# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering

### R113, R114, R115, R116

**A comprehensive 107 page overview of how the following qualifications match to the Learning Outcomes for Cambridge Nationals in Engineering, Principles in Engineering and Engineering Business showing opportunities for holistic teaching.**

**21st Century Physics A 2012 J245**

**21st Century Science A 2012 J241**

**21st Century Additional Science A 2012 J242**

**Gateway Additional Science B 2012 J262**

**Gateway Physics B 2012 J265**

**Gateway Science B 2012 J261**

**GCSE Mathematics B J567 Foundation Bronze**

**GCSE Mathematics B J567 Foundation Gold**

**GCSE Mathematics B J567 Foundation Initial**

**GCSE Mathematics B J567 Foundation Silver**

**GCSE Mathematics B J567 Higher Silver**

**Cambridge National ICT Level 1/2 J800/J810/J820**

The suggested matches in this document are not definitive. They are examples of where Maths, Science and ICT can be applied in Cambridge Nationals in Systems Control in Engineering .

You can navigate this pdf by clicking on any of the outer tabs on the unit pages. The Home button will return you to the Contents page.

Oxford Cambridge and RSA

# CAMBRIDGE NATIONAL IN ENGINEERING

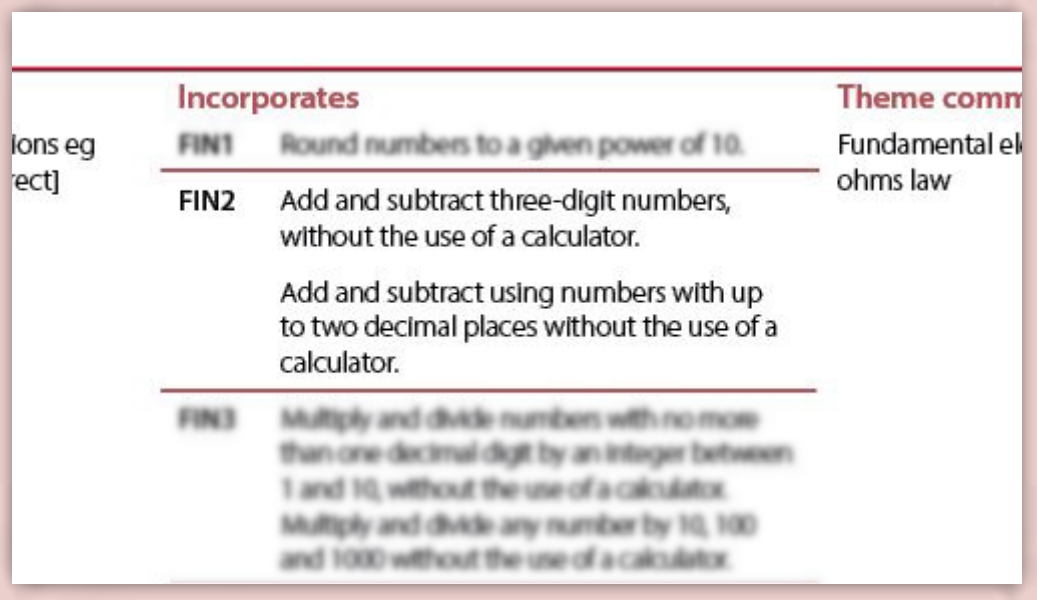
## Systems Control in Engineering – Maths, Science and ICT in Engineering

### Cambridge Nationals in Engineering - Mapping to (maths) and science

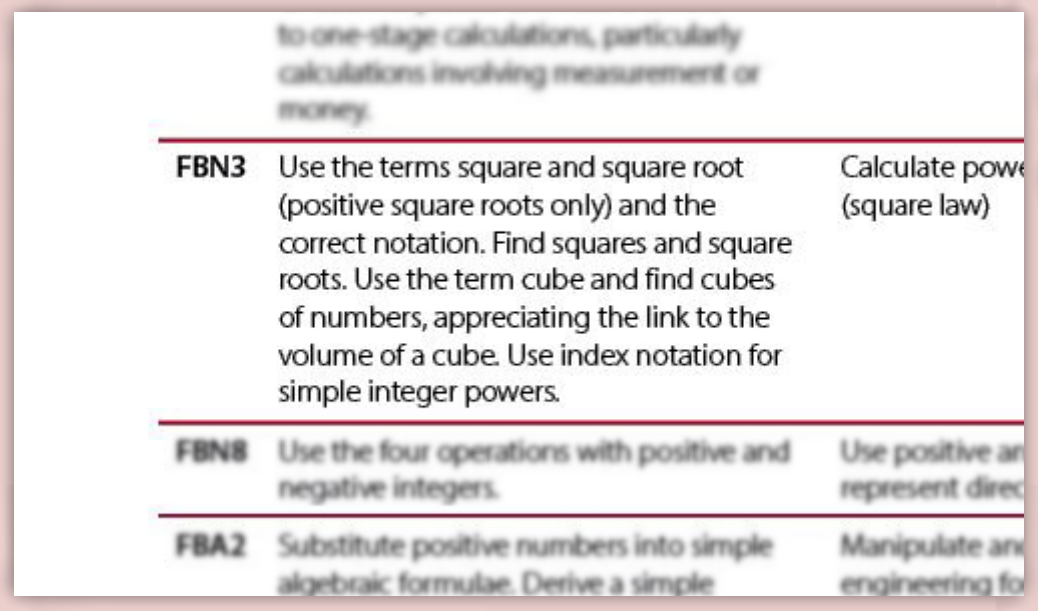
This document will help you plan your curriculum and assist you in delivering related subjects such as maths, science and ICT when teaching your Cambridge Nationals in Engineering.

### The mapping of R113 LO1 to maths foundation – initial and bronze

The example below is an extract from this mapping document and suggests how GCSE maths could be taught and then applied to develop skills in evaluating market data necessary for LO1.



| | Incorporates | Theme comm |
|---|---|---|
| ions eg ect] | | |
| FIN1 | Round numbers to a given power of 10. | Fundamental el ohms law |
| FIN2 | Add and subtract three-digit numbers, without the use of a calculator.<br>Add and subtract using numbers with up to two decimal places without the use of a calculator. | |
| FIN3 | Multiply and divide numbers with no more than one decimal digit by an integer between 1 and 10, without the use of a calculator.<br>Multiply and divide any number by 10, 100 and 1000 without the use of a calculator. | |



| | | |
|---|---|---|
| | to one-stage calculations, particularly calculations involving measurement or money. | |
| FBN3 | Use the terms square and square root (positive square roots only) and the correct notation. Find squares and square roots. Use the term cube and find cubes of numbers, appreciating the link to the volume of a cube. Use index notation for simple integer powers. | Calculate powe (square law) |
| FBN8 | Use the four operations with positive and negative integers. | Use positive an represent direc |
| FBA2 | Substitute positive numbers into simple algebraic formulae. Derive a simple | Manipulate an engineering fo |

Learners are required to calculate values of power, voltage, current, resistance, capacitance, inductance, electromagnetism and frequency. In maths, (FIN2) learners are required to add and subtract three-digit numbers, multiply and divide any number by 10, 100 and 1000 without the use of a calculator. They should also be able to round numbers to the nearest integer or to any given number of significant figures or decimal places (FBN2) and use the terms square and square root (FBN3). Learners could apply the knowledge they acquire from their maths studies to use when calculating electrical units. Joining these two requirements together makes the learning experience much more relevant to learners and should ultimately increase their interest.

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Contents

Click on any of the Learning Outcomes to navigate to the page.

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R113 Electronic principles

### LO1: Understand basic electronic principles

Learners must be taught:

- **principles, units and measurement, ie**
  - current (amps)
  - Electro Motive Force (EMF)
  - Induction/back EMF (henry)
  - potential difference (volts)
  - resistance (ohms)
  - capacitance (farads)
  - power and energy (watts)
  - frequency (hertz)
- **values for voltage, current, resistance and power by calculation, ie**
  - Ohm's Law and power law ( V=IR, P=IV, P=I2R)
- **circuit components, symbols and diagrams, ie**
  - interpretation of simple circuit schematic diagrams
- **series and parallel circuits, ie**
  - uses of series and parallel circuits
  - calculation of resistance within series and parallel circuits
- **the operation of a potential divider, ie**
  - calculation of component values for potential divider circuits
  - calculation of output voltage from a potential divider circuit
- **types of power sources available, ie**
  - battery
  - solar
  - mains
  - combined
- **reasons for selection of suitable power sources, ie**
  - portable eg battery
  - sustainable eg solar
  - continuous eg mains (under normal conditions)
- **function and application of voltage regulators in power supply circuits**

Foundation Initial | Foundation Bronze | Foundation Silver | Foundation Gold

## Foundation Initial – GCSE Mathematics B J567

**Keywords/Themes** Voltage, current, resistance, capacitance, inductance, electromagnetism, frequency.

**Calculations: ohms law and potential divider. Power law.**

Schematic diagrams.

Sustainable power sources.

| Theme | Incorporates | | Theme comments |
|---|---|---|---|
| Fundamental electrical calculations eg Using ohms law, power law [Direct] | **FIN1** | Round numbers to a given power of 10. | Fundamental electrical calculations eg Using ohms law |
| | **FIN2** | Add and subtract three-digit numbers, without the use of a calculator.<br>Add and subtract using numbers with up to two decimal places without the use of a calculator. | |
| | **FIN3** | Multiply and divide numbers with no more than one decimal digit by an integer between 1 and 10, without the use of a calculator. Multiply and divide any number by 10, 100 and 1000 without the use of a calculator. | |
| | **FIN4** | Multiply and divide a three-digit number by a two-digit number.<br>Multiply numbers with up to two decimal places by an integer. | |
| | **FIN9** | Solve problems using the four operations on integer and decimal numbers using a calculator | |
| | **FIN11** | Perform calculations involving the use of brackets and the order of operations. | |
| Measure and estimate values of voltage, current etc [Direct] | **FIG2** | Make sensible estimates of a range of measures in everyday settings. | Measure and estimate values of voltage, current etc |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R113 Electronic principles

### LO1: Understand basic electronic principles

Learners must be taught:

- **principles, units and measurement, ie**
  - current (amps)
  - Electro Motive Force (EMF)
  - Induction/back EMF (henry)
  - potential difference (volts)
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  - battery
  - solar
  - mains
  - combined
- **reasons for selection of suitable power sources, ie**
  - portable eg battery
  - sustainable eg solar
  - continuous eg mains (under normal conditions)
- **function and application of voltage regulators in power supply circuits**

Foundation Initial | Foundation Bronze | Foundation Silver | Foundation Gold

## Foundation Bronze – GCSE Mathematics B J567

**Keywords/Themes** Voltage, current, resistance, capacitance, inductance, electromagnetism, frequency.

**Calculations: ohms law and potential divider. Power law.**

Schematic diagrams.

Sustainable power sources.

| Theme | Incorporates | | Theme comments |
|---|---|---|---|
| Fundamental electrical calculations eg Using ohms law, power law [Direct] | **FBN2** | Round numbers to the nearest integer or to any given number of significant figures or decimal places. Estimate answers to one-stage calculations, particularly calculations involving measurement or money. | Round and estimate values in engineering calculations |
| | **FBN3** | Use the terms square and square root (positive square roots only) and the correct notation. Find squares and square roots. Use the term cube and find cubes of numbers, appreciating the link to the volume of a cube. Use index notation for simple integer powers. | Calculate power using the Power Law (square law) |
| | **FBN8** | Use the four operations with positive and negative integers. | Use positive and negative numbers to represent direction of current flow |
| | **FBA2** | Substitute positive numbers into simple algebraic formulae. Derive a simple formula. | Manipulate and solve fundamental electrical engineering formulae |
| | **FBA3** | Manipulate algebraic expressions by collecting like terms. | |
| | **FBA4** | Solve simple equations involving two steps. | |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R113 Electronic principles

### LO1: Understand basic electronic principles

Learners must be taught:

- **principles, units and measurement, ie**
  - current (amps)
  - Electro Motive Force (EMF)
  - Induction/back EMF (henry)
  - potential difference (volts)
  - resistance (ohms)
  - capacitance (farads)
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- **types of power sources available, ie**
  - battery
  - solar
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  - combined
- **reasons for selection of suitable power sources, ie**
  - portable eg battery
  - sustainable eg solar
  - continuous eg mains (under normal conditions)
- **function and application of voltage regulators in power supply circuits**

Foundation Initial | Foundation Bronze | Foundation Silver | Foundation Gold

## Foundation Silver – GCSE Mathematics B J567

**Keywords/Themes** Voltage, current, resistance, capacitance, inductance, electromagnetism, frequency.

**Calculations: ohms law and potential divider. Power law.**

Schematic diagrams.

Sustainable power sources.

| Theme | Incorporates | | Theme comments |
|---|---|---|---|
| Fundamental electrical calculations eg Using ohms law [Direct] | **FSN4** | Use the four operations on decimals without the use of a calculator. | Solve engineering calculations without a calculator |
| | **FSN6** | Use a calculator effectively and efficiently, entering a range of measures including 'time', interpreting the display and rounding off a final answer to a reasonable degree of accuracy. Perform calculations using the order of operations. | Solve engineering calculations with the use of a calculator |
| Manipulate electrical engineering formula and plot data to determine other values [Indirect] | **FSA1** | Use and generate formulae. Substitute positive and negative numbers into a formula or an expression. | Use given engineering formulae to generate new formulae and solve numerically and using graphs e.g voltage vs current, power vs resistance |
| | **FSA2** | Set-up and solve linear equations with integer coefficients. This will include equations in which the unknown appears on both sides of the equation, or with brackets. | |
| | **FSA3** | Manipulate algebraic expressions by multiplying a single term over a bracket and by taking out common factors. | |
| | **FSA4** | Use tables to plot graphs of linear functions given explicitly. | |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R113 Electronic principles

### LO1: Understand basic electronic principles

Learners must be taught:

- **principles, units and measurement, ie**
  - current (amps)
  - Electro Motive Force (EMF)
  - Induction/back EMF (henry)
  - potential difference (volts)
  - resistance (ohms)
  - capacitance (farads)
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  - calculation of component values for potential divider circuits
  - calculation of output voltage from a potential divider circuit
- **types of power sources available, ie**
  - battery
  - solar
  - mains
  - combined
- **reasons for selection of suitable power sources, ie**
  - portable eg battery
  - sustainable eg solar
  - continuous eg mains (under normal conditions)
- **function and application of voltage regulators in power supply circuits**

Foundation Initial | Foundation Bronze | Foundation Silver | Foundation Gold

## Foundation Gold – GCSE Mathematics B J567

**Keywords/Themes** Voltage, current, resistance, capacitance, inductance, electromagnetism, frequency.

**Calculations: ohms law and potential divider. Power law**

Schematic diagrams

Sustainable power sources

| Theme | Incorporates | Theme comments |
|---|---|---|
| Fundamental electrical calculations eg Using ohms law [Direct] | **FGA3** Change the subject of a formula in cases where the subject only appears once. | Rearrange formula eg voltage=current x resistance |

Manipulate electrical engineering formula and plot data to determine other values [Indirect]

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

Extended opportunities

## Unit R113 Electronic principles

**LO2: Understand the operating principles of electronic components**

Learners must be taught:

- **appropriate cable types for specific applications giving reasons for their use**
- **identification and application of resistors used in electronic circuits**
- **identification and application of capacitors used in electronic circuits**
- **application and function of resistor/capacitor circuit and RC time constant**
- **identification, application and function of switches**
- **application, function and benefits of circuit protection**
- **systems approach**
- **identification, function and application of input devices**
- **identification, function and application of process devices**
- **identification, function and application of output devices**
- **application and function of DC electric motor control**
- **identification of smart and modern materials**

Foundation Initial | Foundation Bronze | Foundation Silver | Foundation Gold

## Foundation Initial – GCSE Mathematics B J567

**Keywords/Themes** Resistance, capacitance.

**RC circuits: exponential function**

Electromagnetism: motors.

Smart materials: QTC, SMA

| Theme | Incorporates | | Theme comments |
|---|---|---|---|
| Fundamental electrical calculations of RC time constant [Direct] | **FIN1** | Round numbers to a given power of 10. | Fundamental electrical calculations of RC time constant |
| | **FIN2** | Add and subtract three-digit numbers, without the use of a calculator.<br>Add and subtract using numbers with up to two decimal places without the use of a calculator. | |
| | **FIN3** | Multiply and divide numbers with no more than one decimal digit by an integer between 1 and 10, without the use of a calculator. Multiply and divide any number by 10, 100 and 1000 without the use of a calculator. | |
| | **FIN4** | Multiply and divide a three-digit number by a two-digit number.<br>Multiply numbers with up to two decimal places by an integer. | |
| | **FIN9** | Solve problems using the four operations on integer and decimal numbers using a calculator | |
| | **FIN11** | Perform calculations involving the use of brackets and the order of operations. | |
| Measure and estimate values of voltage in RC circuits [Direct] | **FIG2** | Make sensible estimates of a range of measures in everyday settings. | Measure and estimate values of voltage to determine RC time constant |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R113 Electronic principles

**LO2: Understand the operating principles of electronic components**

Learners must be taught:

- **appropriate cable types for specific applications giving reasons for their use**
- **identification and application of resistors used in electronic circuits**
- **identification and application of capacitors used in electronic circuits**
- **application and function of resistor/capacitor circuit and RC time constant**
- **identification, application and function of switches**
- **application, function and benefits of circuit protection**
- **systems approach**
- **identification, function and application of input devices**
- **identification, function and application of process devices**
- **identification, function and application of output devices**
- **application and function of DC electric motor control**
- **identification of smart and modern materials**



## Foundation Bronze – GCSE Mathematics B J567

**Keywords/Themes** Resistance, capacitance.

**RC circuits: exponential function**

Electromagnetism: motors.

Smart materials: QTC, SMA

| Theme | Incorporates | | Theme comments |
|---|---|---|---|
| Fundamental electrical calculations of RC time constant | **FBN2** | Round numbers to the nearest integer or to any given number of significant figures or decimal places. Estimate answers to one-stage calculations, particularly calculations involving measurement or money. | Round and estimate values in RC circuits |
| | **FBN8** | Use the four operations with positive and negative integers. | Use positive and negative numbers to represent voltage and current in RC circuits |
| | **FBA2** | Substitute positive numbers into simple algebraic formulae. Derive a simple formula. | Manipulate and solve formulae for RC circuits |
| | **FBA3** | Manipulate algebraic expressions by collecting like terms. | |
| | **FBA4** | Solve simple equations involving two steps. | |

Measure and estimate values of voltage to determine RC time constant

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R113 Electronic principles

**LO2: Understand the operating principles of electronic components**

Learners must be taught:

- **appropriate cable types for specific applications giving reasons for their use**
- **identification and application of resistors used in electronic circuits**
- **identification and application of capacitors used in electronic circuits**
- **application and function of resistor/capacitor circuit and RC time constant**
- **identification, application and function of switches**
- **application, function and benefits of circuit protection**
- **systems approach**
- **identification, function and application of input devices**
- **identification, function and application of process devices**
- **identification, function and application of output devices**
- **application and function of DC electric motor control**
- **identification of smart and modern materials**

Foundation Initial | Foundation Bronze | Foundation Silver | Foundation Gold

## Foundation Silver – GCSE Mathematics B J567

**Keywords/Themes** Resistance, capacitance.

**RC circuits: exponential function**

Electromagnetism: motors

Smart materials: QTC, SMA

| Theme | Incorporates | | Theme comments |
|---|---|---|---|
| Fundamental electrical calculations of RC time constant [Direct] | **FSN4** | Use the four operations on decimals without the use of a calculator. | Fundamental electrical calculations of RC time constant |
| | **FSN6** | Use a calculator effectively and efficiently, entering a range of measures including 'time', interpreting the display and rounding off a final answer to a reasonable degree of accuracy. Perform calculations using the order of operations. | |
| Interpret and manipulate formulae used in RC circuits. [Direct] | **FSA1** | Use and generate formulae. Substitute positive and negative numbers into a formula or an expression. | Use given formulae for RC circuits to generate new formulae and solve numerically and using graphs. |
| | **FSA2** | Set-up and solve linear equations with integer coefficients. This will include equations in which the unknown appears on both sides of the equation, or with brackets. | |
| | **FSA3** | Manipulate algebraic expressions by multiplying a single term over a bracket and by taking out common factors. | |
| | **FSA4** | Use tables to plot graphs of linear functions given explicitly. | |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R113 Electronic principles

**LO2: Understand the operating principles of electronic components**

Learners must be taught:

- **appropriate cable types for specific applications giving reasons for their use**
- **identification and application of resistors used in electronic circuits**
- **identification and application of capacitors used in electronic circuits**
- **application and function of resistor/capacitor circuit and RC time constant**
- **identification, application and function of switches**
- **application, function and benefits of circuit protection**
- **systems approach**
- **identification, function and application of input devices**
- **identification, function and application of process devices**
- **identification, function and application of output devices**
- **application and function of DC electric motor control**
- **identification of smart and modern materials**

Foundation Initial | Foundation Bronze | Foundation Silver | Foundation Gold

## Foundation Gold – GCSE Mathematics B J567

**Keywords/Themes** Resistance, capacitance.

**RC circuits: exponential function**

Electromagnetism: motors

Smart materials: QTC, SMA

| Theme | Incorporates | Theme comments |
|---|---|---|
| Fundamental electrical calculations of RC time constant [Direct] | **FGA3** Change the subject of a formula in cases where the subject only appears once. | Fundamental electrical calculations of RC time constant |

Interpret and manipulate formulae used in RC circuits. [Direct]

# Unit R113
# Electronic principles

**LO2: Complex electrical calculations**

Resistance, capacitance.

**RC circuits: exponential function**

Electromagnetism: motors

Smart materials: QTC, SMA

**Mathematics B J567**
**Higher Gold**

## Extended opportunities – GCSE Mathematics B J567 Higher Gold

| Theme | Incorporates | Theme comments |
|---|---|---|
| Interpret and manipulate formulae used in RC circuits. [Direct] | **HGN5** Use calculators to explore exponential growth and decay. | Exponential voltage growth and decay in RC circuits. |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R113 Electronic principles

**LO3: Know test methods for electronic circuits**

Learners must be taught:

- **techniques to identify potential electrical hazards and the reasons for their use**
- **fault-finding procedures**
- **appropriate test equipment**

Foundation Initial | Foundation Bronze | Foundation Silver | Foundation Gold

## Foundation Initial – GCSE Mathematics B J567

**Keywords/Themes** **Measuring voltage, current, resistance**

**Logic**

**Oscilloscope: waveforms**

| Theme | Incorporates | Theme comments |
|---|---|---|
| Measure and estimate values of voltage, current etc [Direct] | **FIG2** Make sensible estimates of a range of measures in everyday settings. | Measure and estimate values of voltage, current etc |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R113 Electronic principles

**LO3: Know test methods for electronic circuits**

Learners must be taught:

- **techniques to identify potential electrical hazards and the reasons for their use**
- **fault-finding procedures**
- **appropriate test equipment**

Foundation Initial | Foundation Bronze | Foundation Silver | Foundation Gold

## Foundation Bronze, Silver and Gold – GCSE Mathematics B J567

**None of the learning outcomes can be directly mapped for LO3.**

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R113 Electronic principles

**LO4: Understand commercial circuit construction methods**

Learners must be taught:

- techniques to identify potential electrical hazards and the reasons for their use
- fault-finding procedures
- appropriate test equipment

Foundation Initial | Foundation Bronze | Foundation Silver | Foundation Gold

## Foundation Initial, Bronze, Silver and Gold – GCSE Mathematics B J567

**None of the learning outcomes can be directly mapped for LO4.**

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R113 Electronic principles

**LO1: Understand basic electronic principles**

Learners must be taught:

- **principles, units and measurement**
- **values for voltage, current, resistance and power by calculation**
- **circuit components, symbols and diagrams**
- **series and parallel circuits**
- **the operation of a potential divider**
- **types of power sources available**
- **reasons for selection of suitable power sources**
- **function and application of voltage regulators in power supply circuits**

**Gateway Additional Science B 2012 J262** | **21st Century Science A 2012 J242**

**Keywords/Themes** **Voltage, current, resistance, capacitance, inductance, electromagnetism, frequency.**

Calculations: **ohms law and potential divider**.

Schematic diagrams.

**Sustainable power sources.**

| Theme | Incorporates | Theme comments |
|---|---|---|
| Calculation of electrical resistance and power [Direct]<br><br>Calculate resistance and voltage [Direct]<br><br>Understand how a motor and generator work [Direct] | **P4c** Radiation for life (safe electrical) | Calculating resistance from voltage and current, calculating power from voltage and current |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R113 Electronic principles

**LO1: Understand basic electronic principles**

Learners must be taught:

- **principles, units and measurement**
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- **circuit components, symbols and diagrams**
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- **the operation of a potential divider**
- **types of power sources available**
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**Gateway Additional Science B 2012 J262** | **21st Century Science A 2012 J242**

Keywords/Themes **Voltage, current, resistance, capacitance, inductance, electromagnetism, frequency**

Calculations: **ohms law and potential divider**

Schematic diagrams

**Sustainable power sources**

| Theme | Incorporates | | Theme comments |
|---|---|---|---|
| Calculation of electrical resistance and power [Direct] | **P5.1, P5.2** | Electric circuits | Understanding current and calculating power and resistance |
| Calculate resistance and voltage [Direct] | **P5.3** | Electric circuits | Calculate value of resistors in series and parallel, and voltages in a potential divider |
| Understand how a motor and generator work [Direct] | **P5.4/P5.5** | Electric circuits | Understand how motors and generators work |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R113 Electronic principles

### LO2: Understand the operating principles of electronic components

Learners must be taught:

- **appropriate cable types for specific applications giving reasons for their use**
- **identification and application of resistors used in electronic circuits**
- **identification and application of capacitors used in electronic circuits**
- **application and function of resistor/capacitor circuit and RC time constant**
- **identification, application and function of switches**
- **application, function and benefits of circuit protection**
- **systems approach**
- **identification, function and application of input devices**
- **identification, function and application of process devices**
- **identification, function and application of output devices**
- **application and function of DC electric motor control**
- **identification of smart and modern materials**

**Gateway Additional Science B 2012 J262** | **21st Century Science A 2012 J242**

**Keywords/Themes** **Resistance, capacitance**

RC circuits: exponential function

**Electromagnetism: motors**

**Smart materials: QTC, SMA**

| Theme | Incorporates | Theme comments |
|---|---|---|
| Calculation of electrical resistance and power [Direct] | **P4c** Radiation for life (safe electrical) | Calculating resistance from voltage and current, calculating power from voltage and current |
| Calculate resistance and voltage [Direct] | | |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R113 Electronic principles

### LO2: Understand the operating principles of electronic components

Learners must be taught:

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- **identification of smart and modern materials**

**Gateway Additional Science B 2012 J262** | **21st Century Science A 2012 J242**

**Keywords/Themes** **Resistance, capacitance**

RC circuits: exponential function

**Electromagnetism: motors**

**Smart materials: QTC, SMA**

| Theme | Incorporates | Theme comments |
|---|---|---|
| Calculation of electrical resistance and power [Direct] | **P5.1, P5.2** Electric circuits | Understanding current and calculating power and resistance |
| Calculate resistance and voltage [Direct] | **P5.3** Electric circuits | Calculate value of resistors in series and parallel, and voltages in a potential divider |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R113 Electronic principles

**LO3: Know test methods for electronic circuits**

Learners must be taught:

- **techniques to identify potential electrical hazards and the reasons for their use**
- **fault-finding procedures**
- **appropriate test equipment**

**Gateway Additional Science B 2012 J262** | **21st Century Science A 2012 J242**

**Keywords/Themes** Measuring **voltage, current, resistance**

Logic.

**Oscilloscope: waveforms**

| Theme | Incorporates | Theme comments |
|---|---|---|
| Calculation of electrical resistance and power [Direct]<br><br>Calculate resistance and voltage [Direct] | **P4c** Radiation for life (safe electrical) | Calculating resistance from voltage and current, calculating power from voltage and current |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R113 Electronic principles

**LO3: Know test methods for electronic circuits**

Learners must be taught:

- **techniques to identify potential electrical hazards and the reasons for their use**
- **fault-finding procedures**
- **appropriate test equipment**

**Gateway Additional Science B 2012 J262**

**21st Century Science A 2012 J242**

**Keywords/Themes** Measuring **voltage, current, resistance**

Logic.

**Oscilloscope: waveforms**

| Theme | Incorporates | Theme comments |
|---|---|---|
| Calculation of electrical resistance and power [Direct] | **P5.1, P5.2** Electric circuits | Understanding current and calculating power and resistance |
| Calculate resistance and voltage [Direct] | **P5.3** Electric circuits | Calculate value of resistors in series and parallel, and voltages in a potential divider |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R113 Electronic principles

**LO4: Understand commercial circuit construction methods**

Learners must be taught:

- techniques to identify potential electrical hazards and the reasons for their use
- fault-finding procedures
- appropriate test equipment

**Gateway Additional Science B 2012 J262**

**21st Century Science A 2012 J242**

**None of the learning outcomes can be directly mapped for LO4.**

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R113 Engineering principles

### LO1: Understand basic electronic principles

Learners must be taught:

- **principles, units and measurement**
- **values for voltage, current, resistance and power by calculation**
- **circuit components, symbols and diagrams**
- **series and parallel circuits**
- **the operation of a potential divider**
- **types of power sources available**
- **reasons for selection of suitable power sources**
- **function and application of voltage regulators in power supply circuits**

**Gateway Physics B 2012 J265** | **21st Century Physics A 2012 J245**

Keywords/Themes **Voltage, current, resistance, capacitance, inductance, electromagnetism, frequency**

Calculations: **ohms law and potential divider**

Schematic diagrams

**Sustainable power sources**

| Theme | Incorporates | Theme comments |
|---|---|---|
| Understand how electricity is generated [Direct] | **P2b** Living for the future (Generating electricity) | Understand how electricity is generated using a generator and an energy source |
| The use of fuels for power, power and energy [Direct] | **P2d** Living for the future ( Fuels for power) | Calculation of power from voltage and current, also energy in kWh |
| Calculation of electrical resistance and power [Direct] | **P4c** Radiation for life (resisting)<br>**P6a** Electricity for gadgets (resisting) | Calculating resistance from voltage and current, calculating power from voltage and current |
| Calculate resistance and voltage [Direct] | **P6b** Electricity for gadgets (sharing) | Calculate value of resistors in series and parallel, and voltages in a potential divider |
| Understand how a motor and generator work [Direct] | **P6e** Electricity for gadgets (motoring)<br>**P6f** Electricity for gadgets (generating) | Understand how electric motors and generators convert electrical energy to and from mechanical energy |
| Understand a.c. Electricity [Direct] | | |
| Understands energy and its practical applications [Direct] | **P2a** Collecting energy from the sun | Understand the conversion of energy from the sun into electrical energy. |
| Understand how transformers work [Indirect] | **P6g** Electricity for gadgets (transforming) | Understand how electrical transformers increase or decrease a.c. voltage. |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R113 Engineering principles

### LO1: Understand basic electronic principles

Learners must be taught:

- **principles, units and measurement**
- **values for voltage, current, resistance and power by calculation**
- **circuit components, symbols and diagrams**
- **series and parallel circuits**
- **the operation of a potential divider**
- **types of power sources available**
- **reasons for selection of suitable power sources**
- **function and application of voltage regulators in power supply circuits**

Gateway Physics B 2012 J265

21st Century Physics A 2012 J245

Keywords/Themes **Voltage, current, resistance, capacitance, inductance, electromagnetism, frequency.**

Calculations: **ohms law and potential divider.**

| Theme | Incorporates | Theme comments |
|---|---|---|
| Understand how electricity is generated [Direct] | **P3.2 Sustainable energy** | Understand how electric generators produce mains electricity from energy sources |
| The use of fuels for power, power and energy [Direct] | **P3.1 Sustainable energy** | Calculation of power from voltage and current, also energy in kWh |
| Calculation of electrical resistance and power [Direct] | **P5.1, P5.2 Electric circuits** | Understanding current and calculating power and resistance |
| Calculate resistance and voltage [Direct] | **P5.3 Electric circuits** | Calculate value of resistors in series and parallel, and voltages in a potential divider |
| Understand how a motor and generator work [Direct] | **P5.4/P5.5 Electric circuits** | Understand how motors and generators work |
| Understand a.c. Electricity [Direct] | **P1.2 The Earth in the Universe** | Understand the frequency of waves in hertz (Hz) in relation to a.c. electricity |
| Understands energy and its practical applications [Direct] | **P3.3 Sustainable energy** | Understand how energy sources are chosen to create electricity |
| Understand how transformers work [Indirect] | | |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R113 Electronic principles

### LO2: Understand the operating principles of electronic components

Learners must be taught:

- **appropriate cable types for specific applications giving reasons for their use**
- **identification and application of resistors used in electronic circuits**
- **identification and application of capacitors used in electronic circuits**
- **application and function of resistor/capacitor circuit and RC time constant**
- **identification, application and function of switches**
- **application, function and benefits of circuit protection**
- **systems approach**
- **identification, function and application of input devices**
- **identification, function and application of process devices**
- **identification, function and application of output devices**
- **application and function of DC electric motor control**
- **identification of smart and modern materials**

**Gateway Physics B 2012 J265** | **21st Century Physics A 2012 J245**

**Keywords/Themes** **Resistance, capacitance**

RC circuits: exponential function

**Electromagnetism: motors**

**Smart materials: QTC, SMA**

| Theme | Incorporates | Theme comments |
|---|---|---|
| Calculation of electrical resistance and power [Indirect] | **P4c** Radiation for life (resisting)<br>**P6a** Electricity for gadgets (resisting) | Calculating resistance from voltage and current, calculating power from voltage and current |
| Calculate resistance and voltage [Indirect] | **P6b** Electricity for gadgets (sharing) | Calculate value of resistors in series and parallel, and voltages in a potential divider |
| Understand how a motor and generator work [Direct] | **P6e** Electricity for gadgets (motoring)<br>**P6f** Electricity for gadgets (generating) | Understand how electric motors and generators convert electrical energy to and from mechanical energy |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R113 Electronic principles

### LO2: Understand the operating principles of electronic components

Learners must be taught:

- **appropriate cable types for specific applications giving reasons for their use**
- **identification and application of resistors used in electronic circuits**
- **identification and application of capacitors used in electronic circuits**
- **application and function of resistor/capacitor circuit and RC time constant**
- **identification, application and function of switches**
- **application, function and benefits of circuit protection**
- **systems approach**
- **identification, function and application of input devices**
- **identification, function and application of process devices**
- **identification, function and application of output devices**
- **application and function of DC electric motor control**
- **identification of smart and modern materials**

**Gateway Physics B 2012 J265** | **21st Century Physics A 2012 J245**

**Keywords/Themes** **Resistance, capacitance**

RC circuits: exponential function

**Electromagnetism: motors**

**Smart materials: QTC, SMA**

| Theme | Incorporates | Theme comments |
|---|---|---|
| Calculation of electrical resistance and power [Indirect] | **P5.1, P5.2** Electric circuits | Understanding current and calculating power and resistance |
| Calculate resistance and voltage [Indirect] | **P5.3** Electric circuits | Calculate value of resistors in series and parallel, and voltages in a potential divider |
| Understand how a motor and generator work [Direct] | **P5.4/P5.5** Electric circuits | Understand how motors and generators work |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R113 Electronic principles

### LO3: Know test methods for electronic circuits

Learners must be taught:

- **techniques to identify potential electrical hazards and the reasons for their use**
- **fault-finding procedures**
- **appropriate test equipment**

**Gateway Physics B 2012 J265** | **21st Century Physics A 2012 J245**

**Keywords/Themes** Measuring **voltage, current, resistance**

**Logic**

Oscilloscope: **waveforms**

| Theme | Incorporates | Theme comments |
|---|---|---|
| Calculation of electrical resistance and power from measurements [Direct] | **P4c** Radiation for life (resisting)<br>**P6a** Electricity for gadgets (resisting) | Calculating resistance from voltage and current, calculating power from voltage and current |
| Calculate resistance and voltage from measurements [Direct] | **P6b** Electricity for gadgets (sharing) | Calculate value of resistors in series and parallel, and voltages in a potential divider |
| Understand a.c. Electricity [Direct] | **P2b** Generating electricity | Understand the frequency of waves in hertz (Hz) in relation to a.c. electricity (eg when using an oscilloscope) |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R113 Electronic principles

### LO3: Know test methods for electronic circuits

Learners must be taught:

- **techniques to identify potential electrical hazards and the reasons for their use**
- **fault-finding procedures**
- **appropriate test equipment**

**Gateway Physics B 2012 J265** | **21st Century Physics A 2012 J245**

**Keywords/Themes** Measuring **voltage, current, resistance**

**Logic**

Oscilloscope: **waveforms**

| Theme | Incorporates | Theme comments |
|---|---|---|
| Understanding current and calculating power and resistance | **P5.1, P5.2** Electric circuits | Understanding current and calculating power and resistance |
| Calculate value of resistors in series and parallel, and voltages in a potential divider | **P5.3** Electric circuits | Calculate value of resistors in series and parallel, and voltages in a potential divider |
| Understand the frequency of waves in hertz (Hz) in relation to a.c. electricity (eg when using an oscilloscope) | **P1.2** The Earth in the Universe | Understand the frequency of waves in hertz (Hz) in relation to a.c. electricity (eg when using an oscilloscope) |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R113 Electronic principles

**LO4: Understand commercial circuit construction methods**

Learners must be taught:

- techniques to identify potential electrical hazards and the reasons for their use
- fault-finding procedures
- appropriate test equipment

**Gateway Physics B 2012 J265**

**21st Century Physics A 2012 J245**

**None of the learning outcomes can be directly mapped for LO4.**

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R113 Engineering principles

### LO1: Understand basic electronic principles

Learners must be taught:

- **principles, units and measurement**
- **values for voltage, current, resistance and power by calculation**
- **circuit components, symbols and diagrams**
- **series and parallel circuits**
- **the operation of a potential divider**
- **types of power sources available**
- **reasons for selection of suitable power sources**
- **function and application of voltage regulators in power supply circuits**

**Gateway Science B 2012 J261** | **21st Century Science A 2012 J241**

Keywords/Themes **Voltage, current, resistance, capacitance, inductance, electromagnetism, frequency**

Calculations: **ohms law and potential divider**

Schematic diagrams

**Sustainable power sources**

| Theme | Incorporates | Theme comments |
|---|---|---|
| Understand how electricity is generated [Direct] | **P2b** Generating electricity | Understand how electricity is generated using a generator |
| The use of fuels for power [Direct] | **P2d** Fuels for power | Calculation of power from voltage and current, also energy in kWh |
| Understands energy and its practical applications including sustainability[Direct] | **P2a:** Collecting energy from the Sun<br>**P2b:** Generating electricity<br>**P2c:** Global warming<br>**P2d:** Fuels for power<br>**P2e:** Nuclear radiations | Understand the conversion of energy from the sun into electrical energy. Also energy from other renewable sources eg wind turbines |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R113 Engineering principles

### LO1: Understand basic electronic principles

Learners must be taught:

- **principles, units and measurement**
- **values for voltage, current, resistance and power by calculation**
- **circuit components, symbols and diagrams**
- **series and parallel circuits**
- **the operation of a potential divider**
- **types of power sources available**
- **reasons for selection of suitable power sources**
- **function and application of voltage regulators in power supply circuits**

**Gateway Science B 2012 J261**

**21st Century Science A 2012 J241**

**Keywords/Themes** **Voltage, current, resistance, capacitance, inductance, electromagnetism, frequency**

Calculations: **ohms law and potential divider**

Schematic diagrams

**Sustainable power sources**

| Theme | Incorporates | Theme comments |
|---|---|---|
| Understand how electricity is generated [Direct] | **P3.1, P3.2** Sustainable energy | Understand how electricity is generated using a generator<br>Calculation of power from voltage and current |
| The use of fuels for power [Direct] | | |
| Understands energy and its practical applications including sustainability[Direct] | **P3.1, P3.3** Sustainable energy | Understand the conversion of energy into electrical energy. Eg fossil fuels, nuclear, biofuels, wind, waves, sun |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R113 Electronic principles

### LO2: Understand the operating principles of electronic components

Learners must be taught:

- **appropriate cable types for specific applications giving reasons for their use**
- **identification and application of resistors used in electronic circuits**
- **identification and application of capacitors used in electronic circuits**
- **application and function of resistor/capacitor circuit and RC time constant**
- **identification, application and function of switches**
- **application, function and benefits of circuit protection**
- **systems approach**
- **identification, function and application of input devices**
- **identification, function and application of process devices**
- **identification, function and application of output devices**
- **application and function of DC electric motor control**
- **identification of smart and modern materials**

**Gateway Science B 2012 J261** | **21st Century Science A 2012 J241**

**Keywords/Themes** **Resistance, capacitance**

RC circuits: exponential function

**Electromagnetism: motors**

**Smart materials: QTC, SMA**

| Theme | Incorporates | Theme comments |
|---|---|---|
| Understand how electricity is generated [Direct] | **P2b** Generating electricity | Understand how electricity is generated using a generator |
| Understand smart and modern materials [Direct] | **C2c** Metals and alloys | Know about smart alloys and their applications |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R113 Electronic principles

### LO2: Understand the operating principles of electronic components

Learners must be taught:

- **appropriate cable types for specific applications giving reasons for their use**
- **identification and application of resistors used in electronic circuits**
- **identification and application of capacitors used in electronic circuits**
- **application and function of resistor/capacitor circuit and RC time constant**
- **identification, application and function of switches**
- **application, function and benefits of circuit protection**
- **systems approach**
- **identification, function and application of input devices**
- **identification, function and application of process devices**
- **identification, function and application of output devices**
- **application and function of DC electric motor control**
- **identification of smart and modern materials**

**Gateway Science B 2012 J261** | **21st Century Science A 2012 J241**

**Keywords/Themes** **Resistance, capacitance**

RC circuits: exponential function

**Electromagnetism: motors**

**Smart materials: QTC, SMA**

| Theme | Incorporates | Theme comments |
|---|---|---|
| Understand how electricity is generated [Direct] | **P3.1, P3.2** Sustainable energy | Understand how electricity is generated using a generator<br><br>Calculation of power from voltage and current |
| Understand smart and modern materials [Direct] | | |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R113 Electronic principles

### LO3: Know test methods for electronic circuits

Learners must be taught:

- **techniques to identify potential electrical hazards and the reasons for their use**
- **fault-finding procedures**
- **appropriate test equipment**

**Gateway Science B 2012 J261** | **21st Century Science A 2012 J241**

**Keywords/Themes** Measuring **voltage, current, resistance**

**Logic**

Oscilloscope: **waveforms**

| Theme | Incorporates | Theme comments |
|---|---|---|
| Understand a.c. Electricity [Direct] | **P1c** A spectrum of waves | Understand the frequency of waves in hertz (Hz) in relation to a.c. electricity (eg when using an oscilloscope) |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R113 Electronic principles

### LO3: Know test methods for electronic circuits

Learners must be taught:

- **techniques to identify potential electrical hazards and the reasons for their use**
- **fault-finding procedures**
- **appropriate test equipment**

Gateway Science B 2012 J261 | 21st Century Science A 2012 J241

**Keywords/Themes** Measuring **voltage, current, resistance**

**Logic**

Oscilloscope: **waveforms**

| Theme | Incorporates | Theme comments |
|---|---|---|
| Understand a.c. Electricity [Direct] | **P1.2** The Earth in the Universe | Understand the frequency of waves in hertz (Hz) in relation to a.c. electricity (eg when using an oscilloscope) |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R113 Electronic principles

**LO4: Understand commercial circuit construction methods**

Learners must be taught:

- techniques to identify potential electrical hazards and the reasons for their use
- fault-finding procedures
- appropriate test equipment

**Gateway Science B 2012 J261**

**21st Century Science A 2012 J241**

**None of the learning outcomes can be directly mapped for LO4.**

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R114 Simulate, construct and test electronic circuits

**LO1: Be able to use Computer Aided Design (CAD) for circuit simulation and design**

Learners must be taught:

- **circuit schematic diagram drawing using CAD software**
- **circuit simulation and test using CAD software**
- **PCB layout production to include both track and component views (eg export of schematic diagrams, use of component libraries)**

Foundation Initial | Foundation Bronze | Foundation Silver | Foundation Gold

## Foundation Initial – GCSE Mathematics B J567

**Keywords/Themes** Electronic components.

**CAD drawing** (circuits)

| Theme | Incorporates | | Theme comments |
|---|---|---|---|
| Use CAD with electronic circuits, simulation and for PCB layout. [Direct] | **FIG2** | Make sensible estimates of a range of measures in everyday settings. | Interpret voltage, resistance and current on CAD circuit drawings and simulations. |
| Use CAD with electronic circuits, simulation and for PCB layout. [Indirect] | **FIN1** | Round numbers to a given power of 10. | Interpret and manipulate voltage, resistance and current on CAD circuit drawings and simulations. |
| | **FIN2** | Add and subtract three-digit numbers, without the use of a calculator | |
| | | Add and subtract using numbers with up to two decimal places without the use of a calculator. | |
| | **FIN3** | Multiply and divide numbers with no more than one decimal digit by an integer between 1 and 10, without the use of a calculator. Multiply and divide any number by 10, 100 and 1000 without the use of a calculator. | |
| | **FIN4** | Multiply and divide a three-digit number by a two-digit number. Multiply numbers with up to two decimal places by an integer. | |
| | **FIN5** | Calculate a fraction of a given quantity. Identify fractions of a shape. | |
| | **FIN9** | Solve problems using the four operations on integer and decimal numbers using a calculator | |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R114 Simulate, construct and test electronic circuits

**LO1: Be able to use Computer Aided Design (CAD) for circuit simulation and design**

Learners must be taught:

- **circuit schematic diagram drawing using CAD software**
- **circuit simulation and test using CAD software**
- **PCB layout production to include both track and component views (eg export of schematic diagrams, use of component libraries)**

Foundation Initial | Foundation Bronze | Foundation Silver | Foundation Gold

## Foundation Initial – GCSE Mathematics B J567

**Keywords/Themes** Electronic components.

**CAD drawing** (circuits)

| Theme | Incorporates | Theme comments |
|---|---|---|
| Use CAD with electronic circuits, simulation and for PCB layout. [Direct]<br><br>Use CAD with electronic circuits, simulation and for PCB layout. [Indirect] | **FBN8** Use the four operations with positive and negative integers. | Interpret and manipulate voltage, resistance and current on CAD circuit drawings and simulations |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R114 Simulate, construct and test electronic circuits

**LO1: Be able to use Computer Aided Design (CAD) for circuit simulation and design**

Learners must be taught:

- **circuit schematic diagram drawing using CAD software**
- **circuit simulation and test using CAD software**
- **PCB layout production to include both track and component views (eg export of schematic diagrams, use of component libraries)**

Foundation Initial | Foundation Bronze | Foundation Silver | Foundation Gold

## Foundation Silver and Gold – GCSE Mathematics B J567

**None of the learning outcomes can be directly mapped for LO1.**

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R114 Simulate, construct and test electronic circuits

### LO2: Be able to construct circuits

Learners must be taught:

- **safe use of manually-operated hand tools, ie**
  - soldering iron
  - wire cutters
  - wire strippers
  - pliers
  - screwdrivers
  - de-soldering tools
  - manual/PCB drills
  - appropriate PPE
- **circuit construction following circuit diagram(s) (eg transistor circuits using sensors and switches, alarm circuits, audio circuits, optical circuits, counting circuits, logic circuits)**
- **safe construction of PCBs (eg photoresist methods, etch resist methods, engraving)**
- **circuit construction using appropriate methods (eg component assembly, PCB soldering techniques, heat sinks for delicate components)**
- **construction techniques for joining external components, ie**
  - soldering
  - connecting between boards (eg ribbon cable, connecting plugs and sockets, PCB to case fittings, sleeves, insulation, heat shrink, screw terminals)

Foundation Initial | Foundation Bronze | Foundation Silver | Foundation Gold

## Foundation Initial, Bronze, Silver and Gold – GCSE Mathematics B J567

**None of the learning outcomes can be directly mapped for LO2.**

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R114 Simulate, construct and test electronic circuits

### LO3: Be able to test electronic circuits

Learners must be taught:

- **techniques for testing electronic circuits, ie**
  - visual inspection, ie
    - fitting of incorrect component
    - mis-placed components
    - dry joint
    - bridged or damaged PCB tracks
  - appropriate testing and fault-finding methods, (eg continuity testing, test-point voltage, current measurement, signal tracing (eg half-split, input to output, output to input)
  - use of physical test equipment, (eg power supplies, multi-meter, logic probe, oscilloscope, signal generator)



## Foundation Initial – GCSE Mathematics B J567

**Keywords/Themes** Measuring voltage, current, resistance

Logic

Oscilloscope: waveforms

| Theme | Incorporates | Theme comments |
|---|---|---|
| Measure and estimate values of voltage, current etc [Direct] | **FIG2** Make sensible estimates of a range of measures in everyday settings. | Measure and estimate values of voltage, current etc |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R114 Simulate, construct and test electronic circuits

**LO1: Be able to use Computer Aided Design (CAD) for circuit simulation and design**

Learners must be taught:

- **circuit schematic diagram drawing using CAD software**
- **circuit simulation and test using CAD software**
- **PCB layout production to include both track and component views (eg export of schematic diagrams, use of component libraries)**

Foundation Initial | Foundation Bronze | Foundation Silver | Foundation Gold

## Foundation Bronze, Silver and Gold – GCSE Mathematics B J567

**None of the learning outcomes can be directly mapped for LO1 Foundation Bronze, Silver or Gold.**

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R114 Simulate, construct and test electronic circuits

**LO1: Be able to use Computer Aided Design (CAD) for circuit simulation and design**

Learners must be taught:

- **circuit schematic diagram drawing using CAD software**
- **circuit simulation and test using CAD software**
- **PCB layout production to include both track and component views (eg export of schematic diagrams, use of component libraries)**

**Gateway Additional Science B 2012 J262**

**21st Century Science A 2012 J242**

**Keywords/Themes** Electronic components.

**CAD drawing** (circuits)

**None of the learning outcomes can be directly mapped for LO1.**

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R114 Simulate, construct and test electronic circuits

### LO2: Be able to construct circuits

Learners must be taught:

- **safe use of manually-operated hand tools, ie**
  - soldering iron
  - wire cutters
  - wire strippers
  - pliers
  - screwdrivers
  - de-soldering tools
  - manual/PCB drills
  - appropriate PPE
- **circuit construction following circuit diagram(s) (eg transistor circuits using sensors and switches, alarm circuits, audio circuits, optical circuits, counting circuits, logic circuits)**
- **safe construction of PCBs (eg photoresist methods, etch resist methods, engraving)**
- **circuit construction using appropriate methods (eg component assembly, PCB soldering techniques, heat sinks for delicate components)**
- **construction techniques for joining external components, ie**
  - soldering
  - connecting between boards (eg ribbon cable, connecting plugs and sockets, PCB to case fittings, sleeves, insulation, heat shrink, screw terminals)

**Gateway Additional Science B 2012 J262**

**21st Century Science A 2012 J242**

**Keywords/Themes** Electronic components.

**CAD drawing** (circuits)

**None of the learning outcomes can be directly mapped for LO2.**

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R114 Simulate, construct and test electronic circuits

### LO3: Be able to test electronic circuits

Learners must be taught:

- **techniques for testing electronic circuits, ie**
  - visual inspection, ie
    - fitting of incorrect component
    - miss-placed components
    - dry joint
    - bridged or damaged PCB tracks
  - appropriate testing and fault-finding methods, (eg continuity testing, test-point voltage, current measurement, signal tracing (eg half-split, input to output, output to input)
  - use of physical test equipment, (eg power supplies, multi-meter, logic probe, oscilloscope, signal generator)

**Gateway Additional Science B 2012 J262** | **21st Century Science A 2012 J242**

**Keywords/Themes** Measuring **voltage, current, resistance**

**Logic**

Oscilloscope: **waveforms**

| Theme | Incorporates | Theme comments |
|---|---|---|
| Calculation of electrical resistance and power [Direct] | **P4c** Radiation for life (safe electrical) | Calculating resistance from voltage and current, calculating power from voltage and current |
| Calculate resistance and voltage [Direct] | | |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R114 Simulate, construct and test electronic circuits

### LO3: Be able to test electronic circuits

Learners must be taught:

- **techniques for testing electronic circuits, ie**
  - visual inspection, ie
    - fitting of incorrect component
    - miss-placed components
    - dry joint
    - bridged or damaged PCB tracks
  - appropriate testing and fault-finding methods, (eg continuity testing, test-point voltage, current measurement, signal tracing (eg half-split, input to output, output to input)
  - use of physical test equipment, (eg power supplies, multi-meter, logic probe, oscilloscope, signal generator)

Gateway Additional Science B 2012 J262 | 21st Century Science A 2012 J242

**Keywords/Themes** Measuring **voltage, current, resistance**

**Logic**

Oscilloscope: **waveforms**

| Theme | Incorporates | Theme comments |
|---|---|---|
| Calculation of electrical resistance and power [Direct] | **P5.1, P5.2** Electric circuits | Understanding current and calculating power and resistance |
| Calculate resistance and voltage [Direct] | **P5.3** Electric circuits | Calculate value of resistors in series and parallel, and voltages in a potential divider |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R114 Simulate, construct and test electronic circuits

**LO1: Be able to use Computer Aided Design (CAD) for circuit simulation and design**

Learners must be taught:

- **circuit schematic diagram drawing using CAD software**
- **circuit simulation and test using CAD software**
- **PCB layout production to include both track and component views (eg export of schematic diagrams, use of component libraries)**

**Gateway Physics B 2012 J265**

**21st Century Physics A 2012 J245**

**None of the learning outcomes can be directly mapped for LO1.**

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R114 Simulate, construct and test electronic circuits

### LO2: Be able to construct circuits

Learners must be taught:

- **safe use of manually-operated hand tools, ie**
  - soldering iron
  - wire cutters
  - wire strippers
  - pliers
  - screwdrivers
  - de-soldering tools
  - manual/PCB drills
  - appropriate PPE
- **circuit construction following circuit diagram(s) (eg transistor circuits using sensors and switches, alarm circuits, audio circuits, optical circuits, counting circuits, logic circuits)**
- **safe construction of PCBs (eg photoresist methods, etch resist methods, engraving)**
- **circuit construction using appropriate methods (eg component assembly, PCB soldering techniques, heat sinks for delicate components)**
- **construction techniques for joining external components, ie**
  - soldering
  - connecting between boards (eg ribbon cable, connecting plugs and sockets, PCB to case fittings, sleeves, insulation, heat shrink, screw terminals)

Gateway Physics B 2012 J265

21st Century Physics A 2012 J245

**None of the learning outcomes can be directly mapped for LO2.**

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R114 Simulate, construct and test electronic circuits

### LO3: Be able to test electronic circuits

Learners must be taught:

- **techniques for testing electronic circuits, ie**
  - visual inspection, ie
    - fitting of incorrect component
    - miss-placed components
    - dry joint
    - bridged or damaged PCB tracks
  - appropriate testing and fault-finding methods, (eg continuity testing, test-point voltage, current measurement, signal tracing (eg half-split, input to output, output to input)
  - use of physical test equipment, (eg power supplies, multi-meter, logic probe, oscilloscope, signal generator)

**Gateway Physics B 2012 J265** | **21st Century Physics A 2012 J245**

**Keywords/Themes** Measuring **voltage, current, resistance**

**Logic**

Oscilloscope: **waveforms**

| Theme | Incorporates | Theme comments |
|---|---|---|
| Calculation of electrical resistance and power from measurements [Direct] | **P4c** Radiation for life (resisting)<br>**P6a** Electricity for gadgets (resisting) | Calculating resistance from voltage and current, calculating power from voltage and current |
| Calculate resistance and voltage from measurements [Direct] | **P6b** Electricity for gadgets (sharing) | Calculate value of resistors in series and parallel, and voltages in a potential divider |
| Understand a.c. Electricity [Direct] | **P2b** Generating electricity | Understand the frequency of waves in hertz (Hz) in relation to a.c. electricity (eg when using an oscilloscope) |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R114 Simulate, construct and test electronic circuits

### LO3: Be able to test electronic circuits

Learners must be taught:

- **techniques for testing electronic circuits, ie**
  - visual inspection, ie
    - fitting of incorrect component
    - miss-placed components
    - dry joint
    - bridged or damaged PCB tracks
  - appropriate testing and fault-finding methods, (eg continuity testing, test-point voltage, current measurement, signal tracing (eg half-split, input to output, output to input)
  - use of physical test equipment, (eg power supplies, multi-meter, logic probe, oscilloscope, signal generator)

Gateway Physics B 2012 J265

21st Century Physics A 2012 J245

**None of the learning outcomes can be directly mapped for LO3.**

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R114 Simulate, construct and test electronic circuits

**LO1: Be able to use Computer Aided Design (CAD) for circuit simulation and design**

Learners must be taught:

- **circuit schematic diagram drawing using CAD software**
- **circuit simulation and test using CAD software**
- **PCB layout production to include both track and component views (eg export of schematic diagrams, use of component libraries)**

**Gateway Science B 2012 J261**

**21st Century Science A 2012 J241**

**None of the learning outcomes can be directly mapped for LO1.**

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R114 Simulate, construct and test electronic circuits

### LO2: Be able to construct circuits

Learners must be taught:

- **safe use of manually-operated hand tools, ie**
  - soldering iron
  - wire cutters
  - wire strippers
  - pliers
  - screwdrivers
  - de-soldering tools
  - manual/PCB drills
  - appropriate PPE
- **circuit construction following circuit diagram(s) (eg transistor circuits using sensors and switches, alarm circuits, audio circuits, optical circuits, counting circuits, logic circuits)**
- **safe construction of PCBs (eg photoresist methods, etch resist methods, engraving)**
- **circuit construction using appropriate methods (eg component assembly, PCB soldering techniques, heat sinks for delicate components)**
- **construction techniques for joining external components, ie**
  - soldering
  - connecting between boards (eg ribbon cable, connecting plugs and sockets, PCB to case fittings, sleeves, insulation, heat shrink, screw terminals)

**Gateway Science B 2012 J261**

**21st Century Science A 2012 J241**

**None of the learning outcomes can be directly mapped for LO2.**

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R114 Simulate, construct and test electronic circuits

### LO3: Be able to test electronic circuits

Learners must be taught:

- **techniques for testing electronic circuits, ie**
  - visual inspection, ie
    - fitting of incorrect component
    - miss-placed components
    - dry joint
    - bridged or damaged PCB tracks
  - appropriate testing and fault-finding methods, (eg continuity testing, test-point voltage, current measurement, signal tracing (eg half-split, input to output, output to input)
  - use of physical test equipment, (eg power supplies, multi-meter, logic probe, oscilloscope, signal generator)

**Gateway Science B 2012 J261** | **21st Century Science A 2012 J241**

**Keywords/Themes** Measuring **voltage, current, resistance**
**Logic**
Oscilloscope: **waveforms**

| Theme | Incorporates | Theme comments |
|---|---|---|
| Understand a.c. Electricity [Direct] | **P1c** A spectrum of waves | Understand the frequency of waves in hertz (Hz) in relation to a.c. electricity (eg when using an oscilloscope) |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R114 Simulate, construct and test electronic circuits

### LO3: Be able to test electronic circuits

Learners must be taught:

- **techniques for testing electronic circuits, ie**
  - visual inspection, ie
    - fitting of incorrect component
    - miss-placed components
    - dry joint
    - bridged or damaged PCB tracks
  - appropriate testing and fault-finding methods, (eg continuity testing, test-point voltage, current measurement, signal tracing (eg half-split, input to output, output to input)
  - use of physical test equipment, (eg power supplies, multi-meter, logic probe, oscilloscope, signal generator)

Gateway Science B 2012 J261 | 21st Century Science A 2012 J241

**Keywords/Themes** Measuring **voltage, current, resistance**
**Logic**
Oscilloscope: **waveforms**

| Theme | Incorporates | Theme comments |
|---|---|---|
| Understand a.c. Electricity [Direct] | **P1.2** The Earth in the Universe | Understand the frequency of waves in hertz (Hz) in relation to a.c. electricity (eg when using an oscilloscope) |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R114 Simulate, construct and test electronic circuits

**LO1: Be able to use Computer Aided Design (CAD) for circuit simulation and design**

Learners must be taught:

- **circuit schematic diagram drawing using CAD software**
- **circuit simulation and test using CAD software**
- **PCB layout production to include both track and component views (eg export of schematic diagrams, use of component libraries)**

## Cambridge National in ICT: J800/J810/J820

**Keywords/Themes** Electronic components.

**CAD drawing (circuits)**

| Theme | Incorporates | Theme comments |
|---|---|---|
| CAD Software for circuit simulation and design [Direct] | **R006 (C)**<br>**LO1:** Be able to specify a digital image solution for a client's needs<br>**LO2:** Be able to create digital images<br>**LO3:** Be able to store, retrieve and present digital images | Use CAD software for circuit design and simulation, and PCB design production |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R115 Engineering applications of computers

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

Learners must be taught:

- **how computers are used within engineering industries to design new products, ie**
  - how Computer Aided Design (CAD) systems and graphical packages are used to design and prototype new products
- **how computers are used within engineering industries to manufacture products, monitor production and manage process control, ie**
  - how Computer Aided Manufacture (CAM) systems are used in the manufacturing process
  - how computers are used to automate manufacturing (eg Programmable Logic Controllers (PLC), Programmable Interface Controller (PIC)
  - how computers are used to monitor production/production operations (eg automated test systems)
  - how computers are used for stock control (eg automatic stock movement, Radio Frequency Identification Devices (RFID))
- **features of computer controlled automation (eg temperature control, weight control, position sensing, size sensing, workflow, warehousing and product movement, safety systems and machine interlocks).**

Foundation **Initial** | Foundation **Bronze** | Foundation **Silver** | Foundation **Gold**

## Foundation Initial – GCSE Mathematics B J567

**Keywords/Themes** CAD

Radio frequency tags

**Data control, collection and analysis**

| Theme | Incorporates | | Theme comments |
|---|---|---|---|
| Understand data collection and interpretation with computer controlled automation. [Indirect] | **FIA5** | Construct and interpret simple graphs, including conversion graphs. | Interpret and analyse data generated by a computer controlled automation system. |
| | **FIS4** | Draw and interpret simple frequency tables, charts, pictograms and bar charts for discrete data. | |
| | **FIS5** | Extract and use information from common two-way tables including timetables. | |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R115 Engineering applications of computers

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

Learners must be taught:

- **how computers are used within engineering industries to design new products, ie**
  - how Computer Aided Design (CAD) systems and graphical packages are used to design and prototype new products
- **how computers are used within engineering industries to manufacture products, monitor production and manage process control, ie**
  - how Computer Aided Manufacture (CAM) systems are used in the manufacturing process
  - how computers are used to automate manufacturing (eg Programmable Logic Controllers (PLC), Programmable Interface Controller (PIC)
  - how computers are used to monitor production/production operations (eg automated test systems)
  - how computers are used for stock control (eg automatic stock movement, Radio Frequency Identification Devices (RFID)
- **features of computer controlled automation (eg temperature control, weight control, position sensing, size sensing, workflow, warehousing and product movement, safety systems and machine interlocks).**

Foundation Initial | Foundation Bronze | Foundation Silver | Foundation Gold

## Foundation Bronze – GCSE Mathematics B J567

**Keywords/Themes** CAD

Radio frequency tags

**Data control, collection and analysis**

| Theme | Incorporates | | Theme comments |
|---|---|---|---|
| Understand data collection and interpretation with computer controlled automation. [Indirect] | **FBA5** | Interpret information presented in a range of linear and non-linear graphs, including travel (distance/time) graphs. | Interpret and analyse data generated by a computer controlled automation system. |
| | **FBS3** | Construct and interpret pie charts. | |
| | **FBS4** | Interpret graphs representing real data, including recognising misleading diagrams. | |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R115 Engineering applications of computers

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

Learners must be taught:

- **how computers are used within engineering industries to design new products, ie**
  - how Computer Aided Design (CAD) systems and graphical packages are used to design and prototype new products
- **how computers are used within engineering industries to manufacture products, monitor production and manage process control, ie**
  - how Computer Aided Manufacture (CAM) systems are used in the manufacturing process
  - how computers are used to automate manufacturing (eg Programmable Logic Controllers (PLC), Programmable Interface Controller (PIC)
  - how computers are used to monitor production/production operations (eg automated test systems)
  - how computers are used for stock control (eg automatic stock movement, Radio Frequency Identification Devices (RFID)
- **features of computer controlled automation (eg temperature control, weight control, position sensing, size sensing, workflow, warehousing and product movement, safety systems and machine interlocks).**

Foundation Initial | Foundation Bronze | Foundation Silver | Foundation Gold

## Foundation Silver – GCSE Mathematics B J567

**Keywords/Themes** CAD

Radio frequency tags

**Data control, collection and analysis**

### Theme

Understand data collection and interpretation with computer controlled automation. [Indirect]

### Incorporates

**FSS3** Draw and interpret a wide range of graphs and diagrams for discrete and continuous data, including frequency polygons and stem and leaf diagrams. Compare distributions and make inferences, using the shapes of the distributions and measures of average and range.

### Theme comments

Interpret and analyse data generated by a computer controlled automation system.

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R115 Engineering applications of computers

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

Learners must be taught:

- **how computers are used within engineering industries to design new products, ie**
  - how Computer Aided Design (CAD) systems and graphical packages are used to design and prototype new products
- **how computers are used within engineering industries to manufacture products, monitor production and manage process control, ie**
  - how Computer Aided Manufacture (CAM) systems are used in the manufacturing process
  - how computers are used to automate manufacturing (eg Programmable Logic Controllers (PLC), Programmable Interface Controller (PIC)
  - how computers are used to monitor production/production operations (eg automated test systems)
  - how computers are used for stock control (eg automatic stock movement, Radio Frequency Identification Devices (RFID)
- **features of computer controlled automation (eg temperature control, weight control, position sensing, size sensing, workflow, warehousing and product movement, safety systems and machine interlocks).**

Foundation Initial | Foundation Bronze | Foundation Silver | Foundation Gold

## Foundation Gold – GCSE Mathematics B J567

**Keywords/Themes** CAD

Radio frequency tags

**Data control, collection and analysis**

| Theme | Incorporates | Theme comments |
|---|---|---|
| Understand data collection and interpretation with computer controlled automation. [Indirect] | **FGA5** Draw and interpret graphs modelling real situations, which may be nonlinear, including simple quadratic graphs. | Interpret and analyse data generated by a computer controlled automation system. |
| | **FGS3** Draw and interpret scatter graphs for discrete and continuous variables, including using and understanding lines of best fit. Understand the vocabulary of correlation, including: positive, negative and zero correlation; weak, strong and moderate correlation. Look at data to find patterns and exceptions | |

# CAMBRIDGE NATIONAL IN ENGINEERING

**Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering**

Extended opportunities

## Unit R115 Engineering applications of computers

**LO2: Understand how computers are used for maintenance of engineering systems**

Learners must be taught:

- **how computers are used within engineering system maintenance, ie**
  - – Human Machine Interface (HMI), ie
    - system operation, diagnostics and maintenance
    - use of system operation data
    - modification or correction of system operation
  - – expert systems, ie
    - use within system operation, diagnostics and maintenance
    - use of system operation data
    - interpretation of results to modify or correct system operation

Foundation Initial | Foundation Bronze | Foundation Silver | Foundation Gold

## Foundation Initial – GCSE Mathematics B J567

**Keywords/Themes** Use of data: analysis of data and information (graphs, charts etc)

| Theme | Incorporates | | Theme comments |
|---|---|---|---|
| Understand data collection and interpretation with computer controlled automation. [Indirect] | **FIA5** | Construct and interpret simple graphs, including conversion graphs. | Understand how HMI and expert systems generate and represent maintenance data. |
| | **FIS4** | Draw and interpret simple frequency tables, charts, pictograms and bar charts for discrete data. | |
| | **FIS5** | Extract and use information from common two-way tables including timetables. | |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R115 Engineering applications of computers

**LO2: Understand how computers are used for maintenance of engineering systems**

Learners must be taught:

- **how computers are used within engineering system maintenance, ie**
  - Human Machine Interface (HMI), ie
    - system operation, diagnostics and maintenance
    - use of system operation data
    - modification or correction of system operation
  - expert systems, ie
    - use within system operation, diagnostics and maintenance
    - use of system operation data
    - interpretation of results to modify or correct system operation

Foundation Initial | Foundation Bronze | Foundation Silver | Foundation Gold

## Foundation Bronze – GCSE Mathematics B J567

**Keywords/Themes** Use of data: analysis of data and information (graphs, charts etc)

| Theme | Incorporates | | Theme comments |
|---|---|---|---|
| Understand data collection and interpretation with computer controlled automation. [Indirect] | **FBA5** | Interpret information presented in a range of linear and non-linear graphs, including travel (distance/time) graphs. | Understand how HMI and expert systems generate and represent maintenance data. |
| | **FBS3** | Construct and interpret pie charts. | |
| | **FBS4** | Interpret graphs representing real data, including recognising misleading diagrams. | |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R115 Engineering applications of computers

**LO2: Understand how computers are used for maintenance of engineering systems**

Learners must be taught:

- **how computers are used within engineering system maintenance, ie**
  - – Human Machine Interface (HMI), ie
    - system operation, diagnostics and maintenance
    - use of system operation data
    - modification or correction of system operation
  - – expert systems, ie
    - use within system operation, diagnostics and maintenance
    - use of system operation data
    - interpretation of results to modify or correct system operation



## Foundation Silver – GCSE Mathematics B J567

**Keywords/Themes** Use of data: analysis of data and information (graphs, charts etc)

| Theme | Incorporates | Theme comments |
|---|---|---|
| Understand data collection and interpretation with computer controlled automation. [Indirect] | **FSS3** Draw and interpret a wide range of graphs and diagrams for discrete and continuous data, including frequency polygons and stem and leaf diagrams. Compare distributions and make inferences, using the shapes of the distributions and measures of average and range | Understand how HMI and expert systems generate and represent maintenance data. |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R115 Engineering applications of computers

**LO2: Understand how computers are used for maintenance of engineering systems**

Learners must be taught:

- **how computers are used within engineering system maintenance, ie**
  - – Human Machine Interface (HMI), ie
    - system operation, diagnostics and maintenance
    - use of system operation data
    - modification or correction of system operation
  - – expert systems, ie
    - use within system operation, diagnostics and maintenance
    - use of system operation data
    - interpretation of results to modify or correct system operation

Foundation Initial | Foundation Bronze | Foundation Silver | Foundation Gold

## Foundation Gold – GCSE Mathematics B J567

**Keywords/Themes** Use of data: analysis of data and information (graphs, charts etc)

| Theme | Incorporates | Theme comments |
|---|---|---|
| Understand data collection and interpretation with computer controlled automation. [Indirect] | **FGA5** Draw and interpret graphs modelling real situations, which may be nonlinear, including simple quadratic graphs.<br>**FGS3** Draw and interpret scatter graphs for discrete and continuous variables, including using and understanding lines of best fit. Understand the vocabulary of correlation, including: positive, negative and zero correlation; weak, strong and moderate correlation. Look at data to find patterns and exceptions. | Understand how HMI and expert systems generate and represent maintenance data. |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R115 Engineering applications of computers

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

Learners must be taught:

- **the use of computers to communicate and exchange data during production operations (eg assembly/production recording, efficiency information, cycle times)**
- **how data from production operations is used in maintenance (eg assembly/ production recording, efficiency information, cycle times, maintenance planning)**
- **how computers are used to communicate and exchange data for maintenance operations (eg remote monitoring of engineered systems, transmission of service data, monitoring and recording maintenance operations, parts used, control of stock, prediction of failure, work scheduling)**
- **the use of hand-held computer devices in manufacturing and maintenance systems ie**
  - bar code scanning (eg monitor stock usage, automatic update of service records)
  - service information and instructions (eg data loggers, data collection and analysis, work scheduling, maintenance checklists).

Foundation Initial | Foundation Bronze | Foundation Silver | Foundation Gold

## Foundation Initial – GCSE Mathematics B J567

**Keywords/Themes** Use of data: analysis of data and information (graphs, charts etc)

Stock control, prediction of failure

| Theme | Incorporates | | Theme comments |
|---|---|---|---|
| Understand data collection and interpretation with computer controlled automation. [Indirect] | **FIA5** | Construct and interpret simple graphs, including conversion graphs. | Understand how computers communicate and present production and maintenance data (eg efficiency, cycle time, stock control, failure data) |
| | **FIS4** | Draw and interpret simple frequency tables, charts, pictograms and bar charts for discrete data. | |
| | **FIS5** | Extract and use information from common two-way tables including timetables. | |
| Undertake statistical analysis relating to reliability and maintenance interval [Indirect] | **FIS1** | Understand and use the vocabulary of probability, including terms such as 'fair', 'evens', 'certain', 'likely', 'unlikely' and 'impossible'. Understand and use the probability scale. | Calculate mean time to failure (MTTF), mean time between failure (MTBF). Construct and interpret graphs showing failure rates. |
| | **FIS3** | Calculate the mean, median, mode and range of discrete data. | |
| | **FIS4** | Draw and interpret simple frequency tables, charts, pictograms and bar charts for discrete data. | |
| | **FIS5** | Extract and use information from common two-way tables including timetables. | |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R115 Engineering applications of computers

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

Learners must be taught:

- **the use of computers to communicate and exchange data during production operations (eg assembly/production recording, efficiency information, cycle times)**
- **how data from production operations is used in maintenance (eg assembly/ production recording, efficiency information, cycle times, maintenance planning)**
- **how computers are used to communicate and exchange data for maintenance operations (eg remote monitoring of engineered systems, transmission of service data, monitoring and recording maintenance operations, parts used, control of stock, prediction of failure, work scheduling)**
- **the use of hand-held computer devices in manufacturing and maintenance systems ie**
  - bar code scanning (eg monitor stock usage, automatic update of service records)
  - service information and instructions (eg data loggers, data collection and analysis, work scheduling, maintenance checklists).

Foundation Initial | **Foundation Bronze** | Foundation Silver | Foundation Gold

## Foundation Bronze – GCSE Mathematics B J567

**Keywords/Themes** Use of data: analysis of data and information (graphs, charts etc)

Stock control, prediction of failure

| Theme | Incorporates | | Theme comments |
|---|---|---|---|
| Understand data collection and interpretation with computer controlled automation. [Indirect] | **FBA5** | Interpret information presented in a range of linear and non-linear graphs, including travel (distance/time) graphs. | Understand how computers communicate and present production and maintenance data (eg efficiency, cycle time, stock control, failure data) |
| | **FBS3** | Construct and interpret pie charts. | |
| | **FBS4** | Interpret graphs representing real data, including recognising misleading diagrams. | |
| Undertake statistical analysis relating to reliability and maintenance interval [Indirect] | **FBS1** | Understand and use measures of probability from equally likely outcomes.<br>List all outcomes for two successive events in a systematic way and derive related probabilities. | Calculate mean time to failure (MTTF), mean time between failure (MTBF). Construct and interpret graphs showing failure rates as pie charts. Interpret graphs showing real data (eg MTTF, MTBF) |
| | **FBS2** | Use and interpret the statistical measures: mode, median, mean and range for discrete and continuous data, including comparing distributions. | |
| | **FBS3** | Construct and interpret pie charts. | |
| | **FBS4** | Interpret graphs representing real data, including recognising misleading diagrams. | |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R115 Engineering applications of computers

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

Learners must be taught:

- **the use of computers to communicate and exchange data during production operations (eg assembly/production recording, efficiency information, cycle times)**
- **how data from production operations is used in maintenance (eg assembly/ production recording, efficiency information, cycle times, maintenance planning)**
- **how computers are used to communicate and exchange data for maintenance operations (eg remote monitoring of engineered systems, transmission of service data, monitoring and recording maintenance operations, parts used, control of stock, prediction of failure, work scheduling)**
- **the use of hand-held computer devices in manufacturing and maintenance systems ie**
  - bar code scanning (eg monitor stock usage, automatic update of service records)
  - service information and instructions (eg data loggers, data collection and analysis, work scheduling, maintenance checklists).



## Foundation Silver – GCSE Mathematics B J567

**Keywords/Themes** Use of data: analysis of data and information (graphs, charts etc)

Stock control, prediction of failure

| Theme | Incorporates | Theme comments |
|---|---|---|
| Understand data collection and interpretation with computer controlled automation. [Indirect] | **FSS3** Draw and interpret a wide range of graphs and diagrams for discrete and continuous data, including frequency polygons and stem and leaf diagrams. Compare distributions and make inferences, using the shapes of the distributions and measures of average and range. | Understand how computers communicate and present production and maintenance data (eg efficiency, cycle time, stock control, failure data) |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R115 Engineering applications of computers

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

Learners must be taught:

- **the use of computers to communicate and exchange data during production operations (eg assembly/production recording, efficiency information, cycle times)**
- **how data from production operations is used in maintenance (eg assembly/ production recording, efficiency information, cycle times, maintenance planning)**
- **how computers are used to communicate and exchange data for maintenance operations (eg remote monitoring of engineered systems, transmission of service data, monitoring and recording maintenance operations, parts used, control of stock, prediction of failure, work scheduling)**
- **the use of hand-held computer devices in manufacturing and maintenance systems ie**
  - bar code scanning (eg monitor stock usage, automatic update of service records)
  - service information and instructions (eg data loggers, data collection and analysis, work scheduling, maintenance checklists).

Foundation Initial | Foundation Bronze | Foundation Silver | Foundation Gold

## Foundation Gold – GCSE Mathematics B J567

**Keywords/Themes** Use of data: analysis of data and information (graphs, charts etc)

Stock control, prediction of failure

| Theme | Incorporates | Theme comments |
|---|---|---|
| Understand data collection and interpretation with computer controlled automation. [Indirect] | **FGA5** Draw and interpret graphs modelling real situations, which may be nonlinear, including simple quadratic graphs.<br>**FGS3** Draw and interpret scatter graphs for discrete and continuous variables, including using and understanding lines of best fit. Understand the vocabulary of correlation, including: positive, negative and zero correlation; weak, strong and moderate correlation. Look at data to find patterns and exceptions. | Understand how computers communicate and present production and maintenance data (eg efficiency, cycle time, stock control, failure data) |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R115 Engineering applications of computers

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

Learners must be taught:

- **how computers are used within engineering industries to design new products, ie**
  - how Computer Aided Design (CAD) systems and graphical packages are used to design and prototype new products
- **how computers are used within engineering industries to manufacture products, monitor production and manage process control, ie**
  - how Computer Aided Manufacture (CAM) systems are used in the manufacturing process
  - how computers are used to automate manufacturing (eg Programmable Logic Controllers (PLC), Programmable Interface Controller (PIC)
  - how computers are used to monitor production/production operations (eg automated test systems)
  - how computers are used for stock control (eg automatic stock movement, Radio Frequency Identification Devices (RFID)
- **features of computer controlled automation (eg temperature control, weight control, position sensing, size sensing, workflow, warehousing and product movement, safety systems and machine interlocks).**

Gateway Additional Science B 2012 J262

21st Century Science A 2012 J242

**None of the learning outcomes can be directly mapped for LO1.**

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R115 Engineering applications of computers

**LO2: Understand how computers are used for maintenance of engineering systems**

Learners must be taught:

- **how computers are used within engineering system maintenance, ie**
  - Human Machine Interface (HMI), ie
    - system operation, diagnostics and maintenance
    - use of system operation data
    - modification or correction of system operation
  - expert systems, ie
    - use within system operation, diagnostics and maintenance
    - use of system operation data
    - interpretation of results to modify or correct system operation

**Gateway Additional Science B 2012 J262**

**21st Century Science A 2012 J242**

**None of the learning outcomes can be directly mapped for LO2.**

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R115 Engineering applications of computers

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

Learners must be taught:

- **the use of computers to communicate and exchange data during production operations (eg assembly/production recording, efficiency information, cycle times)**
- **how data from production operations is used in maintenance (eg assembly/ production recording, efficiency information, cycle times, maintenance planning)**
- **how computers are used to communicate and exchange data for maintenance operations (eg remote monitoring of engineered systems, transmission of service data, monitoring and recording maintenance operations, parts used, control of stock, prediction of failure, work scheduling)**
- **the use of hand-held computer devices in manufacturing and maintenance systems ie**
  - bar code scanning (eg monitor stock usage, automatic update of service records)
  - service information and instructions (eg data loggers, data collection and analysis, work scheduling, maintenance checklists).

**Gateway Additional Science B 2012 J262**

**21st Century Science A 2012 J242**

**None of the learning outcomes can be directly mapped for LO3.**

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R115 Engineering applications of computers

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

Learners must be taught:

- **how computers are used within engineering industries to design new products, ie**
  - how Computer Aided Design (CAD) systems and graphical packages are used to design and prototype new products
- **how computers are used within engineering industries to manufacture products, monitor production and manage process control, ie**
  - how Computer Aided Manufacture (CAM) systems are used in the manufacturing process
  - how computers are used to automate manufacturing (eg Programmable Logic Controllers (PLC), Programmable Interface Controller (PIC)
  - how computers are used to monitor production/production operations (eg automated test systems)
  - how computers are used for stock control (eg automatic stock movement, Radio Frequency Identification Devices (RFID)
- **features of computer controlled automation (eg temperature control, weight control, position sensing, size sensing, workflow, warehousing and product movement, safety systems and machine interlocks).**

**Gateway Physics B 2012 J265** | **21st Century Physics A 2012 J245**

**Keywords/Themes** CAD

**Radio frequency tags**

Data control, collection and analysis

| Theme | Incorporates | Theme comments |
|---|---|---|
| Understand how radio is used to monitor and manage process control [Indirect] | **P1c** A spectrum of waves | Understand the use a radio frequency tags in stock control |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R115 Engineering applications of computers

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

Learners must be taught:

- **how computers are used within engineering industries to design new products, ie**
  - how Computer Aided Design (CAD) systems and graphical packages are used to design and prototype new products
- **how computers are used within engineering industries to manufacture products, monitor production and manage process control, ie**
  - how Computer Aided Manufacture (CAM) systems are used in the manufacturing process
  - how computers are used to automate manufacturing (eg Programmable Logic Controllers (PLC), Programmable Interface Controller (PIC)
  - how computers are used to monitor production/production operations (eg automated test systems)
  - how computers are used for stock control (eg automatic stock movement, Radio Frequency Identification Devices (RFID)
- **features of computer controlled automation (eg temperature control, weight control, position sensing, size sensing, workflow, warehousing and product movement, safety systems and machine interlocks).**

Gateway Physics B 2012 J265 | 21st Century Physics A 2012 J245

**Keywords/Themes** CAD

**Radio frequency tags**

Data control, collection and analysis

| Theme | Incorporates | Theme comments |
|---|---|---|
| Understand how radio is used to monitor and manage process control [Indirect] | **P2.4** Radiation and life | Understand the use a radio frequency tags in stock control |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R115 Engineering applications of computers

**LO2: Understand how computers are used for maintenance of engineering systems**

Learners must be taught:

- **how computers are used within engineering system maintenance, ie**
  - Human Machine Interface (HMI), ie
    - system operation, diagnostics and maintenance
    - use of system operation data
    - modification or correction of system operation
  - expert systems, ie
    - use within system operation, diagnostics and maintenance
    - use of system operation data
    - interpretation of results to modify or correct system operation

Gateway Physics B 2012 J265

21st Century Physics A 2012 J245

**None of the learning outcomes can be directly mapped for LO2.**

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R115 Engineering applications of computers

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

Learners must be taught:

- **the use of computers to communicate and exchange data during production operations (eg assembly/production recording, efficiency information, cycle times)**
- **how data from production operations is used in maintenance (eg assembly/ production recording, efficiency information, cycle times, maintenance planning)**
- **how computers are used to communicate and exchange data for maintenance operations (eg remote monitoring of engineered systems, transmission of service data, monitoring and recording maintenance operations, parts used, control of stock, prediction of failure, work scheduling)**
- **the use of hand-held computer devices in manufacturing and maintenance systems ie**
  - bar code scanning (eg monitor stock usage, automatic update of service records)
  - service information and instructions (eg data loggers, data collection and analysis, work scheduling, maintenance checklists).

**Gateway Physics B 2012 J265**

**21st Century Physics A 2012 J245**

**None of the learning outcomes can be directly mapped for LO3.**

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

Extended opportunities

## Unit R115 Engineering applications of computers

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

Learners must be taught:

- **how computers are used within engineering industries to design new products, ie**
  - how Computer Aided Design (CAD) systems and graphical packages are used to design and prototype new products
- **how computers are used within engineering industries to manufacture products, monitor production and manage process control, ie**
  - how Computer Aided Manufacture (CAM) systems are used in the manufacturing process
  - how computers are used to automate manufacturing (eg Programmable Logic Controllers (PLC), Programmable Interface Controller (PIC)
  - how computers are used to monitor production/production operations (eg automated test systems)
  - how computers are used for stock control (eg automatic stock movement, Radio Frequency Identification Devices (RFID)
- **features of computer controlled automation (eg temperature control, weight control, position sensing, size sensing, workflow, warehousing and product movement, safety systems and machine interlocks).**

Gateway Science B 2012 J261

21st Century Science A 2012 J241

**Keywords/Themes** CAD

**Radio frequency tags**

Data control, collection and analysis

| Theme | Incorporates | Theme comments |
|---|---|---|
| Understand how radio is used to monitor and manage process control [Indirect] | **P1c** A spectrum of waves | Understand the use a radio frequency tags in stock control |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R115 Engineering applications of computers

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

Learners must be taught:

- **how computers are used within engineering industries to design new products, ie**
  - how Computer Aided Design (CAD) systems and graphical packages are used to design and prototype new products
- **how computers are used within engineering industries to manufacture products, monitor production and manage process control, ie**
  - how Computer Aided Manufacture (CAM) systems are used in the manufacturing process
  - how computers are used to automate manufacturing (eg Programmable Logic Controllers (PLC), Programmable Interface Controller (PIC)
  - how computers are used to monitor production/production operations (eg automated test systems)
  - how computers are used for stock control (eg automatic stock movement, Radio Frequency Identification Devices (RFID)
- **features of computer controlled automation (eg temperature control, weight control, position sensing, size sensing, workflow, warehousing and product movement, safety systems and machine interlocks).**

Gateway Science B 2012 J261 | 21st Century Science A 2012 J241

**Keywords/Themes** CAD

**Radio frequency tags**

Data control, collection and analysis

| Theme | Incorporates | Theme comments |
|---|---|---|
| Understand how radio is used to monitor and manage process control [Indirect] | **P2.4** Radiation and life | Understand the use a radio frequency tags in stock control |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

Extended opportunities

## Unit R115 Engineering applications of computers

**LO2: Understand how computers are used for maintenance of engineering systems**

Learners must be taught:

- **how computers are used within engineering system maintenance, ie**
  - Human Machine Interface (HMI), ie
    - system operation, diagnostics and maintenance
    - use of system operation data
    - modification or correction of system operation
  - expert systems, ie
    - use within system operation, diagnostics and maintenance
    - use of system operation data
    - interpretation of results to modify or correct system operation

Gateway Science B 2012 J261

21st Century Science A 2012 J241

**None of the learning outcomes can be directly mapped for LO2.**

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

Extended opportunities

## Unit R115 Engineering applications of computers

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

Learners must be taught:

- **the use of computers to communicate and exchange data during production operations (eg assembly/production recording, efficiency information, cycle times)**
- **how data from production operations is used in maintenance (eg assembly/ production recording, efficiency information, cycle times, maintenance planning)**
- **how computers are used to communicate and exchange data for maintenance operations (eg remote monitoring of engineered systems, transmission of service data, monitoring and recording maintenance operations, parts used, control of stock, prediction of failure, work scheduling)**
- **the use of hand-held computer devices in manufacturing and maintenance systems ie**
  - bar code scanning (eg monitor stock usage, automatic update of service records)
  - service information and instructions (eg data loggers, data collection and analysis, work scheduling, maintenance checklists).

Gateway Science B 2012 J261

21st Century Science A 2012 J241

**None of the learning outcomes can be directly mapped for LO3.**

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R115 Engineering applications of computers

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

Learners must be taught:

- **how computers are used within engineering industries to design new products, ie**
  - how Computer Aided Design (CAD) systems and graphical packages are used to design and prototype new products
- **how computers are used within engineering industries to manufacture products, monitor production and manage process control, ie**
  - how Computer Aided Manufacture (CAM) systems are used in the manufacturing process
  - how computers are used to automate manufacturing (eg Programmable Logic Controllers (PLC), Programmable Interface Controller (PIC)
  - how computers are used to monitor production/production operations (eg automated test systems)
  - how computers are used for stock control (eg automatic stock movement, Radio Frequency Identification Devices (RFID)
- **features of computer controlled automation (eg temperature control, weight control, position sensing, size sensing, workflow, warehousing and product movement, safety systems and machine interlocks).**

## Cambridge National in ICT: J800/J810/J820

**Keywords/Themes** **CAD to design/prototype**

Radio frequency tags

**Data control, collection and analysis**

| Theme | Incorporates | Theme comments |
|---|---|---|
| CAD in engineering design, manufacture and process control [Direct] | **R006 (Strand: Creative)**<br>**LO1:** Be able to specify a digital image solution for a client's needs<br>**LO2:** Be able to create digital images<br>**LO3:** Be able to store, retrieve and present digital images | Understand how CAD systems are used to design and prototype new products |
| Computers in manufacture – computer aided manufacture (CAM) [Indirect] | **R008 (Strand: Technical)**<br>**LO1:** Be able to devise algorithms to solve problems<br>**LO2:** Be able to develop computer programs<br>**LO3:** Be able to test and evaluate computer programs | Understand how computers are used in manufacture |
| Computers in data capture [Direct] | **R001 (Strand: Mandatory)**<br>**LO2:** Know how to work with information and data to meet specified business needs | Understand how computers capture and exchange data used in manufacturing (eg stock control using RFID tags) |

# CAMBRIDGE NATIONAL IN ENGINEERING

**Systems Control in Engineering J833/J843**
**– Maths, Science and ICT in Engineering**

## Unit R115 Engineering applications of computers

**LO2: Understand how computers are used for maintenance of engineering systems**

Learners must be taught:

- **how computers are used within engineering system maintenance, ie**
  - – Human Machine Interface (HMI), ie
    - system operation, diagnostics and maintenance
    - use of system operation data
    - modification or correction of system operation
  - – expert systems, ie
    - use within system operation, diagnostics and maintenance
    - use of system operation data
    - interpretation of results to modify or correct system operation

## Cambridge National in ICT: J800/J810/J820

Keywords/Themes **HMI/expert: Use of data: analysis of data and information (graphs, charts etc)**

| Theme | Incorporates | Theme comments |
|---|---|---|
| Computers in data capture and exchanging data [Direct] | **R001 (Strand: Mandatory)**<br>**LO2:** Know how to work with information and data to meet specified business needs | Understand how computers capture and communicate maintenance data used in manufacturing |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R115 Engineering applications of computers

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

Learners must be taught:

- **the use of computers to communicate and exchange data during production operations (eg assembly/production recording, efficiency information, cycle times)**
- **how data from production operations is used in maintenance (eg assembly/ production recording, efficiency information, cycle times, maintenance planning)**
- **how computers are used to communicate and exchange data for maintenance operations (eg remote monitoring of engineered systems, transmission of service data, monitoring and recording maintenance operations, parts used, control of stock, prediction of failure, work scheduling)**
- **the use of hand-held computer devices in manufacturing and maintenance systems ie**
  - bar code scanning (eg monitor stock usage, automatic update of service records)
  - service information and instructions (eg data loggers, data collection and analysis, work scheduling, maintenance checklists).

## Cambridge National in ICT: J800/J810/J820

Keywords/Themes **Use of data: analysis of data and information (graphs, charts etc)**

**Stock control, prediction of failure**

| Theme | Incorporates | Theme comments |
|---|---|---|
| Computers in data capture and exchanging data [Direct] | **R001 (Strand: Mandatory)**<br>**LO2:** Know how to work with information and data to meet specified business needs | Understand how computers capture and exchange production and maintenance data used in manufacturing |

# Unit R115 Engineering applications of computers

LO1: CAD

Radio frequency tags

**Data control, collection and analysis**

Mathematics B J567 Higher Silver

Mathematics B J567 Higher Gold

## Extended opportunities – GCSE Mathematics B J567 Higher Silver

| Theme | Incorporates | Theme comments |
|---|---|---|
| Understand data collection and interpretation with computer controlled automation. [Indirect] | **HSS1** Use tree diagrams to represent outcomes of combined events, recognising when events are independent. Find probabilities using tree diagrams.<br>**HSS2** Draw and interpret cumulative frequency tables and diagrams and box plots for grouped data. Find the median, quartiles and interquartile range. | Interpret and analyse data generated by a computer controlled automation system. |

# Unit R115 Engineering applications of computers

LO1: CAD

Radio frequency tags

**Data control, collection and analysis**

Mathematics B J567 Higher Silver

Mathematics B J567 Higher Gold

## Extended opportunities – GCSE Mathematics B J567 Higher Gold

| Theme | Incorporates | Theme comments |
|---|---|---|
| Understand data collection and interpretation with computer controlled automation. [Indirect] | **FGA5** Draw and interpret graphs modelling real situations, which may be nonlinear, including simple quadratic graphs.<br>**FGS3** Draw and interpret scatter graphs for discrete and continuous variables, including using and understanding lines of best fit. Understand the vocabulary of correlation, including: positive, negative and zero correlation; weak, strong and moderate correlation. Look at data to find patterns and exceptions. | Interpret and analyse data generated by a computer controlled automation system. |

# Unit R115 Engineering applications of computers

LO2: **Use of data: analysis of data and information (graphs, charts etc)**

**Mathematics B J567 Higher Silver** | Mathematics B J567 Higher Gold

## Extended opportunities – GCSE Mathematics B J567 Higher Silver

| Theme | Incorporates | Theme comments |
|---|---|---|
| Understand data collection and interpretation with computer controlled automation. [Indirect] | **FSS3** Draw and interpret a wide range of graphs and diagrams for discrete and continuous data, including frequency polygons and stem and leaf diagrams. Compare distributions and make inferences, using the shapes of the distributions and measures of average and range. | Understand how HMI and expert systems generate and represent maintenance data. |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Principles in Engineering and Engineering Business J830/J840 – Maths, Science and ICT in Engineering

## Unit R115 Engineering applications of computers

LO2: **Use of data: analysis of data and information (graphs, charts etc)**

Mathematics B J567 Higher Silver

Mathematics B J567 Higher Gold

### Extended opportunities – GCSE Mathematics B J567 Higher Gold

| Theme | Incorporates | Theme comments |
|---|---|---|
| Understand data collection and interpretation with computer controlled automation. [Indirect] | **FGA5** Draw and interpret graphs modelling real situations, which may be nonlinear, including simple quadratic graphs.<br>**FGS3** Draw and interpret scatter graphs for discrete and continuous variables, including using and understanding lines of best fit. Understand the vocabulary of correlation, including: positive, negative and zero correlation; weak, strong and moderate correlation. Look at data to find patterns and exceptions. | Understand how HMI and expert systems generate and represent maintenance data. |

# Unit R115 Engineering applications of computers

LO3: **Use of data: analysis of data and information (graphs, charts etc)**

**Stock control, prediction of failure**

**Mathematics B J567 Higher Silver** | **Mathematics B J567 Higher Gold**

## Extended opportunities – GCSE Mathematics B J567 Higher Silver

| Theme | Incorporates | Theme comments |
|---|---|---|
| Understand data collection and interpretation with computer controlled automation. [Indirect] | **HSS1** Use tree diagrams to represent outcomes of combined events, recognising when events are independent. Find probabilities using tree diagrams.<br>**HSS2** Draw and interpret cumulative frequency tables and diagrams and box plots for grouped data. Find the median, quartiles and interquartile range. | Understand how computers communicate and present production and maintenance data (eg efficiency, cycle time, stock control, failure data) |

# Unit R115 Engineering applications of computers

LO3: **Use of data: analysis of data and information (graphs, charts etc)**

**Stock control, prediction of failure**

Mathematics B J567 Higher Silver

Mathematics B J567 Higher Gold

## Extended opportunities – GCSE Mathematics B J567 Higher Gold

| Theme | Incorporates | Theme comments |
|---|---|---|
| Understand data collection and interpretation with computer controlled automation. [Indirect] | **HGS2** Draw and interpret histograms for grouped data. Understand frequency density.<br>**HGS3** Interpret and compare a wide range of data sets (including grouped discrete and continuous data) and draw conclusions. | Understand how computers communicate and present production and maintenance data (eg efficiency, cycle time, stock control, failure data) |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R116 Process control systems

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

Learners must be taught:

- **simple layouts of microcontroller/ microprocessor in products or systems**
- **applications of microcontroller/ microprocessor in products or systems (eg production/assembly systems, engine control systems, office machines, domestic appliances, children's toys)**
- **the basic function of component parts of a control system ie**
  - input devices (eg switch, temperature, position, light, flow, pressure)
  - control device (eg microprocessor, microcontroller)
  - output device (eg lamp, sounder/ speaker, solenoid, relay)
- **the operation of a control system within a product or system that use microprocessor, microcontroller control**

Foundation Initial | Foundation Bronze | Foundation Silver | Foundation Gold

## Foundation Initial, Bronze, Silver and Gold – GCSE Mathematics B J567

**None of the learning outcomes can be directly mapped for LO1.**

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R116 Process control systems

### LO2: Be able to design, develop and simulate a control system solution

Learners must be taught:

- **techniques used to produce a control system solution**
- **the use of resources for a control system solution ie**
  - use of systems diagrams ie
    - input, process (including feedback and variables) and output
    - use of block diagrams to define control systems
    - designs of instructions for control systems, ie
    - repeat loops and subroutines
  - use of input and output sensors (eg analogue/digital - switch, temperature, position, light, flow, pressure)
  - use of programming tools to create a control system programme (eg linear, symbolic, flow-chart)
- **use of simulation for a control system solution**
- **transfer of control programs to programmable devices (eg PIC / PLC)**

Foundation **Initial** | Foundation **Bronze** | Foundation **Silver** | Foundation **Gold**

## Foundation Initial – GCSE Mathematics B J567

**Keywords/Themes** Simulation Sensors

**Theme**

Measure and estimate values of resistance, voltage, current in a range of input sensors and output devices [Direct]

**Incorporates**

**FIG2** Make sensible estimates of a range of measures in everyday settings.

**Theme comments**

Measure and estimate values of resistance, voltage and current for input and output devices used in control systems

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R116 Process control systems

### LO2: Be able to design, develop and simulate a control system solution

Learners must be taught:

- **techniques used to produce a control system solution**
- **the use of resources for a control system solution ie**
  - use of systems diagrams ie
    - input, process (including feedback and variables) and output
    - use of block diagrams to define control systems
    - designs of instructions for control systems, ie
    - repeat loops and subroutines
  - use of input and output sensors (eg analogue/digital - switch, temperature, position, light, flow, pressure)
  - use of programming tools to create a control system programme (eg linear, symbolic, flow-chart)
- **use of simulation for a control system solution**
- **transfer of control programs to programmable devices (eg PIC / PLC)**

Foundation Initial | Foundation Bronze | Foundation Silver | Foundation Gold

## Foundation Bronze, Silver and Gold – GCSE Mathematics B J567

**None of the learning outcomes can be directly mapped for LO2.**

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R116 Process control systems

**LO3: Be able to test control systems**

Learners must be taught:

- **simple layouts of microcontroller/ microprocessor in products or systems**
- **applications of microcontroller/ microprocessor in products or systems (eg production/assembly systems, engine control systems, office machines, domestic appliances, children's toys)**
- **the basic function of component parts of a control system ie**
  - input devices (eg switch, temperature, position, light, flow, pressure)
  - control device (eg microprocessor, microcontroller)
  - output device (eg lamp, sounder/speaker, solenoid, relay)
- **the operation of a control system within a product or system that use microprocessor, microcontroller control**

Foundation Initial | Foundation Bronze | Foundation Silver | Foundation Gold

## Foundation Initial, Bronze, Silver and Gold – GCSE Mathematics B J567

**None of the learning outcomes can be directly mapped for LO3.**

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R116 Process control systems

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

Learners must be taught:

- **simple layouts of microcontroller/ microprocessor in products or systems**
- **applications of microcontroller/ microprocessor in products or systems (eg production/assembly systems, engine control systems, office machines, domestic appliances, children's toys)**
- **the basic function of component parts of a control system ie**
  - input devices (eg switch, temperature, position, light, flow, pressure)
  - control device (eg microprocessor, microcontroller)
  - output device (eg lamp, sounder/ speaker, solenoid, relay)
- **the operation of a control system within a product or system that use microprocessor, microcontroller control**

**Gateway Additional Science B 2012 J262**

**21st Century Science A 2012 J242**

**None of the learning outcomes can be directly mapped for LO1.**

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R116 Process control systems

### LO2: Be able to design, develop and simulate a control system solution

Learners must be taught:

- **techniques used to produce a control system solution**
- **the use of resources for a control system solution ie**
  - – use of systems diagrams ie
    - input, process (including feedback and variables) and output
    - use of block diagrams to define control systems
    - designs of instructions for control systems, ie
    - repeat loops and subroutines
  - – use of input and output sensors (eg analogue/digital - switch, temperature, position, light, flow, pressure)
  - – use of programming tools to create a control system programme (eg linear, symbolic, flow-chart)
- **use of simulation for a control system solution**
- **transfer of control programs to programmable devices (eg PIC / PLC)**

Gateway Additional Science B 2012 J262

21st Century Science A 2012 J242

**Keywords/Themes** Block diagrams
Simulation

| Theme | Incorporates | Theme comments |
|---|---|---|
| Understand the function and operation of a range of input sensors and output devices used on control systems [Indirect] | **P4c** Radiation for life (safe electrical) | Calculating resistance from voltage and current, calculating power from voltage and current |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R116 Process control systems

### LO2: Be able to design, develop and simulate a control system solution

Learners must be taught:

- **techniques used to produce a control system solution**
- **the use of resources for a control system solution ie**
  - use of systems diagrams ie
    - input, process (including feedback and variables) and output
    - use of block diagrams to define control systems
    - designs of instructions for control systems, ie
    - repeat loops and subroutines
  - use of input and output sensors (eg analogue/digital - switch, temperature, position, light, flow, pressure)
  - use of programming tools to create a control system programme (eg linear, symbolic, flow-chart)
- **use of simulation for a control system solution**
- **transfer of control programs to programmable devices (eg PIC / PLC)**

Gateway Additional Science B 2012 J262

21st Century Science A 2012 J242

**Keywords/Themes** Block diagrams
Simulation

| Theme | Incorporates | Theme comments |
|---|---|---|
| Understand the function and operation of a range of input sensors and output devices used on control systems [Indirect] | **P5.1, P5.2** Electric circuits<br>**P5.3** Electric circuits<br>**P5.4/P5.5** Electric circuits | Understanding current and calculating power and resistance<br>Calculate value of resistors in series and parallel, and voltages in a potential divider<br>Understand how motors and generators work |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R116 Process control systems

### LO3: Be able to test control systems

Learners must be taught:

- **simple layouts of microcontroller/ microprocessor in products or systems**
- **applications of microcontroller/ microprocessor in products or systems (eg production/assembly systems, engine control systems, office machines, domestic appliances, children's toys)**
- **the basic function of component parts of a control system ie**
  - input devices (eg switch, temperature, position, light, flow, pressure)
  - control device (eg microprocessor, microcontroller)
  - output device (eg lamp, sounder/speaker, solenoid, relay)
- **the operation of a control system within a product or system that use microprocessor, microcontroller control**

**Gateway Additional Science B 2012 J262**

**21st Century Science A 2012 J242**

**None of the learning outcomes can be directly mapped for LO3.**

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R116 Process control systems

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

Learners must be taught:

- **simple layouts of microcontroller/ microprocessor in products or systems**
- **applications of microcontroller/ microprocessor in products or systems (eg production/assembly systems, engine control systems, office machines, domestic appliances, children's toys)**
- **the basic function of component parts of a control system ie**
  - input devices (eg switch, temperature, position, light, flow, pressure)
  - control device (eg microprocessor, microcontroller)
  - output device (eg lamp, sounder/ speaker, solenoid, relay)
- **the operation of a control system within a product or system that use microprocessor, microcontroller control**

**Gateway Physics B 2012 J265**

**21st Century Physics A 2012 J245**

**None of the learning outcomes can be directly mapped for LO1.**

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R116 Process control systems

### LO2: Be able to design, develop and simulate a control system solution

Learners must be taught:

- **techniques used to produce a control system solution**
- **the use of resources for a control system solution ie**
  - use of systems diagrams ie
    - input, process (including feedback and variables) and output
    - use of block diagrams to define control systems
    - designs of instructions for control systems, ie
    - repeat loops and subroutines
  - use of input and output sensors (eg analogue/digital - switch, temperature, position, light, flow, pressure)
  - use of programming tools to create a control system programme (eg linear, symbolic, flow-chart)
- **use of simulation for a control system solution**
- **transfer of control programs to programmable devices (eg PIC / PLC)**

**Gateway Physics B 2012 J265**

**21st Century Physics A 2012 J245**

**Keywords/Themes** Block diagrams
Simulation
Sensors

| Theme | Incorporates | Theme comments |
|---|---|---|
| Understand the function and operation of a range of input sensors and output devices used on control systems [Indirect] | **P4c** Radiation for life (resisting)<br>**P6a** Electricity for gadgets (resisting) | Calculating resistance from voltage and current, calculating power from voltage and current |
| | **P6b** Electricity for gadgets (sharing) | Calculate value of resistors in series and parallel, and voltages in a potential divider |
| | **P6e** Electricity for gadgets (motoring)<br>**P6f** Electricity for gadgets (generating) | Understand how electric motors and generators convert electrical energy to and from mechanical energy |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R116 Process control systems

### LO2: Be able to design, develop and simulate a control system solution

Learners must be taught:

- **techniques used to produce a control system solution**
- **the use of resources for a control system solution ie**
  - use of systems diagrams ie
    - input, process (including feedback and variables) and output
    - use of block diagrams to define control systems
    - designs of instructions for control systems, ie
    - repeat loops and subroutines
  - use of input and output sensors (eg analogue/digital - switch, temperature, position, light, flow, pressure)
  - use of programming tools to create a control system programme (eg linear, symbolic, flow-chart)
- **use of simulation for a control system solution**
- **transfer of control programs to programmable devices (eg PIC / PLC)**

Gateway Physics B 2012 J265 | 21st Century Physics A 2012 J245

**Keywords/Themes** Block diagrams
Simulation
Sensors

| Theme | Incorporates | Theme comments |
|---|---|---|
| Understand the function and operation of a range of input sensors and output devices used on control systems [Indirect] | **P5.1, P5.2** Electric circuits | Understanding current and calculating power and resistance |
| | **P5.3** Electric circuits | Calculate value of resistors in series and parallel, and voltages in a potential divider |
| | **P5.4/P5.5** Electric circuits | Understand how motors and generators work |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R116 Process control systems

### LO3: Be able to test control systems

Learners must be taught:

- **simple layouts of microcontroller/ microprocessor in products or systems**
- **applications of microcontroller/ microprocessor in products or systems (eg production/assembly systems, engine control systems, office machines, domestic appliances, children's toys)**
- **the basic function of component parts of a control system ie**
  - input devices (eg switch, temperature, position, light, flow, pressure)
  - control device (eg microprocessor, microcontroller)
  - output device (eg lamp, sounder/speaker, solenoid, relay)
- **the operation of a control system within a product or system that use microprocessor, microcontroller control**

**Gateway Physics B 2012 J265**

**21st Century Physics A 2012 J245**

**None of the learning outcomes can be directly mapped for LO3.**

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R116 Process control systems

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

Learners must be taught:

- **simple layouts of microcontroller/ microprocessor in products or systems**
- **applications of microcontroller/ microprocessor in products or systems (eg production/assembly systems, engine control systems, office machines, domestic appliances, children's toys)**
- **the basic function of component parts of a control system ie**
  - input devices (eg switch, temperature, position, light, flow, pressure)
  - control device (eg microprocessor, microcontroller)
  - output device (eg lamp, sounder/ speaker, solenoid, relay)
- **the operation of a control system within a product or system that use microprocessor, microcontroller control**

**Gateway Science B 2012 J261**

**21st Century Science A 2012 J241**

**None of the learning outcomes can be directly mapped for LO1.**

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R116
## Process control systems

### LO2: Be able to design, develop and simulate a control system solution

Learners must be taught:

- **techniques used to produce a control system solution**
- **the use of resources for a control system solution ie**
  - use of systems diagrams ie
    - input, process (including feedback and variables) and output
    - use of block diagrams to define control systems
    - designs of instructions for control systems, ie
    - repeat loops and subroutines
  - use of input and output sensors (eg analogue/digital - switch, temperature, position, light, flow, pressure)
  - use of programming tools to create a control system programme (eg linear, symbolic, flow-chart)
- **use of simulation for a control system solution**
- **transfer of control programs to programmable devices (eg PIC / PLC)**

**Gateway Science B 2012 J261**

**21st Century Science A 2012 J241**

**None of the learning outcomes can be directly mapped for LO2.**

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R116 Process control systems

### LO3: Be able to test control systems

Learners must be taught:

- **simple layouts of microcontroller/ microprocessor in products or systems**
- **applications of microcontroller/ microprocessor in products or systems (eg production/assembly systems, engine control systems, office machines, domestic appliances, children's toys)**
- **the basic function of component parts of a control system ie**
  - input devices (eg switch, temperature, position, light, flow, pressure)
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  - output device (eg lamp, sounder/speaker, solenoid, relay)
- **the operation of a control system within a product or system that use microprocessor, microcontroller control**

**Gateway Science B 2012 J261**

**21st Century Science A 2012 J241**

**None of the learning outcomes can be directly mapped for LO3.**

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R116 Process control systems

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

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- **the basic function of component parts of a control system ie**
  - input devices (eg switch, temperature, position, light, flow, pressure)
  - control device (eg microprocessor, microcontroller)
  - output device (eg lamp, sounder/ speaker, solenoid, relay)
- **the operation of a control system within a product or system that use microprocessor, microcontroller control**

## Cambridge National in ICT: J800/J810/J820

Keywords/Themes **Layouts of microprocessor systems/fcn/operation**

| Theme | Incorporates | Theme comments |
|---|---|---|
| Microprocessor/ microcontroller control system layout | **R009 (Strand: Technical)**<br>**LO1:** Be able to select computer system devices and platforms (identification) | Understand the layout of a microprocessor /microcontroller control system in an engineered product or system |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R116 Process control systems

### LO2: Be able to design, develop and simulate a control system solution

Learners must be taught:

- **techniques used to produce a control system solution**
- **the use of resources for a control system solution ie**
  - use of systems diagrams ie
    - input, process (including feedback and variables) and output
    - use of block diagrams to define control systems
    - designs of instructions for control systems, ie
    - repeat loops and subroutines
  - use of input and output sensors (eg analogue/digital - switch, temperature, position, light, flow, pressure)
  - use of programming tools to create a control system programme (eg linear, symbolic, flow-chart)
- **use of simulation for a control system solution**
- **transfer of control programs to programmable devices (eg PIC / PLC)**

## Cambridge National in ICT: J800/J810/J820

Keywords/Themes **Design/simulate control system solution (software)**

| Theme | Incorporates | Theme comments |
|---|---|---|
| Design and simulation of control systems | **R010 (Strand: Technical)**<br>**LO1:** Be able to design control systems<br>**LO2:** Be able to implement control systems<br><br>**R008 (T)**<br>**LO1:** Be able to devise algorithms to solve problems<br>**LO2:** Be able to develop computer programs | Be able to design and simulate a control system solution (including programming techniques) |

# CAMBRIDGE NATIONAL IN ENGINEERING

## Systems Control in Engineering J833/J843 – Maths, Science and ICT in Engineering

## Unit R116 Process control systems

### LO3: Be able to test control systems

Learners must be taught:

- **simple layouts of microcontroller/ microprocessor in products or systems**
- **applications of microcontroller/ microprocessor in products or systems (eg production/assembly systems, engine control systems, office machines, domestic appliances, children's toys)**
- **the basic function of component parts of a control system ie**
  - input devices (eg switch, temperature, position, light, flow, pressure)
  - control device (eg microprocessor, microcontroller)
  - output device (eg lamp, sounder/speaker, solenoid, relay)
- **the operation of a control system within a product or system that use microprocessor, microcontroller control**

## Cambridge National in ICT: J800/J810/J820

Keywords/Themes **Test and validate control system solution (software)**

| Theme | Incorporates | Theme comments |
|---|---|---|
| Test and evaluation of control systems | **R010 (Strand: Technical)**<br>**LO2:** Be able to implement control systems<br>**LO3:** Be able to test control systems<br><br>**R008 (Strand: Technical)**<br>**LO1:** Be able to test and evaluate computer programs | Be able to test and evaluate a control system solution including making refinements |

# Maths GCSE

GCSE Mathematics is a tiered qualification comprising **Foundation**, **Initial**, **Bronze**, **Silver** and **Gold** and **Higher Initial**, **Higher Bronze**, **Higher Silver** and **Higher Gold**. A number of key mathematical themes directly and indirectly relevant to solving engineering problems are covered across tiers with increasing breadth and depth. Key themes include application of number, algebra, trigonometry and statistical analysis. Relevance to engineering problem solving includes producing and re-arranging equations and formulae, producing and interpreting graphs, understanding proportion, percentages, volumes and masses, and performing statistical operations.

# Contact us

Staff at the OCR Customer Contact Centre are available to take your call between 8am and 5.30pm, Monday to Friday.

We're always delighted to answer questions and give advice.

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To give us feedback on, or ideas feedback text the OCR resources you have used, email resourcesfeedback@ocr.org.uk