CAMBRIDGE NATIONALS

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Oxford Cambridge and RSA

CAMBRIDGE NATIONALS

Moderators' report

SYSTEMS CONTROL IN ENGINEERING

J833, J843

R114-R116 Summer 2022 series

Version 1

ocr.org.uk/cambridgenationals

Contents

Introduction

Our Lead Moderators' reports are produced to offer constructive feedback on centres' assessment of moderated work, based on what has been observed by the moderation team. These reports include a general commentary of accuracy of internal assessment judgements; identify good practice in relation to evidence collation and presentation and comments on the quality of centre assessment decisions against individual Learning Objectives. This report also highlights areas where requirements have been misinterpreted and provides guidance to centre assessors on requirements for accessing higher mark bands. Where appropriate, the report will also signpost to other sources of information that centre assessors will find helpful.

OCR completes moderation of centre-assessed work in order to quality assure the internal assessment judgements made by assessors within a centre. Where OCR cannot confirm the centre's marks, we may adjust them in order to align them to the national standard. Any adjustments to centre marks are detailed on the Moderation Adjustments report, which can be downloaded from Interchange when results are issued. Centres should also refer to their individual centre report provided after moderation has been completed. In combination, these centre-specific documents and this overall report should help to support centres' internal assessment and moderation practice for future series.

Advance Information for Summer 2022 assessments

To support student revision, advance information was published about the focus of exams for Summer 2022 assessments. Advance information was available for most GCSE, AS and A Level subjects, Core Maths, FSMQ, and Cambridge Nationals Information Technologies. You can find more information on our website.

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Unit R114 General overview

In this unit, candidates will produce schematic diagrams for an electronic circuit using CAD software. They will test their virtual circuit using simulation and virtual testing tools and take it forward to produce a printed circuit board (PCB) track layout for manufacturing. The PCB is then manufactured, populated with components, and finally tested and evaluated. The unit is best communicated by an annotated screenshots, photographs and commentary that communicate the processes from virtual design to a functioning physical outcome. Step-by-step evidence of safely manufacturing and populating the PCB, including how the PCB was manufactured and how components were safely joined to it, was occasionally a little disappointing, as was evidence of detailed testing and evaluation based on use of test and fault-finding equipment.

Comments by LO

LO1 – Be able to use CAD for circuit simulation and design

Candidates were able to produce a circuit schematic diagram using CAD software library components. Most candidates were able to simulate basic function, and the more able to modify their circuit design through testing. It should be noted that the higher mark bands cannot be accessed without evidence of simulation, testing and circuit modification. There was good evidence to show candidates understood the process to produce a printed circuit board (PCB), showing both track and component views, but rarely was evidence of testing a PCB layout to ensure functionality provided. The permitted changes for 2022 did allow for simplifying the circuit for the scenario to make schematic entry, simulation and circuit construction simpler. This LO is best communicated by annotated screenshots showing step-by-step progression from producing the circuit schematic diagram through to testing the layout.

LO2 – Be able to construct circuits

Centres were offered adaptations to the LO for 2022. The more favoured adaptation allowed for candidates to be supplied with a pre-made bare PCB ready for assemble with components rather than having to produce one themselves. However, candidates were still required to explain the process of safely manufacturing the bare PCB. In common with candidates who produced their own PCB by etching or milling, communication of the processes of making the PCB and safety considerations, including appropriate PPE, were often not explained in sufficient detail: evidence of testing the blank PCB to ensure correct functionality was rarely provided.

Moving on from the production of a blank PCB, essential requirements of this LO were not always communicated appropriately by candidates including, reference to safety precautions, and step-by-step evidence of the PCB being populated with components. A risk assessment could be used to identify potential risks and appropriate control measures, and annotated photographs to communicate step-by-step safe construction of the PCB. It was good to see many candidates were able to construct a high quality fully functioning PCB.

The permitted adaptations for 2022 allowed for candidates to be able to use a prototype/breadboard to construct the circuit ready for testing.

A witness statement is requested to corroborate the level of candidate independence in this LO: witness statements were not always used correctly.

OCR support

Witness statements:

Full guidance on how to use witness statements can be found in Appendix A of the Specification Handbook.

It is important to remember that they cannot be used as a substitute for direct evidence that the candidate can produce. They should only be used to support and corroborate things like independent and safe working, or the quality of a finished product.

Assessment for learning

High quality circuit:

High Quality in the context of the final part of this LO (Mark Band 3) refers to being able to produce a fully operational circuit.

Please refer to the Assessment Guidance in Appendix B of the Specification Handbook and read this in conjunction with the Marking Criteria and the Unit Specification to see what is required.

LO3 – Be able to test electronic circuits

Many candidates had difficulty accessing high marks from Mark Band 3 (MB3) in this LO because their testing and evaluation of the operation of the electronic circuit was not sufficiently thorough and detailed, even after allowing for permitted changes for 2022. There was a reduced requirement for evidence of testing, which could include visual inspection, and the taking of one or two voltages or current values using only a multimeter. Ideally, candidates could tabulate readings comparing actual values with expected values and evaluate the operation of the circuit.

The permitted changes for 2022 also provided adaptations for candidates who could not physically test a completed PCB such as, a professional discussion/Q&A where candidates explain how they would perform a test.

A witness statement can be used to corroborate candidate-generated evidence.

Unit R115 General overview

This unit of work was often well attempted. Where candidates studied local industry, meaningful and relevant investigation underpinned knowledge and understanding of how computers are used in engineering in industry. However, due to restrictions of access to industry, many centres provided candidates with a view of industry and a set of operating data with known conditions for them to interpret and suggest remedial actions, as permitted in the adaptations for 2022.

Comments by LO

LO1 – Understand how computers are used in engineering design, manufacture and process control

Candidates referred to a range of computer systems including CAD, CAM, CNC, PLC's PIC's and how they are used within engineering design, manufacture, and process control: understanding of production monitoring and stock control was less detailed, perhaps as a result of restricted access to engineering workplaces. To access the top range of marks from Mark Band 3 (MB3), candidates could be encouraged to make more explicit synoptic links between learning for this LO and prior learning for other units in the specification. For example, the function and application of input, control, and output devices (R113), and how they can be used to monitor automated production and production operations (e.g., temperature control, weight control, position sensing, size sensing, workflow, warehousing and product movement, safety systems and machine interlocks).

Assessment for learning

Synoptic teaching and learning:

Candidates are required for this LO to draw on skills/knowledge/understanding from other units in the specification and it would be useful if this was made explicit within their responses.

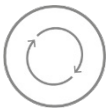
LO2 – Understand how computers are used for maintenance of engineering systems

Overall, candidates demonstrate a sound understanding of the use of 'Human Machine Interface (HMI)' and 'expert systems' within system operation, diagnostics, and maintenance. Due to limitations on access to physical systems that gather system operation data, the permitted adaptations for 2022 allowed centres to provide candidates with a set of operating data with known conditions, such as operating status, fault conditions. Candidates interpreted the data and suggested appropriate remedial actions. This was often limited to 2-3 pieces of data.

LO3 – Know how computers are used to communicate and use data for production and maintenance

Perhaps due to restricted access to industrial settings, overall descriptions of how computers are used to communicate and exchange data in both production and maintenance operations was not always as comprehensive as it could have been. Centres and candidates are encouraged to consider the issues identified in the content for LO3 in the specification handbook. Candidates must also provide more detailed knowledge with specific examples of how hand-held devices are used in both manufacturing and maintenance systems (e.g., monitor stock usage, automatic update of service records, data loggers, data collection and analysis, work scheduling, maintenance checklists), and the range of devices that are used (e.g., barcode scanner, mobile phone and laptop) in order to access the higher MB3 marks.

Assessment for learning



Referencing:

LO1 and LO3 provide excellent opportunity for candidates to reference the information they have found while researching.

Referencing is important to avoid potential plagiarism, and further guidance on referencing is available on the OCR website.

Unit R116 General overview

There was sound evidence of candidates researching uses of control systems and microprocessor/microcontroller layouts in products, however, summaries of research could benefit from greater clarity and detail. Many candidates were able to design, develop and simulate a control system but the communication of synoptic links to skills, knowledge and understanding from other units in the specification were rarely explicit. The testing of control systems was often well detailed but refinements based on testing could be developed and communicated more effectively.

There were a range of permitted adaptations for 2022 however, the standard and quality of candidate evidence demonstrated very limited changes from previous series submissions.

Comments by LO

LO1 – Understand the application and operation of microcontrollers and microprocessors in engineered products

In general, candidates were able to demonstrate understanding of simple layouts of microprocessors and microcontrollers in products or systems, and some understanding of the application and operation of microprocessors and microcontrollers in engineered products or systems, but the depth of knowledge and understanding demonstrated was often insufficient to merit high marks from Mark Band 3 (MB3). Perhaps research of a broader range of examples of the operation of microprocessor/microcontrollers in a product or system could help candidates to explain applications more effectively. Most candidates described the basic function of a wide range of input, control and output devices used in microprocessor/microcontrollers.

Assessment for learning

Referencing:

The LO provides excellent opportunity for candidates to reference the information they have found while researching.

Referencing is important to avoid potential plagiarism, and further guidance on referencing is available from the OCR website.

Misconception

Common misconception

A common misconception with this LO is that candidates explain (often with diagrams) the internal architecture of the microprocessor or microcontroller itself. This is not what is required here. The layout should be for the whole system used in a product or system employing one of these programmable devices.

LO2 – Be able to design, develop and simulate a control system

Candidates were able to design, develop and simulate a control system for a control system problem using a range of appropriate input and output sensors and devices however, communication of the LO was not always particularly detailed. High quality evidence included a description of aims, a sequence of operations, annotated flow charts, annotated screen shots showing programming taking place with the function of components described in detail, annotated program code, and justification for modifications based on simulation outcomes, etc. Most candidates were able to download a control programme to a programmable device, evidence of which was often supported by a witness statement: on occasion, witness statements were used inappropriately. Video evidence of downloaded solutions were most appropriate however, they were not always accessible (please refer to the Accepted File Formats for digital video evidence in Appendix C of the specification handbook). Perhaps, when providing evidence by video, several photographs at key stages could also be included with candidates work.

Although permitted adaptations for 2022 allowed for centres to simplify the control system for the scenario to include fewer input/output devices, making programming, simulation, and realisation of a physical system simpler, there appeared no discernible deviations from previous submissions.

When designing a solution to a control system problem candidates could be much more explicit on how they draw on relevant skills/knowledge/understanding from other units in the specification.

OCR support

Witness statements:

Full guidance on how to use witness statements can be found in Appendix A of the Specification Handbook.

It is important to remember that they cannot be used as a substitute for direct evidence that the candidate can produce. They should only be used to support and corroborate things like independent and safe working, or the quality of a finished product.

Assessment for learning

Synoptic teaching and learning:

Candidates are required for this LO to draw on skills/knowledge/understanding from other units in the specification and it would be useful if this was made explicit within their responses.

LO3 – Be able to test control systems

Candidates are required to develop a test plan and to test their system against this plan. Many candidates provided their evidence in the form of a tabulated test plan, which is good practice. Candidates achieved high marks where there was evidence of comprehensive testing of the control systems using the test plan, and refinements to the control systems were based on the outcome of testing and evaluation: refinements were not always adequately justified.

OCR support

Test plan template:

Candidates could be provided with a blank tabulated test template to complete for this LO.

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