

Beths Grammar School KS5 Electronics Curriculum Map

Term	INTENT	IMPLEMENTATION	IMPACT
	<p>Substantive Knowledge Topics to be covered = subject matter to be learned. Note we use Eduqas as our exam board. This should be read in conjunction with the specification, which can be found here: https://www.eduqas.co.uk/umbraco/surface/blobstorage/download?nodeId=11666</p> <p>Format: A1 XX = AS text book chapter XX https://resources.eduqas.co.uk/Pages/ResourceSingle.aspx?rId=937</p> <p>Format: A2 YY = A2 text book chapter YY https://resources.eduqas.co.uk/Pages/ResourceSingle.aspx?rId=1179</p>	<p>Disciplinary Knowledge (Skills) Most lessons will consist of peer marking the homework from the previous lesson or a starter consisting of an exam question, theory, then practical, which may consist of computer simulation or building circuits in real life. At the end of each topic there will be a formal end of unit test.</p> <p style="background-color: yellow; text-align: center;">SEE BELOW FOR A MUCH MORE DETAILED VERSION</p>	<p>Assessment opportunities Students will be assessed on homework marks, end of unit tests and trail exams.</p>
<p>The timetable below is based on the 2023/5 lesson planned sequence and is subject to change.</p>			
<p>Year 12 Autumn 1</p>	<p>Intro to Electronics. Some material from the A1 Core Concepts and A1 01s chapters will be covered https://resource.download.wjec.co.uk/vtc/2016-17/16-17_1-9/gce-electronics-book-core-concepts.pdf gce-electronics-book-chapter-1.pdf (wjec.co.uk)</p>		
	<p>A1 05 Semiconductor components gce-electronics-book-chapter-5.pdf (wjec.co.uk)</p>		
	<p>A1 02 Logic systems gce-electronics-book-chapter-2.pdf (wjec.co.uk)</p>		
<p>Autumn 2</p>	<p>A1 02 Timing Circuits gce-electronics-book-chapter-3.pdf (wjec.co.uk)</p>		
	<p>A1 03 Sequential Logic Systems gce-electronics-book-chapter-3.pdf (wjec.co.uk)</p>		
	<p>A1 04 Operational Amplifiers gce-electronics-book-chapter-4.pdf (wjec.co.uk)</p>		
<p>Spring 1</p>	<p>A1 04 Operational Amplifiers continued gce-electronics-book-chapter-4.pdf (wjec.co.uk)</p>		
	<p>A1 06 Microcontrollers (Physical computing using flowchart interpreter) gce-electronics-book-chapter-6.pdf (wjec.co.uk)</p>		
<p>Spring 2</p>	<p>A1 07 Mains Power Supplies</p>		

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	gce-electronics-book-chapter-7.pdf (wjec.co.uk)		
	A2 01 Further Sequential Logic Systems gce-electronics-book-chapter-1.pdf (wjec.co.uk)		
Summer 1	A2 04 AC Circuits gce-electronics-book-chapter-4.pdf (wjec.co.uk)		
	A2 05 Signal conversion (Analogue to digital conversion) gce-electronics-book-chapter-5.pdf (wjec.co.uk)		
Summer 2	A2 09 Communications systems (intro to sending data long distance) gce-electronics-book-chapter-9.pdf (wjec.co.uk)		
	A2 02 Further Mains Power Supplies gce-electronics-book-chapter-2.pdf (wjec.co.uk)		
	A2 08 High Power Switching Systems gce-electronics-book-chapter-8.pdf (wjec.co.uk)		
Year 13	Start of year test		
Autumn 1	Past papers AS and A Level Electronics Edugas		
	A2 10 Wireless Transmission (Intro to radio communications) gce-electronics-book-chapter-10.pdf (wjec.co.uk)		
	A2 07 Instrumentation Systems (differential op amps, encoders and strain gauges) gce-electronics-book-chapter-7.pdf (wjec.co.uk)		
	A2 11 Digital Communications (Intro to data links) gce-electronics-book-chapter-11.pdf (wjec.co.uk)		
	A2 12 Optical Communications (Intro to fibre optic communications) gce-electronics-book-chapter-12.pdf (wjec.co.uk)		
Autumn 2	A2 06 Audio Systems gce-electronics-book-chapter-6.pdf (wjec.co.uk)		
	A2 03 Further Microcontrollers (assembly language physical computing) gce-electronics-book-chapter-3.pdf (wjec.co.uk)		
	A2 13 Further Semiconductors (how PN junctions & FETs work) gce-electronics-book-chapter-13.pdf (wjec.co.uk)		
	Assembly language coursework (NEA 1)		
Spring 1	Main project (NEA 2)		
Spring 2	Main project (NEA 2) continued		As above
Easter 1	NEA 1 & 2 hand in		
	Revision		
Easter 2	Revision		
	Exams		

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	<p>Substantive Knowledge Topics to be covered = subject matter to be learned. Note we use Eduqas as our exam board. This should be read in conjunction with the specification, which can be found here: https://www.eduqas.co.uk/umbraco/surface/blobstorage/download?nodeid=11666</p> <p>Format: A1 XX = AS text book chapter XX https://resources.eduqas.co.uk/Pages/ResourceSingle.aspx?rId=937</p> <p>Format: A2 YY = A2 text book chapter YY https://resources.eduqas.co.uk/Pages/ResourceSingle.aspx?rId=1179</p>	<p>Disciplinary Knowledge (Skills) Most lessons will consist of peer marking the homework from the previous lesson or a starter consisting of an exam question, theory, then practical, which may consist of computer simulation or building circuits in real life. At the end of each topic there will be a formal end of unit test.</p> <p>This document has been produced in two lengths at the request of Beths' leadership team. The first is the short version with links to the chapters and the specification.</p> <p>The second is the same document with the key passages from the specification cut, pasted and formatted to fit.</p> <p>I would be interested to find out which version is most useful to you – please do email me at mrmorgan AT beths.bexley.sch.uk</p>	<p>Assessment opportunities Students will be assessed on homework marks, end of unit tests and trial exams.</p>
<p>The timetable below is based on the 2023/5 lesson planned sequence and is subject to change.</p>			
<p>Year 12 Autumn 1</p>	<p>Intro to Electronics. Some material from the A1 Core Concepts and A1 01s chapters will be covered https://resource.download.wjec.co.uk/vtc/2016-17/16-17_1-9/gce-electronics-book-core-concepts.pdf gce-electronics-book-chapter-1.pdf (wjec.co.uk)</p> <p><i>This first unit in Year 12 builds from the prior knowledge from the work covered in Year 11 in the 'Electricity' module and enable students to build a step-by-step approach to more complex systems</i></p> <p>At the end of this topic you should be able to:</p>	<p>distinguish between electrical charge, current and voltage;</p> <ul style="list-style-type: none"> • distinguish between energy supplied and power rating; • recall and use the formula: $P=I \times V$; • distinguish between conductors, insulators and semiconductors in terms of their electrical conduction properties; • distinguish between series and parallel connections; • recall that ammeters are connected in series with the component under investigation, that voltmeters are connected in parallel with the component under investigation and that multimeters combine the functions of ammeter and voltmeter 	<p>Weekly homework</p> <p>Past paper questions as starters</p> <p>Classwork Marked</p> <p>Peer and self-assessment</p> <p>End of unit tests for chapter</p>

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	<ul style="list-style-type: none"> • recognise that electronic systems are assembled from sensing, processing and output sub-systems; • state the need for and use driver sub-systems; • design, analyse or modify a block diagram of a system. 		
	<p>A1 05 Semiconductor components gce-electronics-book-chapter-5.pdf wjec.co.uk</p>	<p>1. SEMICONDUCTOR COMPONENTS Overview This topic covers the construction of semiconductors in terms of n-type and p-type materials and the processes at a p-n junction and looks at the use of a range of diodes and transistors. Electronic skills The topic gives learners the opportunity to explore the action of several types of diodes and npn bipolar and MOSFET transistors. Learners will also work with various semiconductor devices and calculate values using component data and graphs. Mathematical skills There are a number of opportunities for the development of mathematical skills in this topic. These include: recognising and using expressions in decimal and standard form; estimating results; using an appropriate number of significant figures; changing the subject of an equation; and translating information between graphical, numerical and algebraic forms. Learners should be able to: (a) recall the conduction processes in n- and p-type semiconductors in terms of electrons and holes (b) recall conduction processes at a p-n junction, the reasons for the difference in</p>	<p>Weekly homework</p> <p>Past paper questions as starters</p> <p>Classwork Marked</p> <p>Peer and self-assessment</p> <p>End of unit tests for chapter</p>

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		<p>the conducting properties of a p-n diode in the different directions and explain the operation of an LED</p> <p>(c) recall the principles of operation of a photodiode</p> <p>(d) explain the properties of an n-channel enhancement mode MOSFET in terms of the effects of bias voltage on the conducting channel (pinching)</p> <p>(e) describe the use of light-emitting diodes, silicon diodes and zener diodes in electronic systems and using data, including interpreting and sketching characteristic graphs to carry out relevant calculations on circuits containing these devices</p> <p>(f) calculate series resistor values for LED circuits and select appropriate zener diodes</p> <p>(g) describe the use of n-channel enhancement mode MOSFETs and npn bipolar transistors in switching circuits, using data to select suitable components for circuits</p> <p>(h) define g_m as the gradient of an I_D-V_{GS} graph.</p> <p>(i) select and apply the equations</p> <p>$I_C = h_{FE} I_B$ bipolar transistor</p> <p>$D M G S I . g (V .3) MOSFET$</p> <p>2</p> <p>$D D S o n P . I r$ power dissipated in a MOSFET.</p>	
	<p>A1 02 Logic systems gce-electronics-book-chapter-2.pdf wjec.co.uk</p>	<p>2. LOGIC SYSTEMS</p> <p>Overview</p> <p>This topic involves the study of logic gates in control. Learners will look at the types of logic gates and their function, develop combinations of logic gates to perform other logic functions and to solve set tasks. Methods for simplifying logic systems will also be developed.</p> <p>Electronic skills</p>	<p>Weekly homework</p> <p>Past paper questions as starters</p> <p>Classwork Marked</p> <p>Peer and self-assessment</p> <p>End of unit tests for chapter</p>

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		<p>This topic involves learners exploring the use of logic to control systems. Learners will work with different types of logic gates, understand how to connect and combine them to create different functions. They will use several methods to examine the workings of logic systems and be able to simplify these systems.</p> <p>Mathematical skills</p> <p>There are a number of opportunities for the development of mathematical skills in this topic. These include: recognising and using expressions in Boolean algebra; simplifying logic systems using Boolean algebra, Karnaugh maps and multiplexers; and translating information between graphical, numerical and algebraic forms.</p> <p>Learners should be able to:</p> <ul style="list-style-type: none">(a) identify and use NOT; 2 and 3-input AND, NAND, OR, NOR, XNOR and XOR logic gates(b) construct, recognise and use truth tables for these gates and simple combinations of them(c) use combinations of one or more types of gate to perform other logic functions including NAND-gate simplification(d) simplify logic systems using Boolean algebra, Karnaugh maps and multiplexers(e) design and construct circuits containing logic gates, with consideration to sourcing, sinking, pull-up and pull-down resistors	
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		<p>(f) use de Morgan's theorem to simplify a logic system</p> $\overline{A+B} = \overline{A} \cdot \overline{B}$ $\overline{A \cdot B} = \overline{A} + \overline{B}$ <p>(g) use the Boolean identities</p> $A \cdot 1 = A, A \cdot 0 = 0, A \cdot A = A, A \cdot \overline{A} = 0, A + 1 = 1, A + 0 = A, A + A = A, A + \overline{A} = 1$ <p>(h) select and apply the Boolean identities</p> $A + \overline{A} \cdot B = A + B$ $A \cdot B + A = A \cdot (B + 1) = A$	
<p>Autumn 2</p>	<p>A1 02 Timing Circuits gce-electronics-book-chapter-3.pdf wjec.co.uk</p>	<p>TIMING CIRCUITS Overview This topic develops the use of RC circuits to create time delays and their use in the creation of mono and astable timing circuits. Electronic skills This topic gives learners the opportunities to explore the charging and discharging of a RC network and its application in debouncing switches. Learners also investigate the operation of a 555 timer IC in monostable and astable circuits through calculation, modelling and simulation. They will also study astable circuits based upon Schmitt triggers. Mathematical skills There are a number of opportunities for the development of mathematical skills in this topic. These include: recognising and using expressions in decimal and standard form; using an appropriate number of significant figures; changing the subject of an equation; substituting numerical values into algebraic equations using appropriate units for physical quantities; using calculators to find and use power, exponential and logarithmic functions; solving simple algebraic equations; translating information between graphical, numeric and algebraic form; plotting two variables from</p>	<p>Weekly homework</p> <p>Past paper questions as starters</p> <p>Classwork Marked</p> <p>Peer and self-assessment</p> <p>End of unit tests for chapter</p>

experimental or other data; interpreting and plotting logarithmic plots; interpret data presented in graphical form; and changing the subject of an equation.

Learners should be able to:

(a) use the equation for the time constant (T) for an RC circuit: $T = RC$

(b) select and apply the exponential charging and discharging equations:

$$V_c = V_0 \left(1 - e^{-\frac{t}{RC}} \right) \quad \text{for a charging capacitor}$$

$$V_c = V_0 e^{-\frac{t}{RC}} \quad \text{for a discharging capacitor}$$

and use $0.69 RC$ as the half time and $5 RC$ as an approximation to estimate effective charging and discharging times

(c) select and apply the equations

$$t = -RC \ln \left(1 - \frac{V_c}{V_0} \right) \quad \text{charging capacitor}$$

$$t = -RC \ln \left(\frac{V_c}{V_0} \right) \quad \text{discharging capacitor}$$

d) calculate

values of T, R and C for a charging / discharging capacitor by using

a graph (including log graphs)

(e) use a RC circuit in debouncing switches

(f) recall the properties of monostable circuits

(g) explain the use of a monostable circuit in conjunction with a RC network in a time-delay circuit

(h) recall the properties of an astable circuit and its use as a pulse generator

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		<p>(i) explain the operation, draw and design the circuit of an astable circuit based upon a Schmitt trigger and select and apply the approximation $f \approx \frac{1}{RC}$, where f is the operating frequency</p> <p>(j) draw and analyse circuits for monostable and astable circuits based upon a 555 timer IC, and select and apply the following equations to calculate their characteristics including pulse duration, frequency, mark-space ratio</p> $f = \frac{1}{T}$ <p>frequency, period relationship</p> $T = 1.1RC$ <p>555 monostable</p> $t_H = 0.7(R_1 + R_2)C$ <p>mark time of a 555 astable circuit</p> $t_L = 0.7R_2C$ <p>space time of a 555 astable circuit</p> $f = \frac{1.44}{(R_1 + 2R_2)C}$ <p>frequency of a 555 astable circuit</p> $\frac{T_{ON}}{T_{OFF}} = \frac{R_1 + R_2}{R_2}$ <p>mark/space ratio of an astable.</p>	
	<p>A1 03 Sequential Logic Systems gce-electronics-book-chapter-3.pdf wjec.co.uk</p>	<p>OPERATIONAL AMPLIFIERS Overview This topic develops the uses of operational amplifiers (op-amps) and how they can be connected for different purposes. It involves the study of gain and outputs calculated from different inputs and resistor values and looks at bandwidth, distortion and slew-rate. Electronic skills This topic gives learners the opportunity to explore the different types of op-amps through modelling or simulation and to compare results to expected estimations and calculated results. Mathematical skills There are a number of opportunities for the development of mathematical skills in this topic. These include: recognising and using expressions in decimal and standard form; understanding and using the symbols: =, <, <<, >>, >, ~, ;, ; estimating results; using an appropriate number of significant figures; making order of magnitude</p>	<p>Weekly homework</p> <p>Past paper questions as starters</p> <p>Classwork Marked</p> <p>Peer and self-assessment</p> <p>End of unit tests for chapter</p>

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calculations; translating information between graphical and numerical form;
interpreting data presented in graphical form; and
changing the subject of an equation.
Learners should be able to:
(a) recall the characteristics of an ideal op-amp and be aware that these may be different for a typical op-amp
(b) recognise that the voltage difference between the two inputs of an op-amp with negative feedback is virtually zero (resulting in a virtual earth if one of the inputs is at 0 V) provided the output is not saturated
(c) explain the use of an op-amp in a comparator circuit
(d) recall how the output state of a comparator depends upon the relative values of the two input states and design comparator switching circuits
(e) recall and apply the conditions for the balance of a bridge circuit
(f) define the voltage gain, G , of an amplifier as $G = \frac{V_{out}}{V_{in}}$ and be able to select and apply the equation
(g) draw, recognise and recall the characteristics of the following op-amp circuits:
. non-inverting amplifier
. inverting amplifier
. summing amplifier
. comparator
. voltage follower circuit
(h) select and apply the following equations for op-amp circuits:

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		<ul style="list-style-type: none"> • non-inverting amplifier $G = 1 + \frac{R_F}{R_1}$ • inverting amplifier $G = -\frac{R_F}{R_{IN}}$ • summing amplifier $V_{OUT} = -R_F \left(\frac{V_1}{R_1} + \frac{V_2}{R_2} + \dots \right)$ <p>(i) select and apply the following equations for op-amp circuits:</p> <ul style="list-style-type: none"> • comparator $V_{OUT} = V_s$ for $V_+ > V_-$ $V_{OUT} = -V_s$ for $V_+ < V_-$ • voltage follower circuit $V_{OUT} = V_{IN}$ <p>(j) relate the input impedance of an op-amp to its configuration (k) recall that the bandwidth is the frequency range over which the voltage gain is greater than $\frac{1}{\sqrt{2}}$ of its maximum value and estimate this bandwidth from a frequency response curve and use the gain-bandwidth product (unity gain bandwidth) to estimate bandwidth (l) design single stage amplifiers based on inverting and non-inverting voltage amplifiers to achieve a specified voltage gain or bandwidth; (m) explain how clipping and slew-rate can lead to distortion (n) select and apply the equations</p> <p>slew rate = $\frac{\Delta V_{OUT}}{\Delta t}$ definition of slew rate</p> <p>slew rate = $2\pi f V_p$ minimum slew-rate for distortion of free sinusoidal signal.</p>	
	<p>A1 04 Operational Amplifiers gce-electronics-book-chapter-4.pdf wjec.co.uk</p>	<p>OPERATIONAL AMPLIFIERS Overview This topic develops the uses of operational amplifiers (op-amps) and how they can be connected for different purposes. It involves the study of gain and outputs calculated from different inputs and resistor values and looks at bandwidth, distortion and slew-rate.</p>	<p>Weekly homework Past paper questions as starters Classwork Marked Peer and self-assessment</p>

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		<p>Electronic skills This topic gives learners the opportunity to explore the different types of op-amps through modelling or simulation and to compare results to expected estimations and calculated results.</p> <p>Mathematical skills There are a number of opportunities for the development of mathematical skills in this topic. These include: recognising and using expressions in decimal and standard form; understanding and using the symbols: =, <, <<, >>, >, ~, ., ; estimating results; using an appropriate number of significant figures; making order of magnitude calculations; translating information between graphical and numerical form; interpreting data presented in graphical form; and changing the subject of an equation.</p> <p>Learners should be able to:</p> <ul style="list-style-type: none">(a) recall the characteristics of an ideal op-amp and be aware that these may be different for a typical op-amp(b) recognise that the voltage difference between the two inputs of an op-amp with negative feedback is virtually zero (resulting in a virtual earth if one of the inputs is at 0 V) provided the output is not saturated(c) explain the use of an op-amp in a comparator circuit(d) recall how the output state of a comparator depends upon the relative values of the two input states and design comparator switching circuits(e) recall and apply the conditions for the balance of a bridge circuit(f) define the voltage gain, G, of an amplifier as $G = \frac{V_{out}}{V_{in}}$ and be able to select and apply the equation(g) draw, recognise and recall the characteristics of the following op-amp circuits:	End of unit tests for chapter
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		<p>. non-inverting amplifier . inverting amplifier . summing amplifier . comparator . voltage follower circuit</p> <p>(h) select and apply the following equations for op-amp circuits:</p> <ul style="list-style-type: none"> • non-inverting amplifier $G = 1 + \frac{R_F}{R_1}$ • inverting amplifier $G = -\frac{R_F}{R_{IN}}$ • summing amplifier $V_{OUT} = -R_F \left(\frac{V_1}{R_1} + \frac{V_2}{R_2} + \dots \right)$ <p>(i) select and apply the following equations for op-amp circuits:</p> <ul style="list-style-type: none"> • comparator $V_{OUT} = V_S$ for $V_+ > V_-$ $V_{OUT} = -V_S$ for $V_+ < V_-$ • voltage follower circuit $V_{OUT} = V_{IN}$ <p>(j) relate the input impedance of an op-amp to its configuration</p> <p>(k) recall that the bandwidth is the frequency range over which the voltage gain is greater than $\frac{1}{\sqrt{2}}$ of its maximum value and estimate this bandwidth from a frequency response curve and use the gain-bandwidth product (unity gain bandwidth) to estimate bandwidth</p> <p>(l) design single stage amplifiers based on inverting and non-inverting voltage amplifiers to achieve a specified voltage gain or bandwidth;</p> <p>(m) explain how clipping and slew-rate can lead to distortion</p> <p>(n) select and apply the equations</p> <p>slew rate = $\frac{\Delta V_{OUT}}{\Delta t}$ definition of slew rate</p> <p>slew rate = $2\pi f V_p$ minimum slew-rate for distortion of free sinusoidal signal.</p>	
<p>Spring 1</p>	<p>A1 04 Operational Amplifiers continued gce-electronics-book-chapter-4.pdf wjec.co.uk</p>	<p>As above</p>	

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	<p>A1 06 Microcontrollers (Physical computing using flowchart interpreter) gce-electronics-book-chapter-6.pdf wjec.co.uk</p>	<p>MICROCONTROLLERS Overview This topic covers the microcontroller as a programmable integrated circuit (PIC) and its internal structure. It also covers how microcontrollers are interfaced and programmed through flowcharts and assembler language to perform tasks. Electronic skills Learners will have the opportunity in this topic to work with microcontrollers, interfacing them to inputs and outputs and programming them to perform set tasks. Learners will also use both flowcharts and assembler language to program the microcontrollers and look at the application of microcontrollers. Mathematical skills There are some opportunities for the development of mathematical skills in this topic. These include: converting between binary and decimal number systems; and drawing and interpreting flowcharts. Learners should be able to: (a) analyse and design flowchart programs to program microcontrollers (b) recall and describe the structure of a PIC microcontroller as programmable assemblies of memory, input ports, output ports, CPU, clock and reset (c) recall and explain the use of interrupts to allow an external device to be serviced on request (d) recall and describe the application of a PIC microcontroller (e) analyse, design and program PIC microcontroller-based circuits using assembler language.</p>	<p>Weekly homework Past paper questions as starters Classwork Marked Peer and self-assessment End of unit tests for chapter</p>
<p>Spring 2</p>	<p>A1 07 Mains Power Supplies</p>	<p>MAINS POWER SUPPLY SYSTEMS</p>	<p>Weekly homework</p>

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	<p>gce-electronics-book-chapter-7.pdf (wjec.co.uk)</p>	<p>Overview This topic explores power supplies with half and full wave rectification, the use of capacitors and load and line regulation. The topic also involves the analysis and design of regulators based upon a zener diode, a transistor emitter follower and a non-inverting amplifier.</p> <p>Electronic skills This topic gives learners opportunities to model and simulate half and full wave rectification, by examining the effect of capacitors and loads on the output of simple power supplies. Learners have the opportunity to construct and test a range of voltage regulators consisting of a zener diode, a transistor emitter follower or noninverting amplifier.</p> <p>Mathematical skills There are a number of opportunities for the development of mathematical skills in this topic. These include: recognising and using expressions in decimal and standard form; using an appropriate number of significant figures; making order of magnitude calculations; changing the subject of an equation; translating information between graphical and numerical form; and interpreting data presented in graphical form.</p> <p>Learners should be able to:</p> <p>(a) recall the use of diodes for half-wave and full wave rectification (b) describe the effect of capacitors and loads on the output of a simple power supply (c) select and apply the ripple voltage equation</p> $V_r = \frac{I}{f_r C}$	<p>Past paper questions as starters</p> <p>Classwork Marked</p> <p>Peer and self-assessment</p> <p>End of unit tests for chapter</p>
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		<p>(d) design zener regulated power supplies and draw graphs to show the effect of loading (e) distinguish between load regulation and line regulation (f) analyse and design a voltage regulator based upon a zener diode, a transistor emitter follower and a non-inverting amplifier (g) select and apply the gain equation</p> $V_L \approx V_Z \left(1 + \frac{R_f}{R_i} \right)$	
	<p>A2 01 Further Sequential Logic Systems gce-electronics-book-chapter-1.pdf wjec.co.uk</p>	<p>SEQUENTIAL LOGIC SYSTEMS Overview This topic covers latches based on NAND gates and propagation delays in sequential systems. It involves the study of characteristics and uses for a range of systems based on D-type flip-flops, dedicated 4-bit counters, 2 digit decimal counter and synchronous counter systems. Electronic skills This topic expands on the logic systems topic, which gives learners further opportunities to design and analyse sequential logic systems. Learners will also explore a range of uses for D-type flip-flops. Mathematical skills There are a number of opportunities for the development of mathematical skills in this topic. These include: recognising and using expressions in Boolean algebra; simplifying logic systems using Boolean algebra, Karnaugh maps and multiplexers; translating information between graphical, numerical and algebraic forms, constructing and using timing diagrams; and converting between binary, decimal, hexadecimal and binary-coded decimal (BCD) number systems.</p>	<p>Weekly homework Past paper questions as starters Classwork Marked Peer and self-assessment End of unit tests for chapter</p>

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		<p>Learners should be able to:</p> <p>(a) design and describe the action of a Set-Reset (SR) latch based on NAND gates</p> <p>(b) describe the significance of propagation delays in sequential systems</p> <p>(c) construct and use timing diagrams to explain the operation of sequential logic circuits</p> <p>(d) recall the characteristics and uses of the inputs and outputs of D-type flipflops for:</p> <ul style="list-style-type: none"> . transition gates . frequency divider circuits . asynchronous counters . parallel-in-series-out (PISO) registers . series-in-parallel-out (SIPO) registers . synchronous counters <p>(e) design systems that use a dedicated 4-bit counter and combinational logic to produce a sequence of events</p> <p>(f) design and analyse a 2 digit decimal counting system</p> <p>(g) convert between binary, decimal, hexadecimal and binary-coded decimal (BCD) number systems</p> <p>(h) design sequence generators based on D-type flip-flops configured as synchronous counters, use state diagrams and explain the significance of stuck and unused states, including Boolean manipulation to produce simpler solutions.</p>	
<p>Summer 1</p>	<p>A2 04 AC Circuits gce-electronics-book-chapter-4.pdf wjec.co.uk</p>	<p>AC CIRCUITS AND PASSIVE FILTERS</p> <p>Overview</p> <p>This topic involves the study of resistive loads for AC circuits and impedance to passive filters. High-pass and low-pass passive RC filters and passive LC band-pass filters are also included.</p> <p>Electronic skills</p>	<p>Weekly homework</p> <p>Past paper questions as starters</p> <p>Classwork Marked</p> <p>Peer and self-assessment</p>

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This topic allows learners to explore the use of capacitors and inductors in AC circuits and their use to form filters. Filters are further investigated to see how they can be adapted for different uses.

Mathematical skills

There are a number of opportunities for the development of mathematical skills in this topic. These include: recognising and using expressions in decimal and standard form; calculating squares and square roots; using an appropriate number of significant figures; making order of magnitude calculations; understanding and using the symbols =, p; changing the subject of an equation; substituting numerical values into algebraic equations using appropriate units for physical quantities; finding arithmetic means; translating information between graphical and numeric form; plotting two variables from experimental or other data; interpreting and plotting logarithmic plots; and interpreting data presented in graphical form.

Learners should be able to:

- (a) use V-t, I-t and P-t graphs for resistive loads
- (b) describe the relationship between rms and peak values
- (c) select and apply the equations to calculate the reactance of capacitors and inductors and the impedance for a series circuit

$$X_c = \frac{1}{2\pi fC}$$
$$X_L = 2\pi fL$$
$$Z = \sqrt{R^2 + X^2}$$

- (d) draw, recognise and interpret the output of RC passive filters using linear-log

End of unit tests for chapter

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		<p>and log-log output graphs and describe the advantage of buffering passive filters</p> <p>(e) recognise, analyse, design and draw circuits for high-pass and low-pass passive RC filters and passive LC band-pass filters</p> <p>(f) select and apply the equations</p> $f_0 = \frac{1}{2\pi\sqrt{LC}}$ <p style="text-align: right;">resonant frequency for LC filters</p> $R_D = \frac{L}{r_i C}$ <p style="text-align: right;">dynamic resistance of a resonant circuit</p> $Q = \frac{f_0}{\text{bandwidth}} = \frac{2\pi f_0 L}{r_i}$ <p style="text-align: right;">Q-factor.</p>	
	<p>A2 05 Signal conversion (Analogue to digital conversion)</p> <p>gce-electronics-book-chapter-5.pdf</p> <p>wjec.co.uk</p>	<p>SIGNAL CONVERSION</p> <p>Overview</p> <p>This topic will cover the need for signal conversion and investigate the design and use of both digital to analogue and analogue to digital signal conversion subsystems.</p> <p>Electronic skills</p> <p>This topic allows learners to explore the conversion of digital to analogue signals and analogue to digital signals by using operational amplifiers. ADC converters are further investigated to look at flash and digital ramp ADCs.</p> <p>Mathematical skills</p> <p>There are some opportunities for the development of mathematical skills in this topic. These include: recognising and using expressions in decimal and standard form; estimating results; using an appropriate number of significant figures; and changing the subject of an equation.</p> <p>Learners should be able to:</p> <p>(a) explain the need for signal conversion between analogue and digital form in communications and microprocessors</p> <p>(b) describe how an op-amp summing amplifier can be used as a DAC to convert a digital signal into an analogue signal</p>	<p>Weekly homework</p> <p>Past paper questions as starters</p> <p>Classwork Marked</p> <p>Peer and self-assessment</p> <p>End of unit tests for chapter</p>

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		<p>(c) analyse and design a DAC based upon an op-amp summing amplifier to meet a given specification</p> <p>(d) describe how comparators can be used as an ADC to convert an analogue signal into a digital signal</p> <p>(e) describe the process of digitising audio signals and explain the effects of sampling rate and resolution</p> <p>(f) analyse and design a flash converter ADC based on comparators and priority encoders to meet a specification and describe the factors affecting the resolution</p> <p>(g) select and apply the equation for calculating the resolution of a n-bit flash Converter</p> $\text{resolution} = \frac{\text{i/p voltage range}}{2^n}$ <p>(h) compare the difference of a digital ramp ADC and a flash ADC.</p>	
<p>Summer 2</p>	<p>A2 09 Communications systems (intro to sending data long distance) gce-electronics-book-chapter-9.pdf (wjec.co.uk)</p>	<p>COMMUNICATIONS SYSTEMS Overview This topic involves the study of communication systems and provides a basic understanding of communication systems to develop in wireless transmission, digital communication and optical communication topics. Electronic skills This topic allows learners to explore communications systems. Learners will look at the concept of communication and the structure of communication systems. This progresses to exploring data transmission through calculation of bandwidth, data rate and gain. Learners will also be introduced to the concepts of noise and distortion. Mathematical skills</p>	<p>Weekly homework</p> <p>Past paper questions as starters</p> <p>Classwork Marked</p> <p>Peer and self-assessment</p> <p>End of unit tests for chapter</p>

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There are some opportunities for the development of mathematical skills in this topic.
These include: translating information between graphical and numeric form; changing the subject of an equation; substituting numerical values into algebraic equations; using decibel notation and logarithmic functions; using appropriate units for physical quantities; and interpreting data presented in graphical form.

Learners should be able to:

(a) recall that communication is the transfer of meaningful information from one location to another

(b) recall the structure of a simple communication system consisting of:
information source, transmitter/encoder, transmission medium, amplifier/regenerator receiver/decoder and information destination

(c) recall and explain the relationship between bandwidth, data rate and information-carrying capacity and select and apply the equations

$$N_{\text{CH}} = \frac{\text{available bandwidth}}{\text{channel bandwidth}}$$

maximum data rate = 2 × available bandwidth (d) explain the need to multiplex a number of signals onto one transmission medium and describe the principles of frequency and time division multiplexing

(e) describe the role of filters in communication systems

(f) use the decibel scale to express power gain in amplifiers/attenuation in transmission media and select and apply the equation

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		$G_{dB} = 10 \log_{10} \frac{P_{OUT}}{P_{IN}}$ <p style="text-align: right;">gain in decibels (g)</p> <p>differentiate between noise and distortion (h) calculate the total gain in a communication system given the power gain or attenuation of its component parts (i) state what is signal to noise ratio and select and apply the equations</p> $SNR_{dB} = 10 \log_{10} \frac{P_S}{P_N} = 20 \log_{10} \frac{V_S}{V_N}$ <p style="text-align: right;">signal to noise ratio (j) state what</p> <p>signal attenuation is and describe the significance of signal attenuation (in dB) for the signal-to-noise ratio.</p>	
	<p>A2 02 Further Mains Power Supplies gce-electronics-book-chapter-2.pdf (wjec.co.uk)</p>	<p>Continuation of Mains Power Supplies</p>	<p>Weekly homework</p> <p>Past paper questions as starters</p> <p>Classwork Marked</p> <p>Peer and self-assessment</p> <p>End of unit tests for chapter</p>
	<p>A2 08 High Power Switching Systems gce-electronics-book-chapter-8.pdf (wjec.co.uk)</p>	<p>HIGH POWER SWITCHING SYSTEMS Overview This topic involves the study of high power switching for both DC/AC loads. It covers the use and application of thyristors, diacs and triacs for high power switching. Electronic skills This topic gives opportunities for learners to model and simulate switching circuits for both DC and AC systems. Mathematical skills There are a number of opportunities for the development of mathematical skills in this topic. These include: recognising and using expressions in decimal and standard</p>	<p>Weekly homework</p> <p>Past paper questions as starters</p> <p>Classwork Marked</p> <p>Peer and self-assessment</p> <p>End of unit tests for chapter</p>

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		<p>form; using calculators to find and use power, exponential and tan functions; estimating results; using an appropriate number of significant figures; making order of magnitude calculations; changing the subject of an equation; translating information between graphical and numerical form; and interpret data presented in graphical form.</p> <p>Learners should be able to:</p> <p>(a) describe the advantages of using thyristors and triacs to switch high power DC/AC loads respectively, compared to using a transistor or a relay</p> <p>(b) recall the general thyristor characteristics, the conditions under which a thyristor conducts and explain the significance of the following terms: holding current, minimum gate voltage, minimum gate current</p> <p>(c) design DC thyristor switching circuits and explain the process of capacitor commutation</p> <p>(d) draw the circuit diagram and analyse graphs for an AC phase control circuit, using a RC network, a triac and a diac</p> <p>(e) select and apply the equation</p> $\phi = \tan^{-1} \left(\frac{R}{X_c} \right)$ <p>to calculate the phase shift between supply voltage and capacitor voltage.</p>	
<p>Year 13 Autumn 1</p>	<p>Start of year test Past papers AS and A Level Electronics Edugas</p>		<p>Informs UCAS predicted grades</p>
	<p>A2 10 Wireless Transmission (Intro to radio communications) gce-electronics-book-chapter-10.pdf (wjec.co.uk)</p>	<p>WIRELESS TRANSMISSION Overview This topic covers the principles of wireless transmission including amplitude modulation (AM) and frequency modulation (FM).</p>	<p>Weekly homework Past paper questions as starters</p>

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		<p>Electronic skills This topic gives learners the opportunity to explore wireless transmission, including the radio spectrum for data transmission, bandwidth requirements and available frequency channels. Learners will also perform calculations on the different types of modulation.</p> <p>Mathematical skills There are a number of opportunities for the development of mathematical skills in this topic. These include: recognising and using expressions in decimal and standard form; understanding and using the symbols =,.,; substituting numerical values into algebraic equations; using appropriate units for physical quantities; solving simple algebraic equations; estimating results; using an appropriate number of significant figures; making order of magnitude calculations; translating information between graphical and numerical form; interpreting data presented in graphical form; and changing the subject of an equation.</p> <p>Learners should be able to: (a) recall and explain the use of the different regions of the radio spectrum for the transmission of data, including in terms of bandwidth requirements and available frequency channels (b) describe and explain the use of amplitude modulation and frequency modulation and select and apply the equations</p>	<p>Classwork Marked</p> <p>Peer and self-assessment</p> <p>End of unit tests for chapter</p>
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		$m = \frac{(V_{max} - V_{min})}{(V_{max} + V_{min})} \times 100\%$ <p style="text-align: right;">depth of modulation</p> $\beta = \frac{\Delta f_c}{f_i}$ <p style="text-align: right;">modulation index</p> <p>Bandwidth = $2(\Delta f_0 + f_i) = 2(1 + \beta)f_i$ transmitted FM bandwidth</p> <p>$c = f\lambda$ wave speed</p> <p>(c) sketch, recognise and analyse the resulting waveforms for a sinusoidal carrier being amplitude and frequency modulated by a single frequency audio signal.</p>	
	<p>A2 07 Instrumentation Systems (differential op amps, encoders and strain gauges) gce-electronics-book-chapter-7.pdf (wjec.co.uk)</p>	<p>INSTRUMENTATION SYSTEMS Overview This topic draws together the use of op-amps for instrumentation systems, the use of bridge circuits with thermistors and strain gauges in instrumentation and the use of slotted and encoded discs. Electronic skills This topic enables learners to further explore the op-amp difference amplifier for instrumentation and the use of bridge circuits with thermistors and strain gauges. Learners also investigate methods of sensing rotational speed and angular position using slotted and encoded discs. Mathematical skills There are a number of opportunities for the development of mathematical skills in this topic. These include: recognising and using expressions in decimal form; using appropriate number of significant figures; changing the subject of an equation; substituting numerical values into algebraic equations using appropriate units for physical quantities; translating information between graphical and numeric form; and interpreting data presented in graphical form. Learners should be able to:</p>	<p>Weekly homework</p> <p>Past paper questions as starters</p> <p>Classwork Marked</p> <p>Peer and self-assessment</p> <p>End of unit tests for chapter</p>

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		<p>(a) draw and recognise an op-amp difference amplifier circuit and select and apply the equation</p> $V_{OUT} = V_{DIFF} \left(\frac{R_F}{R_1} \right)$ <p>(b) analyse and design instrumentation amplifiers based upon the op-amp difference amplifier circuit</p> <p>(c) describe the use of bridge circuits with thermistors and strain gauges</p> <p>(d) describe the use of the slotted discs (for sensing rotational speed) and encoded discs (for sensing angular position)</p> <p>(e) compare the Gray coding of encoded discs with binary coding</p> <p>(f) design logic system to process the output of slotted and encoded discs.</p>	
	<p>A2 11 Digital Communications (Intro to data links) gce-electronics-book-chapter-11.pdf wjec.co.uk</p>	<p>DIGITAL COMMUNICATIONS Overview This topic develops the concepts of digital communication by examining different types of modulation and the regeneration of digital signals. Block diagrams of pulse code modulation (PCM) systems are used to explain their operation. Also Nyquist theorem and time division multiplexing (TDM) is introduced. Electronic skills This topic enables learners to explore the construction of systems required for digital communications. They will also have opportunity to explore parts of digital communication systems. Mathematical skills There are some opportunities for the development of mathematical skills in this topic. These include: translating information between graphical and numeric form; plotting two variables from data; and interpreting data presented in graphical form</p>	<p>Weekly homework</p> <p>Past paper questions as starters</p> <p>Classwork Marked</p> <p>Peer and self-assessment</p> <p>End of unit tests for chapter</p>

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		<p>Learners should be able to:</p> <p>(a) analyse and design Schmitt trigger circuits to regenerate a digital signal</p> <p>(b) analyse and draw graphs to illustrate pulse modulation techniques (pulse width modulation (PWM), pulse amplitude modulation (PAM), pulse position modulation (PPM))</p> <p>(c) draw a block diagram for and describe the operation of a pulse code modulation (PCM) communication system consisting of: transmitter low pass filter, sampling gate, sampling clock, ADC, PISO shift register, PISO clock and receiver Schmitt trigger, SIPO shift register, SIPO clock, DAC, low pass filter</p> <p>(d) use the relationship between required sampling frequency to the highest frequency in the signal and Nyquist theorem</p> <p>(e) describe how time division multiplexing (TDM) can be used to improve the user capacity of a PCM communications link</p> <p>(f) state the limitation on the number of channels that can be incorporated into a PCM communications link, using TDM and use given data to calculate how many channels can be incorporated into a PCM communications link, using TDM.</p>	
	<p>A2 12 Optical Communications (Intro to fibre optic communications) gce-electronics-book-chapter-12.pdf wjec.co.uk</p>	<p>OPTICAL COMMUNICATION Overview This topic introduces the principles of optical communication, its limitations and the principles for converting between electrical and optical signals. Electronic skills</p>	<p>Weekly homework</p> <p>Past paper questions as starters</p> <p>Classwork Marked</p> <p>Peer and self-assessment</p>

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		<p>Learners will have the opportunity to study optical communications, with practical opportunities to explore basic circuits for converting between electrical and optical signals by modelling the systems.</p> <p>Learners should be able to:</p> <p>(a) describe how the refractive properties of glass allow signals to be transmitted over long distances in optical fibres</p> <p>(b) describe the effects of dispersion, attenuation and radiation losses in optical fibre communication and the relative advantages of single and multi-mode optical fibres in a communication network</p> <p>(c) describe the principles of operation of circuits for converting between electrical and optical signals</p> <p>(d) describe the use of LED and laser light sources in an optical fibre transmitter.</p>	<p>End of unit tests for chapter</p>
<p>Autumn 2</p>	<p>A2 06 Audio Systems gce-electronics-book-chapter-6.pdf (wjec.co.uk)</p>	<p>AUDIO SYSTEMS Overview This topic develops the use of amplifier and filter sub-systems to construct audio systems. Electronic skills This topic develops ideas studied in earlier topics and involves the use of amplifiers and filters in practical situations for audio systems. Learners will have opportunity to investigate through calculations, modelling and simulation a range of amplifier circuits based on a multi-stage voltage preamplifier, summing amplifier, emitter and source follower power amplifiers, push-pull power amplifiers including active filters. Mathematical skills There are a number of opportunities for the development of mathematical skills in this topic. These include: recognising and using expressions in decimal and standard form; understanding and using the symbols: \approx, \sim; estimating results; using an appropriate number of significant figures; making order of magnitude calculations; changing the subject of an equation; translating information between graphical and numerical form; and interpreting data presented in graphical form. Learners should be able to: (a) recall the structure of a simple audio system based upon preamplifiers, a mixer, tone controls, a power amplifier and</p>	

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		<p>output loudspeaker (b) analyse and design a multi-stage voltage preamplifier to meet bandwidth and gain requirements (c) analyse and design a mixer circuit based upon a summing amplifier (d) describe and explain the operation of first order active filters (bass boost, treble boost, bass cut, treble cut) based upon an op-amp inverting amplifier and select and apply the equation to calculate the break frequency</p> $f_b = \frac{1}{2\pi R C}$ <p>(e) recall and apply the maximum power transfer theorem (f) draw circuits for and recall the properties of emitter and source follower power amplifiers</p> <p>$(V_{OUT} \approx V_{IN} - 0.7$ for an emitter follower and $V_{OUT} \approx V_{IN} - 3$ for source follower)</p> <p>(g) draw circuits for and recall the properties of push-pull power amplifiers consisting of either emitter or source followers and select and apply the equation</p> $P_{MAX} = \frac{V_s^2}{8R_L} \quad \text{push-pull power amplifier}$ <p>(h) analyse and draw graphs of the waveforms for first order active filters, emitter and source follower power amplifiers and push-pull power amplifiers (i) describe cross over distortion in push-pull amplifiers and its removal using negative feedback.</p>	
	<p>A2 03 Further Microcontrollers (assembly language physical computing) gce-electronics-book-chapter-3.pdf wjec.co.uk</p>	<p>MICROCONTROLLERS Overview This topic covers the microcontroller as a programable integrated circuit (PIC) and its internal structure. It also covers how microcontrollers are interfaced and programed through flowcharts and assembler language to perform tasks. Electronic skills Learners will have the opportunity in this topic to work with microcontrollers, interfacing them to inputs and outputs and programing them to perform set tasks.</p>	<p>Weekly homework Past paper questions as starters Classwork Marked Peer and self-assessment End of unit tests for chapter</p>

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		<p>Learners will also use both flowcharts and assembler language to program the microcontrollers and look at the application of microcontrollers.</p> <p>Mathematical skills</p> <p>There are some opportunities for the development of mathematical skills in this topic.</p> <p>These include: converting between binary and decimal number systems; and drawing and interpreting flowcharts.</p> <p>Learners should be able to:</p> <p>(a) analyse and design flowchart programs to program microcontrollers</p> <p>(b) recall and describe the structure of a PIC microcontroller as programmable assemblies of memory, input ports, output ports, CPU, clock and reset</p> <p>(c) recall and explain the use of interrupts to allow an external device to be serviced on request</p> <p>(d) recall and describe the application of a PIC microcontroller</p> <p>(e) analyse, design and program PIC microcontroller-based circuits using assembler language.</p>	
	<p>A2 13 Further Semiconductors (how PN junctions & FETs work) gce-electronics-book-chapter-13.pdf wjec.co.uk</p>	<p>No further information from the exam board available!</p> <p>The chapter is about how PN junctions and FETs work at the atomic level, with students being able to explain how a PN junction and a FET works with reference to doping, depletion regions, and energy levels.</p>	
	<p>Assembly language coursework (NEA 1)</p>	<p>Task 1 is intended to introduce learners to software control techniques using assembly language which is widely used to program microcontrollers for consumer products. It is not expected that learners will be familiar with every instruction in the instruction set, or use every programming technique available. Several manufacturers produce PIC development systems which can be used to deliver this</p>	<p>Past paper questions as starters</p> <p>Weekly homework – NEA pages</p> <p>Peer and self-assessment of NEA progress</p> <p>End of project assessment (NEA)</p>

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		<p>part of the component. The work should not be limited to 'onscreen' design and emulation, but must involve the actual programming of a PIC chip, and its testing remotely on a physical circuit. Initial program testing can be carried out using a development board to prove the program works before final testing on a physical circuit.</p> <p>The report must include a listing of the program, a description of how the program works and testing of the program</p>	
<p>Spring 1</p>	<p>Main project (NEA 2)</p>	<p>Once the learner has decided on a context for the task, they should undertake appropriate research so that a list of performance parameters (specification) can be given. It is expected that the design specification will contain realistic numerical values against which the final performance of the system can be judged.</p> <p>In each task the overall system should be developed as a number of sub-systems which should be individually tested and evaluated before being incorporated into the complete system. This will ensure that the complete system develops by a gradual and incremental process, having been assessed at each stage of its development.</p> <p>For microcontroller-based projects, a sub-routine can be considered as a sub-system provided its specification can be tested and evaluated in a similar fashion to a component-based sub-system. To meet the assessment requirements, a microcontroller-based project will also need to include, as a minimum, some component-based processing sub-systems for interfacing signals to and from the microcontroller (in addition to the microcontroller circuitry).</p> <p>In each task the system should be fully tested when the project is complete. The</p>	<p>Past paper questions as starters</p> <p>Weekly homework – NEA pages</p> <p>Peer and self-assessment of NEA progress</p> <p>End of project assessment (NEA)</p>

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		<p>testing should be documented with results being displayed in tables and graphs, where appropriate. These tests will enable the learner to assess the system and identify any faults and limitations. The learner should attempt to modify the system to correct for any limitations and then produce a final set of performance figures for the completed system. The learner should then evaluate the final system against the design specification and suggest further developments. The learner should fully document the development of each task in a report. It is the evidence contained within this report and the system produced upon which the NEA should be marked and assessed. The report should contain evidence for each task of the following sections:</p> <ul style="list-style-type: none">. System planning – including analysis of the problem and a design specification. System development – including the development of the system in terms of subsystems, annotated circuit diagrams and description of testing each sub-system and the recording of results. System realisation – including annotated block and circuit diagrams; evidence of layout planning; description of testing of complete systems and the recording of results and user guide. Evaluation – including a detailed evaluation of the system against the design specification and suggestions for improvement. <p>The report should be presented in a logical order that is clearly presented and easy to understand. It should contain an acknowledgement of all sources of information and help. Photographs of the complete physical system must be included in the report.</p>	
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Spring 2	Main project (NEA 2) continued		As above
Easter 1	NEA 1 & 2 hand in		
	Revision		
Easter 2	Revision		
	Exams		