monitoring of manufacturing – part 1.	**R109 LO4** – Understand the impact of modern technologies on engineering production. **R112 LO3** – Know how modern technologies can be used in quality control.
	LO1	Computers in automation and monitoring of manufacturing – part 2.	**R109 LO4** – Understand the impact of modern technologies on engineering production. **R112 LO3** – Know how modern technologies can be used in quality control.
	LO1	Computers in stock control in manufacturing.	**R109 LO4** – Understand the impact of modern technologies on engineering production. **R112 LO3** – Know how modern technologies can be used in quality control.
	LO1	Features of computer-controlled automation.	**R109 LO4** – Understand the impact of modern technologies on engineering production. **R112 LO3** – Know how modern technologies can be used in quality control.

	Learning Outcome	Topic area/theme (from R115 specification)	Links to other Cambridge Nationals Engineering units and LOs
Autumn Term	**LO1**	Synoptic links to other units.	**R109 LO4** – Understand the impact of modern technologies on engineering production. **R111 LO2** – Be able to interpret information from Computer Aided Design (CAD) to manufacture components on CNC equipment. **R111 LO4** – Know about applications of computer control processes used to manufacture products. **R112 LO3** – Know how modern technologies can be used in quality control.

	Learning Outcome	Topic area/theme (from R115 specification)	Links to other Cambridge Nationals Engineering units and LOs
Spring Term	**LO2**	Computers in maintenance – Human Machine Interface (HMI) – part 1.	**R109 LO4** – Understand the impact of modern technologies on engineering production. **R112 LO3** – Know how modern technologies can be used in quality control.
	LO2	Computers in maintenance – Human Machine Interface (HMI) – part 2.	**R109 LO4** – Understand the impact of modern technologies on engineering production. **R112 LO3** – Know how modern technologies can be used in quality control.
	LO2	Computers in maintenance – Expert Systems – part 1.	**R109 LO4** – Understand the impact of modern technologies on engineering production. **R112 LO3** – Know how modern technologies can be used in quality control.
	LO2	Computers in maintenance – Expert Systems – part 2.	**R109 LO4** – Understand the impact of modern technologies on engineering production. **R112 LO3** – Know how modern technologies can be used in quality control.
	LO2	Practical activity accessing and interpreting maintenance data.	**R109 LO4** – Understand the impact of modern technologies on engineering production. **R112 LO3** – Know how modern technologies can be used in quality control.
	LO2	Practical activity accessing and interpreting maintenance data.	**R109 LO4** – Understand the impact of modern technologies on engineering production. **R112 LO3** – Know how modern technologies can be used in quality control.
	LO2	Practical activity accessing and interpreting maintenance data.	**R109 LO4** – Understand the impact of modern technologies on engineering production. **R112 LO3** – Know how modern technologies can be used in quality control.
	LO2	Practical activity accessing and interpreting maintenance data.	**R109 LO4** – Understand the impact of modern technologies on engineering production. **R112 LO3** – Know how modern technologies can be used in quality control.
	LO3	Production data – use, communication, and interchange – part 1.	**R109 LO4** – Understand the impact of modern technologies on engineering production. **R112 LO3** – Know how modern technologies can be used in quality control.
	LO3	Production data – use, communication, and interchange – part 2.	**R109 LO4** – Understand the impact of modern technologies on engineering production. **R112 LO3** – Know how modern technologies can be used in quality control.

	Learning Outcome	Topic area/theme (from R115 specification)	Links to other Cambridge Nationals Engineering units and LOs
Summer Term	LO3	Production data – use, communication, and interchange – part 3.	**R109 LO4** – Understand the impact of modern technologies on engineering production. **R112 LO3** – Know how modern technologies can be used in quality control.
	LO3	Using production data to inform maintenance – part 1.	**R109 LO4** – Understand the impact of modern technologies on engineering production. **R112 LO3** – Know how modern technologies can be used in quality control.
	LO3	Using production data to inform maintenance – part 2.	**R109 LO4** – Understand the impact of modern technologies on engineering production. **R112 LO3** – Know how modern technologies can be used in quality control.
	LO3	Using production data to inform maintenance – part 3.	**R109 LO4** – Understand the impact of modern technologies on engineering production. **R112 LO3** – Know how modern technologies can be used in quality control.
	LO3	Computers in maintenance operations – part 1.	**R109 LO4** – Understand the impact of modern technologies on engineering production. **R112 LO3** – Know how modern technologies can be used in quality control.
	LO3	Computers in maintenance operations – part 2.	**R109 LO4** – Understand the impact of modern technologies on engineering production. **R112 LO3** – Know how modern technologies can be used in quality control.
	LO3	Computers in maintenance operations – part 3.	**R109 LO4** – Understand the impact of modern technologies on engineering production. **R112 LO3** – Know how modern technologies can be used in quality control.
	LO3	Hand-held devices in manufacturing and maintenance – part 1.	**R109 LO4** – Understand the impact of modern technologies on engineering production. **R112 LO3** – Know how modern technologies can be used in quality control.
	LO3	Hand-held devices in manufacturing and maintenance – part 2.	**R109 LO4** – Understand the impact of modern technologies on engineering production. **R112 LO3** – Know how modern technologies can be used in quality control.
	LO3	Hand-held devices in manufacturing and maintenance – part 3.	**R109 LO4** – Understand the impact of modern technologies on engineering production. **R112 LO3** – Know how modern technologies can be used in quality control.

Scheme of work (medium term plan – more detailed by academic term)

	Event	Learning Outcome	Topic area/subtopic Area (from R115 specification)	Suggestions for delivery/activities (including scope and depth)	'Have they got it?' – internal unit links with commentary	Useful external resources
Autumn Term	1	LO1	Computers in the design of new products – part 1.	Learners may already have some experience of using Computer Aided Design (CAD) software in other units for design tasks. Case studies including videos could be used to illustrate how computers and graphical packages such as CAD are used in design, including their benefits. An industrial visit could also benefit learners to support this first series of lessons to see how computers are used in design, manufacturing, and automation.		The Autodesk website includes some useful resources and videos about CAD/CAM https://www.autodesk.co.uk/solutions/cad-cam
	2	LO1	Computers in the design of new products – part 2.	Learners could undertake a research activity to investigate further the use of computers in design. They could present their findings as a short report, or a presentation such as a PowerPoint or poster.	R115 LO1 – Learners will be able to produce a report or presentation about the use of computers in the design of new products.	
	3	LO1	Computers in manufacturing – part 1.	Teachers could again use case studies and videos to show how computers are used in manufacturing processes. This could begin with explaining Computer Aided Manufacture (CAM) and could be expanded to include Computer Integrated Manufacture (CIM) and the use of Computer Numerical Control (CNC) machines.		Videos and case studies from www.youtube.com could be useful to explain CAM such as https://www.youtube.com/watch?v=FdipJNG_vV8
	4	LO1	Computers in manufacturing – part 2.	Learners could independently investigate how computers are used in manufacturing processes. They could summarise with examples aspects of manufacture where they can be applied, including the relative benefits.		The following video shows a CNC machine machining an engine part and programmed from CAD https://www.youtube.com/watch?v=wHstzxuryMk

	Event	Learning Outcome	Topic area/subtopic Area (from R115 specification)	Suggestions for delivery/activities (including scope and depth)	'Have they got it?' – internal unit links with commentary	Useful external resources
Autumn Term	5	**LO1**	Computers in manufacturing – part 3.	Learners could conclude their investigation of the application of computers in manufacturing processes and produce a summary of their findings.	**R115 LO1** – Learners will be able to produce a report or presentation about how Computer Aided Manufacture (CAM) systems are used in the manufacturing process.	
	6	**LO1**	Computers in automation and monitoring of manufacturing – part 1	Learners could be introduced to how computers are used to automate manufacturing processes (e.g. using Programmable Logic Controllers (PLCs) or other programmable devices). They could also be introduced to how they are used to monitor production operations (e.g. automated test systems). Videos and case studies could be useful, and an industrial visit if possible.		Videos could be used to show how PLCs are used to automate manufacturing processes https://www.youtube.com/watch?v=ReTtgzN-Dmc
	7	**LO1**	Computers in automation and monitoring of manufacturing – part 2.	Learners will continue to independently investigate the use of computers in automation and monitoring of manufacturing operations and could summarise their findings in a short report or presentation.	**R115 LO1** – Learners will be able to produce a report or presentation about the use of computers in the monitoring of manufacturing/ production operations and in automation.	
	8	**LO1**	Computers in stock control in manufacturing.	Learners could be introduced to the use of computers for stock control to support manufacturing operations (e.g. automatic stock control, use of RFID tags). They could again summarise their findings in a report or presentation.	**R115 LO1** – Learners will be able to produce a report or presentation about the use of computers for stock control.	Manufacturer and vendor websites could be useful to illustrate the use of computers in stock control https://www.barcoding.co.uk/what-is-stock-control-software/
	9	**LO1**	Features of computer-controlled automation.	To conclude this section on the use of computers in manufacturing, learners could be introduced to the features of typical computer-controlled automation systems (e.g. temperature control, weight control, size or position sensing, safety systems etc.). Examples could be used to illustrate features of a range of different automated systems, with learners producing a summary of each type.	**R115 LO1** – Learners will be able to produce a report or presentation about the features of various computer-controlled automation systems.	Videos could be used to illustrate the features of different automatic computer control systems. The following video provides an introduction to control, and feedback https://www.youtube.com/watch?v=5NVjIli9fkY

	Event	Learning Outcome	Topic area/subtopic Area (from R115 specification)	Suggestions for delivery/activities (including scope and depth)	'Have they got it?' – internal unit links with commentary	Useful external resources
Autumn Term	10	LO1	Synoptic links to other units.	In this lesson, learners could review work completed in LO1 of this unit and make links to other units in the specification (especially unit R113). They could produce a simple table documenting links from content covered in LO1 to R113, and other units.	**R109 LO4** – Learners will be able to relate to the impact of modern technologies on engineering manufacture. **R111 LO2** and **LO4** – Learners will be able to relate to the use of CAD/CAM software to setup and operate a CNC machine. **R112 LO3** – Learners will be able to relate to how modern technologies are used in quality control performed during	

	Event	Learning Outcome	Topic area/subtopic Area (from R115 specification)	Suggestions for delivery/activities (including scope and depth)	'Have they got it?' – internal unit links with commentary	Useful external resources
Spring Term	1	**LO2**	Computers in maintenance – Human Machine Interface (HMI) – part 1.	Teachers could begin with an overview of how computers can be used in maintenance operations, including how the Human Machine Interface (HMI) is used. Examples of different types of HMI in industrial applications could be used to illustrate how they are used to inform maintenance operations.		The following webpage and video provides an introduction to HMI https://www.inductiveautomation.com/resources/article/what-is-hmi
	2	**LO2**	Computers in maintenance – Human Machine Interface (HMI) – part 2.	Learners could independently investigate different types of HMI including how the user interacts with them. If physical HMI resources are available, learners could undertake a practical investigation. Findings could be summarised using annotated photographs or screen shots.	**R115 LO2** – Learners will be able to produce a report or presentation explaining HMI and its application in maintenance operations.	
	3	**LO2**	Computers in maintenance – Expert Systems – part 1.	Learners could be introduced to the application of Expert Systems in maintenance operations, with an overview of what an Expert System is. Case studies and videos could be used to show the application of Expert Systems in real situations.		Internet videos explaining Expert Systems, and the application of Artificial Intelligence (AI) in maintenance could be useful such as https://www.youtube.com/watch?v=-PByZ0UqwbU
	4	**LO2**	Computers in maintenance – Expert Systems – part 2.	Learners could independently investigate Expert Systems, producing a summary of what an Expert System is and how it is used to inform maintenance of a system. They could present case studies of where and how such systems are used. Findings could be summarised in a short report or presentation.	**R115 LO2** – Learners will be able to produce a report or presentation explaining Expert Systems and their application in maintenance operations.	
	5	**LO2**	Practical activity accessing and interpreting maintenance data.	In this series of lessons learners will undertake a practical activity to interrogate a system using an HMI or Expert System. They will obtain maintenance data, interpret this data, and suggest system modifications or corrections required in response to the data. Teachers could begin with an introduction to the chosen system, how to obtain and interpret data, and how to use this to make suggested modifications.		Many different systems offer the possibility for performing maintenance by accessing and interpreting data. The following shows the use of an automotive on-board diagnostic (OBD) reader https://www.youtube.com/watch?v=LZUo6jk2uao

	Event	Learning Outcome	Topic area/subtopic Area (from R115 specification)	Suggestions for delivery/activities (including scope and depth)	'Have they got it?' – internal unit links with commentary	Useful external resources
Spring Term	6	**LO2**	Practical activity accessing and interpreting maintenance data.	Learners will continue to undertake a practical activity accessing and interpreting maintenance data in this lesson. Annotated photos or screen shots could be used to show the system data being obtained. Learners could alternatively produce a short video showing the activity taking place.		
	7	**LO2**	Practical activity accessing and interpreting maintenance data.	Learners will continue to undertake a practical activity accessing and interpreting maintenance data in this lesson. Learners could collate data obtained and make a clear interpretation of what it represents. They could begin to make suggestions of how system operation could be modified or corrected in response to the data.		
	8	**LO2**	Practical activity accessing and interpreting maintenance data.	In this final session on accessing and interpreting maintenance data, learners could draw together their evidence including how they have accessed and interpreted data, and their suggestions for system modifications and corrections based on this data. This could be summarised in a short report or other style of presentation (e.g. PowerPoint or poster).	**R115 LO2** – Learners will be able to perform a practical activity to access maintenance data, interpret the data and make suggestions for system modifications or corrections based on the data.	
	9	**LO3**	Production data – use, communication, and interchange – part 1.	Teachers could introduce how data is obtained during production operations, and how this data can be communicated and used to inform these operations. Production data includes the recording of assembly and production operation, efficiency information and cycle times. Case studies and videos could be used to show how production data is used, communicated, and interchanged. An industrial visit could be useful to support this series of lessons.		Internet videos could be used to illustrate how computers use, communicate and exchange data related to production operations such as https://www.youtube.com/watch?v=-6uX_bSeCUM
	10	**LO2**	Production data – use, communication, and interchange – part 2.	Learners could independently investigate how production data is obtained, used, and communicated. They could relate this to how the data can be used to monitor production operations, including how this is communicated to production operators and between different parts of the process.		

	Event	Learning Outcome	Topic area/subtopic Area (from R115 specification)	Suggestions for delivery/activities (including scope and depth)	'Have they got it?' – internal unit links with commentary	Useful external resources
Summer Term	1	**LO3**	Production data – use, communication, and interchange – part 3.	Learners could conclude this series of lessons on the use, communication, and interchange of production data by summarising their findings in a short report or presentation. Case studies could be used to clearly illustrate each aspect, and the benefits this brings to the production process.	**R115 LO3** – Learners will be able to produce a report or presentation about the use, communication, and interchange of data from production operations.	
	2	**LO3**	Using production data to inform maintenance – part 1.	Teachers could show how production data can be used to inform maintenance operations e.g. how decreasing cycle time during production could mean that machinery requires maintenance, or how reaching a set number of cycles could trigger predictive maintenance. Case studies and videos could be used to illustrate examples of the use of production data in informing maintenance.		Videos showing how production data is used to inform maintenance including ones about predictive maintenance could be used https://www.youtube.com/watch?v=ACH1uqdhU_o
	3	**LO3**	Using production data to inform maintenance – part 2.	Learners could independently investigate different strategies for how production data is used to inform maintenance e.g. recording assembly/production quantities or times, efficiency information, cycle times and maintenance planning.		
	4	**LO3**	Using production data to inform maintenance – part 3.	Learners could conclude their investigation of the use of production data to inform maintenance operations by producing a summary with examples. This could be presented as a short report or presentation.	**R115 LO3** – Learners will be able to produce a report or presentation about how production data is used to inform maintenance operations.	
	5	**LO3**	Computers in maintenance operations – part 1.	Teachers could introduce how computers are used in maintenance operations. This could include how they communicate and exchange information e.g. remote monitoring of systems, transmission of service data, recording details of parts required and stock control, prediction of system failure and work scheduling. Case studies and videos could again be used to illustrate different maintenance scenarios.		Videos could be used to show how computers are used in maintenance operations. The following video shows remote machine monitoring https://www.youtube.com/watch?v=cwQAsZ5ANX4

	Event	Learning Outcome	Topic area/subtopic Area (from R115 specification)	Suggestions for delivery/activities (including scope and depth)	'Have they got it?' – internal unit links with commentary	Useful external resources
Summer Term	6	**LO3**	Computers in maintenance operations – part 2.	Learners could independently investigate the use of computers in maintenance operations. They should focus on both how they communicate and exchange maintenance data, and how this data is used to inform and carry-out maintenance.		
	7	**LO3**	Computers in maintenance operations – part 3.	Learners could conclude this series of lessons on the use of computers in maintenance by clearly summarising their findings. They could present these systematically in tabular form to make them easier to review, covering each point separately.	**R115 LO3** – Learners will be able to produce a report or presentation about how computers are used in different aspects of maintenance operations.	
	8	**LO3**	Hand-held devices in manufacturing and maintenance – part 1.	In this final series of lessons, teachers could begin with an introduction to the use of hand-held devices in both production and maintenance operations. Online resources such as manufacturer's websites could be used to show a range of hand-held devices, and their use summarised.		Videos could be used to illustrate the use of hand-held devices in production and maintenance operations. The following video shows a hand-held logger being setup and used to monitor system operation https://www.youtube.com/watch?v=YNFP_6FkPxA
	9	**LO3**	Hand-held devices in manufacturing and maintenance – part 2.	Learners could independently investigate a range of hand-held devices, including hand-held computers and bar-code scanners. They could investigate how they are used to interrogate systems and log data, and to access information. For barcode scanners they could investigate how they are used to record and monitor stock, track products and components and to update service records.		
	10	**LO3**	Hand-held devices in manufacturing and maintenance – part 3.	In this final lesson, learners could draw together their findings on the use of hand-held devices in manufacturing and maintenance. These could be summarised in tabular form along with examples of applications and use of a range of hand-held-devices. Clear distinction should be made between use for manufacturing operations, and use for maintenance.	**R115 LO3** – Learners will be able to produce a report or presentation about how hand-held devices are used in production and maintenance operations.	

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