Beths Grammar School KS4 Electronics Curriculum Map

Term Eduqas Exam Board	INTENT **Substantive Knowledge** This is the specific, factual content for the topic, which should be connected into a careful sequence of learning.	IMPLEMENTATION **Disciplinary Knowledge (Skills)** This is the action taken within a particular topic in order to gain substantive knowledge.	IMPACT **Assessment opportunities** What assessments will be used to measure student progress? Evidence of how well students have learned the intended content.
Year 10 **Term 1**	**Chapter 1: 16 Periods** Electronics Systems. Input, output and process. Control Studio and basic logic. **Chapter 2: 14 Periods** Circuit Concepts **Chapter 3: 16 Periods** Resistive components.	**Electronic Systems** To be able to recognise that electronic systems are assembled from sensing, processing and output sub-systems, including: *• sensing units: light, temperature, magnetic field, pressure, moisture, sound, rotation* *• signal processing: individual logic gates, latch, time delay, comparator* *• output devices: lamp, buzzer, solenoid, LED, actuator (servo)* Pupils to be able recognise the input, processing and output sections of a system. Learners need to know the function of each of the units specified opposite in terms of the effect the input signal(s) has on the output. *For example: a pressure sensor is a digital sensor that converts pressure into an electrical signal. A high signal (logic 1) is produced at the output when someone stands on a pressure mat.* To be able to state the need for and use of transducer drivers. *Learners need to understand that most electronic circuits operate on low voltage and current. In order to drive outputs a transducer driver is required to boost the current to operate output devices.*	Weekly homework Past paper questions as starters Classwork Marked Peer and self-assessment End of unit tests for each chapter

		Learners should be aware that high power loads (solenoids, motors and some lamps) are most likely to need a MOSFET based transducer driver. Lower power outputs like LED's / buzzers could also use a npn transistor switch as the transducer driver. To be able design and test electronic systems. *Learners need to select appropriate input sensors, processing units and output devices to solve a variety of design scenarios and produce block diagrams for the solutions.* *Learners need to evaluate given system block diagrams against a given specification and (if necessary) suggest amendments to the system to bring the design closer to the design specification.* **Circuit Concepts** To be able to draw, communicate and analyse circuits using standard circuit symbols using standard convention. To be able apply current and voltage rules in series and parallel circuits. To be able to apply the current at a junction rule. *Learners should be able to apply this rule to networks of resistors for example two resistors or other components, in parallel with another in series*. To be able to apply the sum of voltages rule. *Learners should be able to apply this rule to two or more resistors or other components in series across a power supply.* To be able to use test equipment to make measurements to test electrical components and circuits including: multimeters (on voltage, current and resistance ranges), timing equipment, logic probes and oscilloscopes (or	

		computers configured as oscilloscopes), including investigating current-voltage characteristics. *Learners should be familiar with the use of a multimeter as a voltmeter, ammeter or resistance meter.* *Learners should be able to investigate the I-V characteristics of a resistor, filament lamp and diode, and explain the resulting characteristic graph.* *Learners should be familiar with signal generators producing sine, square and triangular waveforms.* *Learners should be familiar with a logic probe for testing digital circuits and the oscilloscope for AC circuits.* To be able to analyse circuits in terms of voltage, current, resistance, energy and power and use the equations: **V IR = P VI = 2 P I R = E Pt = and select and apply 2 V P R** *Learners should be able to apply these equations to individual components as well as in a full range of applications. For example in voltage divider circuits, sensor circuits, monostable and astable circuits, comparator circuits etc, as well as standard discrete applications.* *Use of E=Pt will be limited to questions calculating the energy transferred by a light, motor, led etc when used for a given period of time.* **RESISTIVE COMPONENTS IN CIRCUITS** To be able to describe the effect of adding resistors in series and parallel. *Learners should be aware that adding resistors in series increases resistance, whilst adding resistors in parallel decreases resistance.*	

		To be able to use equations for series and parallel resistor combinations resistors in series R R R 1 2 = + resistors in parallel 1 2 1 2 *Learners should be able to use these equations to reduce networks of resistors to a single resistance. Networks may be series, parallel or combinations of both series and parallel components.* To be able to select resistors for use in a circuit by using the colour and E24 codes for values, tolerances and power ratings. *Learners will need to apply the 4 band colour code to determine resistor values and select resistors from the E24 series.* *Learners will be required to determine the tolerance of resistors in order to determine the effect of this in timing calculations and current limiting applications.* To be able to use photosensitive devices, ntc thermistors, pressure, moisture and sound sensors, switches, potentiometers and pulse generators in circuits. *The pulse generator has been included because the timing is controlled by a resistive element. The pulse generator can also be considered as an input sub-system.* To be able to design and test sensing circuits using these components by incorporating them into voltage dividers. *The pulse generator will NOT be incorporated into a voltage divider.* To be able to design and use switches and pullup or pull-down resistors to provide correct logic level/edgetriggered signals for logic gates and timing circuits.	

		Learners should understand the reason for using pull-up and pull-down resistors is to provide the correct logic levels at a logic gate input. To be able to select and apply the voltage divider equation in sensing circuits 2 OUT IN 1 2 R V V R R = + for a voltage divider. *Applications include LDR and thermistor sensors, as well as producing reference voltages for comparator circuits.* To be able to determine the value of a currentlimiting resistor for LEDs in DC circuits. *In examination questions the forward voltage drop for LEDs will be given and will vary with the colour of the LED.*	
Year 10 **Term 2**	**Chapter 4: 16 Periods** Switching Circuits **Chapter 5: 10 Lessons** Applications of diodes **Chapter 6: 16 Lessons** Combinational logic systems	**Switching Circuits** To be able to describe and analyse the operation and use of n-channel enhancement mode MOSFETs and npn transistors in switching circuits, including those which interface to outputs. *Learners should understand that MOSFETs can be used with all output devices, whilst npn transistors are usually used for low power outputs, for example LEDs and lamps.* *Learners should be aware that the gate current of a MOSFET is negligible and can be assumed to be zero.* *To be able to* select and apply the MOSFET equation D M GS I g V = (3) *Understand that an enhancement mode MOSFET does not conduct until the gate threshold voltage (VGSth) is reached. In calculations VGSth is assumed to be 3 V.*	Weekly homework Past paper questions as starters Classwork Marked Peer and self-assessment End of unit tests for each chapter

		To be able to use the following rules for an npn transistor circuit: for VIN < 0.7 V, the transistor is off, VBE = VIN and VCE = the supply voltage for VIN ≥ 0.7 V, the transistor is on, VBE = 0.7 V and VCE = 0 V and select and apply C FE B I h I = until saturation is reached. *Learners should be able to calculate either the base resistor, VIN or base current from given data for the other two variables.* To be able to describe and analyse the operation and use of voltage comparator ICs. *The convention of connecting the inverting input to the reference voltage and the sensing subsystem to the non-inverting input will be used.* To be able to compare the action of switching circuits based on MOSFETs, npn transistors and voltage comparator ICs. *Learners should be aware that the comparator is the most sensitive to changes in the input signals, switches the fastest, but have limited output drive capability. MOSFETs are fast and can handle high currents, but dissipate high power when carrying high currents. A npn transistor should be operated in saturation.* To be able to use data sheets to design switching circuits using MOSFETs, npn transistors and comparators. *Learners should be able to select components based on their key characteristics from data sheets, e.g ID and gm for MOSFETs, hFE, and IC for npn transistors.* **Application of Diodes** To be able to describe the I-V characteristics of a silicon diode.	

		To be able to describe the use of diodes for component protection in DC circuits and half-wave rectification of AC circuits. *Learners should understand the use of the diode to protect devices from the reverse voltage caused by inductive loads, such as motors, relays and solenoids.* *Learners should be able to draw the output graph of a half wave rectifier for a sine wave input. Knowledge of smoothing and full wave rectification is not required.* To be able to describe the use of zener diodes in voltage regulation circuits. *Learners should be able to describe how a fixed DC voltage output can be obtained by using a zener diode in reverse bias as part of a voltage divider.* **Combinational Logic Systems** To be able to recognise 1/0 as two-state logic levels. To be able to identify and use NOT gates and 2-input AND, OR, NAND and NOR gates, singly and in combination. *Combinations of up to 5 gates could be presented.* To be able to produce a suitable truth table from a given system specification and for a given logic circuit. *Truth tables could contain up to 4 inputs.* To be able to use truth tables to analyse a system of gates. To be able to use Boolean algebra to represent the output of truth tables or logic gates and use the basic Boolean identities A.B A B = + and A B A.B	

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		Learners should be able to write down the Boolean expression for systems of up to 3 inputs where the output is a logic 1 for example $Q = A.B.\ C + A.\overline{B}.\ C$ No simplification is required. To be able to design processing systems consisting of logic gates to solve problems. To be able to simplify logic circuits using NAND gate redundancy. *Show how the following logic gates can be made up from NAND gates: NOT, 2 input AND, OR and NOR gates. Implement a given logic circuit using NAND gates. Remove double inversions.* To be able to analyse and design systems from a given truth table to solve a given problem. *Systems with up to 4 inputs should be expected.* To be able to use data sheets to select a logic IC for given applications and to identify pin connections. *Logic ICs will be taken from the CMOS 4000 series and could include pinout diagrams of logic gates with up to 4 inputs.*	
Year 10 **Term 3**	**Chapter 7: 10 Lessons** Timing circuits **Chapter 9: 6 Lessons** Interfacing analogue to digital **Revision and end of year test**	**Timing Circuits** To be able to describe how a RC network can produce a time delay. *Appreciate that a time delay circuit has to be buffered to be of practical use.* To be able to describe how the voltage across a charging or discharging capacitor in a RC circuit varies with time, including the interpretation of decay graphs for RC networks. *Explain in qualitative terms how a time delay may be changed.*	Weekly homework Past paper questions as starters Classwork Marked Peer and self-assessment End of unit tests for each chapter

		To be able to describe how the time delay may be changed by varying R and/or C, including interpretation of the voltagetime graph for monostable and astable timers. *Learners should be able to relate the effect of changing R and C with reference to appropriate formula.* To be able to describe the action of a 555 monostable timer and then use the equation T 1.1RC = , where T is the pulse duration. To be able to describe the action of a 555 astable timer in terms of period and mark-space ratio. To be able to use an oscilloscope, (or a computer configured as an oscilloscope) to measure the amplitude and period of the output of an astable timer. *Learners should be able to calculate amplitude and period from a trace shown on an oscilloscope screen when provided with the time/cm and volts/cm values.* To be able to select and apply equations for the frequency and mark-space ratio of a 555 astable timer 1 f T = frequency, period relationship ( ) 1 2 1.44 f R 2R C = + frequency of an astable ON 1 2 OFF 2 T R R T R + = mark/space ratio of an astable To be able to draw and analyse the circuit diagrams for a monostable and/or astable timer based on a 555 IC. *Learners should be able to draw the complete 555 monostable and/or astable circuit by adding components and connections to the schematic block diagram of a 555 timer.* ***Interfacing Digital to Analogue Circuits***	

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		To be able to describe the action of a Schmitt inverter and its use in debouncing signals produced by mechanical switches and analogue sensors. *Learners should understand that mechanical switches and analogue sensors can produce multiple triggers, or slow changing signals respectively that cause errors at the input to digital systems.* To be able to compare the properties of transistors, comparators and Schmitt inverters as interfaces between analogue and digital systems. To be able to design interface circuits using npn transistors, MOSFETs and comparators to interface input sensors to outputs. *Learners should consider switching speed, output current capability, and response time of input sensors before selecting the most appropriate interface device. Designs could involve circuit calculations.* **Revision** To manage time more effectively when revising and in end of year assessment.	
Year 11 **Term 1**	**Chapter 8: 10 Periods** Sequential Systems **Chapter 10: 8 Lessons** Micro Controllers **Chapter 11: 16 Lessons** Operational Amplifiers	**Sequential Systems** To be able to draw the circuit diagram and describe the action of risingedge-triggered D-type flip-flops used in data transfer, latches, 1- bit and 2-bit binary upcounters. *Learners should be able to draw these circuits without being given the outline of a D-type flip-flop.* To be able to complete timing diagrams for D-type flip-flops used in data transfer, latches, 1-bit and 2-bit binary up-counters.	Weekly homework Past paper questions as starters Classwork Marked Peer and self-assessment End of unit tests for each chapter

	Unit 12: 36 Lessons NEA	*Learners may be asked to complete graphs of Q and $\bar{Q}$.* To be able to complete a truth table to show the signals needed to display a given character on a common cathode 7-segment display. *Characters will include numbers and certain letters for example A, C, E, F, H, I, L, O, P, S, U, b,d,h,n.* To be able to describe the action of and draw timing diagrams for dedicated binary and BCD counters. *To understand the need for BCD counters to reduce the need for additional logic circuitry to reset binary counters for use with BCD counters.* To be able recognise and analyse the block diagram and timing diagrams for a single digit decimal counting system consisting of: 4-bit BCD counter, decoder/driver and 7-segment display. *Realise that decoders are available integrated with BCD counters in a single IC or separately.* To be able to design and analyse systems using counters (which reset at a given value) and combinational logic to produce a given sequence. *Use of logic gates to reset at a given count.* *To be able to d*esign a sequencer using a 4017 decade counter and draw timing diagrams. *Realise that the reset pin can be used to change the sequence length. Designs could include logic gates.* **Micro Controllers - ?**	

		Operational Amplifiers To be able to state that amplifiers increase the power or voltage of signals and select and apply the equation OUT IN. *Learners should be able to apply this formula to a schematic diagram as shown below: The input and output signal may be provided in graph form. Learners might be required to complete graphs from information provided.* To be able to draw a gain-frequency graph for an amplifier, measure the bandwidth from the graph and describe the trade-off between gain and bandwidth. *Learners will need to understand the gain-bandwidth product for a given amplifier, and that bandwidth is measured to the point of 70% of maximum gain.* To produce and interpret voltage-time graphs for the input and output signals of amplifiers. *Learners to be able to know that input signals could be sine waves, square waves or triangular waves.* To be able to draw and analyse circuits for non-inverting and inverting amplifiers based upon an op-amp. To be able to show graphically and explain how clipping distortion may affect the output signal of an amplifier. *Learners to be able to recognise clipping distortion, and describe how it can be reduced by increasing the supply voltage, reducing the gain or reducing input amplitude.* To be able to select and apply the equations F 1 R G 1 R = + and F IN R G R = – for op-amp circuits to select resistors to produce a given gain.	

		Learners are expected to select resistors equal or greater than 1 kΩ. To be able to draw and analyse circuits for mixers based on a summing op-amp circuit and select and apply the equation for output voltage 1 2 OUT F 1 2 V V V R .... R R = − + + ⎛ ⎞⎜ ⎟ ⎝ ⎠ summing amplifier output voltage. *Analysis of mixers with up to four inputs can be expected.* To be able to draw a block diagram of a typical amplifier system consisting of signal source, preamplifier, mixer, power amplifier and loudspeaker. *A minimum of two input signal sources will need to be shown.*	
Year 11 **Term 2**	**Unit 12: 36 Lessons** NEA	NEA The NEA is an integral part of the WJEC Eduqas GCSE in Electronics and contributes 20% to the final assessment. This component requires each learner to produce a single extended system design and realisation task independently. The task builds on the systems developed throughout the specification and the requirement to relate practical circuit design and construction to knowledge and understanding within Components 1 and 2. Task The task enables learners to carry out a design and realisation task based on an individually identified problem, context or opportunity. This will be researched and analysed by the learner to develop their own specification to clearly guide their system development. *Learners will develop their system from a series of sub-systems which will be tested individually before assembly and testing as a complete system. Learners must evaluate the performance of*	Past paper questions as starters Weekly homework – NEA pages Peer and self-assessment of NEA progress End of project assessment (NEA)

		their developed system against their specification and suggest improvements that could be made. The learner should fully document the development of the task in a report. It is the evidence contained within this report and the system produced upon which the NEA will be marked and assessed. The report should provide evidence for the following sections: • System planning – including analysis of the problem and a design specification. • System development – including the development of the system in terms of sub- systems, annotated circuit diagrams and description of testing each sub-system and the recording of results 20. • 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. • be presented in a logical order that is clear to read and understand. • contain an acknowledgement of all sources of information and help. • include photographs of the complete physical system.	
Year 11 **Term 3**	Revision Exam Leave	**Revision** To manage time more effectively when revising and in examinations.	Work through past papers and revision materials.