Teacher Resource Bank

GCE Electronics
Coursework Guidance

COURSEWORK OVERVIEW

The process associated with the design, realisation and evaluation of an electronic system to solve a problem is fundamental to any qualification in Electronics. It is only by considering the application of Electronic systems in this way a candidate will be able to appreciate the relevance of both the beneficial and detrimental effects of Electronics within present society.

For many candidates, their work at AS Level will be their first encounter with Electronic systems and so their choice of project for their coursework should reflect this lack of experience. The coursework undertaken by the candidates will be to design, construct and assess an Electronic system to solve a problem. This work is expected to be carried out alongside the candidates' theoretical studies and the expected outcome is a working Electronic system and a written report detailing the work undertaken and an assessment of the success of the work in solving the initial problem.

There should be sufficient detail within the report to enable someone else to carry out the same work and know what to expect in terms of the system's function and performance. It is expected that the problem identified would normally be solved with the Electronic subsystems covered in the AS Level specification.

The AS coursework undertaken for Unit 3 should be such that it can be completed in 30 hours (with a suggestion of 20 hours laboratory/workshop time and 10 hours private study) and must contain at least 3 active devices. Candidates should be encouraged to select problems to solve in which they are interested, and which are considered achievable by their supervisor.

Supervisors must also ensure that the work undertaken is the candidate's, and is of an appropriate standard for AS Level and not largely software based.

Those candidates continuing to A2 Level will have gained significant experience from their successful AS Level course and so the choice of the A2 coursework should be commensurate with this as well as providing opportunities to revisit some of the skills gained during the AS Level work. The coursework undertaken by the candidates will be to design, construct and assess, an Electronic system to solve a problem. The problems identified will be focussed on the theoretical work of the A2 course, i.e. programmable control systems or communication systems. Candidates will also be required to provide a full evaluation of their system.

The A2 Level coursework undertaken for Unit 6 should be such that it can be completed in 30 hours (suggestion of 20 hours laboratory/workshop time and 10 hours private study) and must contain at least 3 active devices. Candidates should be encouraged to select a problem to solve, in which they are interested, and which is considered achievable, by their supervisor.

Supervisors must also ensure that the work undertaken is that of the candidate and is of an appropriate standard for an A2 Level Electronics course, and not largely software based.

At both AS and A2 Levels, the role of the supervisor is considered crucial. It is the supervisor's task to ensure that appropriate project work is undertaken by the candidate and to provide the candidate with appropriate guidance. The supervisor should also provide additional guidance and assistance if requested, but this must be taken into account when the work is assessed. The attention of candidates and supervisors is drawn to the distinction between Guidance and Assistance given to candidates.

Guidance

- Advice given to the candidate by the supervisor but where the supervisor does not become involved in doing the work
- All candidates are entitled to guidance from their supervisor.

Assistance

- Help given to the candidate by the supervisor where the supervisor becomes involved in doing the work, ie fault finding.

It should be noted that there are no marking criteria which relate to the complexity of the Electronic systems produced. Candidates are required to use a minimum of 3 active devices and will be penalised within section B if they fail to comply. Additional complexity should be used where necessary to complete the Electronic system and maintain the motivation of the candidate. However, it is essential that the candidate has a realistic prospect of achieving a working system.

Physical hardware must be produced by the candidate for the coursework. If there is no hardware then a mark of 0 must be awarded, even if the system has been computer modelled. The absolute minimum requirement for a report is a signed cover sheet and a clear photograph of the hardware and these must be included with all submitted reports.

Supervisors must annotate their candidates' scripts to show the location of the evidence for the marking criteria. It is expected that annotation will take the form of the code letters for the marking point together with the mark, ie Ab1, Db2, etc. Examples and guidance of marking and annotation will be given in standardisation meetings.

AS Coursework ELEC3 - Practical System Development

For many AS Level candidates, the coursework module will be their first attempt at developing a complete Electronics system. Candidates should be:

- Encouraged to use the subsystems covered within modules ELEC1 and ELEC2, rather than utilise more complex subsystems

- Required to select a problem to be solved using Electronics from their surrounding world and experience, and should undertake appropriate research so that a list of performance parameters (specification) can be given.

It is expected that the system specification will contain realistic numerical values to provide a focus for the work and its final assessment. Candidates are expected to consider alternatives and give reasons for selecting their chosen solution.

The overall system should be developed as subsystems which should be tested and assessed in isolation before being incorporated into the complete system. This will ensure that the complete system grows by gradual and increments, having been tested at each stage of its development.

Candidates will be expected to develop their coursework systems on protoboard and may use computer simulations. The systems should be left in protoboard form; there is no requirement for candidates to transfer their work to strip board or printed circuit board. For all modes of circuit assembly, the layout and mounting of components and wiring should be neat and logical, in order to assist in the design, testing and fault finding processes.

Candidates will be expected to undertake Risk Assessments during their coursework in order to ensure the safety of themselves, associated workers, the components and test equipment.

When the system is completed, a plan for testing the whole system should be drawn up prior to any testing of the system. Full testing should take place:

- Only for the conditions likely to be encountered in normal operation
- Not to include testing to destruction
- To cover the important operating parameters of the system as detailed in the specification
- Without the need to measure and record every possible voltage or current
- To include full documentation with results shown in tables and graphs
- To enable the candidate to assess the system and identify faults and limitations
- To allow the candidate to modify the final system to correct for any limitations and then re-assess its final performance.

During the course of the project work, candidates are expected to keep a record of consultations with their supervisor. This can be used to provide supplementary evidence for the award of marks. A copy of the Record of Supervision form is provided in the subject specification and this document.

The candidates are expected to fully document the development of the coursework project in a report. It should be remembered that it is the evidence contained in the report upon which the coursework is marked and assessed. You are asked to note that the report should:

- Be written at the same time as the project is being carried out, ie not be left until all of the practical work is complete
- Provide sufficient evidence to support the award of marks
- Contain clear photographic evidence
- Enable someone else to carry out the same work and to know what to expect in terms of the system's function and performance
- Be presented in a logical order that is easy to read and understand
- Be free from repetition and contain an acknowledgement of all sources of information and help
- Supervisors must annotate reports to justify the award of marks.

This last point can be most easily achieved by noting in the margin of the coursework report at the place where the evidence is to be found the code corresponding to the criterion; ie Ac, Dc etc. There are 2 marks available for each marking point, and the supervisor should allocate a mark of 0, 1 or 2 depending upon how far the candidate has succeeded in satisfying the marking criteria. The mark should be added to the annotation on the report ie Ac1, Dc2 etc.

The assessment scheme for the coursework is criterion-referenced and so it would be acceptable for all the candidates in a centre to gain high marks. Supervisors should note that coursework should be such that access to all of the marks for all of the skills should be available to all of the candidates.

A2 Coursework ELEC6 - Practical System Synthesis

While the process for the work for the A2 Level coursework is similar to that for the AS Level coursework, the additional experience of the candidates for A2 Level means that the assessment of the work can focus on higher Level skills than could be expected from AS Level candidates. Those assessment skills which do overlap provide synopticity.

Candidates must select problems to be solved by Electronic systems which focus on the use of either microprocessor control or communication systems, ie the materials of ELE4 and ELE5. The resulting Electronic systems should be of a standard appropriate for A2 Level coursework. It is appreciated that many systems will contain embedded software, and if so, candidates are required to give a full annotated listing of any software they develop. However, they should bear in mind that the software only needs to be sufficient to enable the functionality of the Electronic system.

Summary of the Higher Level Skills Required From A2 Level Candidates

Section	Skills
A	Able to give a detailed description of the requirements of their system so more emphasis is placed on the performance parameters which are specified and the justification for the values selected.
B	Experienced in constructing circuits and calculating component values. However, the interfacing of subsystems, particularly those involving complex ICs and modules, is important for assessment
C	Able to measure the system performance in terms of the system parameters, and so emphasis is placed on the accuracy of these measurements both in terms of the suitability of the measuring instruments used and their calibrated accuracy
D	Competent in providing a report containing clear photographic evidence and a complete circuit diagram.

It is appropriate to concentrate on the evaluation of the final performance figures for the Electronic system with the performance parameters in the specification. Differences need to be justified as part of the evaluation. However, evaluation can only take place for a system that has been fully specified and it is only possible to know if the performance matches the initial specification if comprehensive testing and measurements have been made.

The report provides opportunity for the assessment of the Quality of Written Communication (QWC). This is undertaken within the 2 marking criteria relating to the description of how the whole system works, A2Bd, in which strand (ii) is assessed and A2Dc, the report itself, in which strands (i) and (iii) are assessed.

AS Electronics Coursework Guidance

Electronics coursework needs to be set in the context of solving a problem using an Electronic system, rather than simply identifying a system that you are going to construct.

The problem to be solved should be focussed on the content of the AS modules ELEC1 and ELEC2.

You should be able to complete the whole coursework within 30 hours.
The coursework must be individual - group activities are not permitted.
Having identified the problem to be solved, this then forms the aim for your coursework. The list below gives suggestions of suitable problems to be solved at AS Level. It is not exhaustive. The key to all good Electronics coursework is a clear and detailed specification. All solutions must contain at least 3 active devices.

Vehicle

- Alert a car driver when the road surface temperature falls below 0°C
- Switch on the side lights of a car when darkness falls
- Sound an alarm when someone attempts to break into a vehicle
- Remind the driver that the headlights have been left switched on
- Alert the driver that a passenger is not wearing a seat belt
- Display the speed of the engine in a car or motorcycle
- Replace the mechanical flasher unit in older cars.

Bicycle

- Sound an alarm when someone attempts to steal a bicycle
- Display the speed of a bicycle.

Home Security

- Switch on an electric lamp when darkness falls
- Switch on the front porch light of a house when someone approaches the front door
- Alert the occupier that there is someone at the front door
- Alert a person who is hard of hearing that there is someone at the front door
- Alert the occupiers that there is smoke in the home
- Alert the occupier that there is fire in the home
- Alert the occupier that there is an intruder
- Protect a property against intruders
- Sound an alarm when someone attempts to steal a pram.

Domestic

- Alert a cook when food has been cooked for a certain length of time
- Display the length of time that food has been cooking
- Maintain the temperature of the water in a tropical fish tank
- Dispense food for animals
- Maintain the temperature of hair straighteners.

Entertainment

- Amplify the output from a portable CD/MP3/minidisk etc player to operate a loudspeaker
- Generate random numbers for playing board games
- Identify which contestant in a quiz first knows the answer to a question
- Increase the Level of bass in an audio signal
- Count the number of laps model racing cars have made around a race circuit
- Keep score for a cricket match.

Music

- Generate musical rhythms
- Increase the strength of the output signal from an electric guitar to operate a loudspeaker
- Combine several audio electronic signals
- Help a musician keep in time
- Help a musician tune a guitar.

Test Equipment problems

- Determine the state of charge of a battery
- Charge a rechargeable battery
- Produce a loud, warning sound
- Give a visual display of the output power of an audio amplifier
- Measure the value of unmarked capacitors
- Measure light intensity
- Measure temperature
- Determine whether there are any live mains cables embedded in a wall
- Measure the pH of a solution
- Measure reaction times
- Display the logic state of a point in a digital circuit.

Gardening

- Deter snails and slugs from eating garden plants
- Alert a gardener when the temperature falls below 0°C
- Detect the presence of bats
- Control the temperature of a greenhouse
- Automatically water plants
- Display the maximum and minimum temperature
- Deter animals from the garden.

Medical

- Monitor the heartbeat of a person
- Monitor the temperature of a person
- Sound an alarm when a baby stops breathing.

Commentary on the AS Marking Criteria

Aa

Candidates should select the problem to solve independently, from their own sphere of reference. A paragraph giving a clear description of the problem is expected at the beginning of the report.

Marks	Guidance
0	The supervisor has to help the candidate choose a problem to solve and the candidate provides an inadequate description
1	The candidate makes an independent choice but gives an inadequate description or receives assistance with the choice but gives a clear description
2	The candidate makes an independent choice and provides an adequate description.

Ab

Having identified the problem, the candidate should carry out research to gain an insight into what products/systems are available to aid the solution of the problem. These can include books, notes, catalogues, websites etc. Full details - pages, URLs etc of the sources must be given both at this point within the report and also in summary in a bibliography at the end of the report. Details of the information gained from the sources must also be given in the report. It is expected that the candidate will consult a minimum of 2 sources.

Marks	Guidance
0	There is inadequate evidence that research has been made from 2 separate named sources
1	There is inadequate evidence documented or when inadequate details are given of the 2 named sources
2	Well documented information from at least 2 separate sources whose full details are recorded.

Ac

As part of their research, candidates are expected to undertake a minimum of 2 practical investigations (nb not CAD generated) into factors relevant to the problem. For example, many candidates will have no experience of the required loudness or frequency for an alarm, and so a signal generator, amplifier, speaker and sound level meter would enable experiments to be undertaken to determine these parameters. Details of these investigations should be documented within the report. Candidates who are unable to identify any practical investigations should consult their supervisor, who may then contact the Coursework Advisor for the centre.

Marks	Guidance
0	There is inadequate evidence that 2 practical investigations have been conducted
1	There is well documented evidence for one practical investigation or when inadequate details are given of the 2 practical investigations
2	Well documented information from at least 2 practical investigations.

Ad

With the research completed, the candidate is now able to provide a full qualitative description of the system to be built. At AS Level, this description is not final and the candidate may well need to modify some of the initial ideas in order to achieve a working solution to the problem.

Marks	Guidance
0	An inadequate description
1	A description of the intended system which lacks detail
2	A detailed description of the intended system.

Ae

With the intended system described, the candidate is now able to provide a quantitative description using at least 3 numerical and realistic parameters for the specification of the system. It is expected that one of these will be the range of supply voltages from which the system will operate. At AS Level, this specification is not final and the candidate may well need to modify some of the initial ideas in order to achieve a working solution to the problem.

Marks	Guidance
0	An inadequate specification containing less than 2 parameters
1	A specification, where inadequate details are given OR when only 2 parameters are specified in detail
2	A detailed specification containing at least 3 numerical and realistic parameters

Af

With the system described and specified, the candidate will now be identifying subsystems with which to construct the complete system. Since there is usually more than one way to achieve a given outcome within Electronics, the candidate will be faced with making decisions about alternative solutions. This can be at system, subsystem or component Level. The candidate is required to give details of one of these decisions, clearly stating the advantages and disadvantages for at least 2 alternatives.

Marks	Guidance
0	Inadequate details given of alternative solutions
1	A description, where the advantages and disadvantages of the alternatives are not fully given
2	A detailed description of the advantages and disadvantages of at least 2 alternatives.

Ag

Having made a decision on the alternatives, the candidate must give details justifying their decisions, including cost, availability as well as functionality, but should not include inadequate knowledge, since it is up to the candidate to gain sufficient knowledge if a particular alternative is included in the choice.

Marks	Guidance
0	Inadequate details given for the choice
1	A weak justification for the choice made
2	A detailed justification for the choice made.

It is expected that the candidate will produce a report, in draft form, up to this point before any construction work is undertaken.

Ba

The candidate starts the construction of the subsystems on prototyping boards and produces the circuit details of at least one of these subsystems with minimal guidance.

Candidates who use fewer than 3 active devices are not eligible for these marks.

Marks	Guidance
0	No significant details of a subsystem or fewer than 3 active devices within the whole system
1	Incomplete details of any subsystem
2	Full details of at least one subsystem.

Bb

Candidates are required to demonstrate that they can calculate component values for the subsystems that they construct. It is expected that full details of how the candidate arrived at the component value will be given.

Candidates who use fewer than 3 active devices are not eligible for these marks.

Marks	Guidance
0	Inadequate details of how the component value was determined or fewer than 3 active devices within the whole system
1	Incomplete details of how any component value was determined or a calculation justifying a component choice
2	Full details of how at least one component value was determined.

Bc

With a subsystem constructed, the candidate needs to test the subsystem by making and recording at least 2 measurements.

Candidates who use fewer than 3 active devices are not eligible for these marks.

Marks	Guidance
0	No significant details of any subsystem measurements or fewer than 3 active devices within the whole system
1	Incomplete details of any subsystem measurements
2	Full details of at least 2 subsystem measurements.

Bd

With all of the subsystems planned, the candidate gives a full and detailed description of how the whole system works. This may be a suitable place for the candidate to include a full circuit diagram with component values and types.

Marks	Guidance
0	Inadequate details of how the system works and/or there is little evidence of any form to the writing
1	Incomplete details of how the system works and/or the form of writing is inappropriate
2	Full details of how the system works and the form and style of writing is appropriate.

Be

To gain these marks, candidates will demonstrate that they can produce well organised circuit board layouts from circuit diagrams, where inputs and outputs are well separated, power supply rails are clearly identified etc, with minimal guidance. It is the process that gains the marks. Suitable evidence can be in the form of labelled drawings or photographs. Neatly produced and well documented layouts are often the key to successful fault finding.

Marks	Guidance
0	A disorganised layout even with guidance
1	A disorganised layout achieved with minimal guidance or a well organised layout with guidance
2	A well organised layout achieved with minimal guidance.

Bf

It is essential that all of the practical work undertaken is carried out safely. Candidates are expected to undertake an assessment of the likely risks (to themselves, their associated workers, test equipment and components) while constructing and making their system function.

Marks	Guidance
0	An inadequate risk assessment and less than 2 subsystems constructed
1	An inadequate risk assessment but at least 2 subs-systems constructed, or an adequate risk assessment and less than 2 subs-systems constructed
2	An adequate risk assessment and at least 2 subs-systems constructed.

Bg

Even though the circuit board layout may be well organised, if the construction is sloppy and contains long curling wires, then fault finding can be hindered. Candidates are expected to take care when constructing their circuits, with wires and connections being organised and neatly made.

Marks	Guidance
0	A system with unnecessarily long wires covering components so making any modifications difficult
1	A system which has been constructed without sufficient care - some wires too long and components not always secured to the circuit board
2	A neatly constructed and carefully organised system.

Bh

It is important that the systems constructed by candidates actually work. The marks for this criteria and that of Bi emphasise this.

Marks	Guidance
0	Little of the system works (one or less subsystems) despite significant supervisor assistance
1	A system in which 2 or more of the system works with or without some supervisor assistance.
2	A system in which most, if not all of the system functions to some extent, with or without significant supervisor guidance.

Bi

These marks reward those candidates who largely work independently and produce fully working systems with minimal guidance. The Candidate Record of Supervision will be important evidence for the award of these marks.

Marks	Guidance
0	A system in which most, if not all of the system functions to some extent, with or without significant supervisor guidance
1	A system which has some minor faults but the candidate received only minimal guidance or when the system fully works and the candidate received some guidance
2	A system which fully works and the candidate received only minimal guidance.

Ca

In order to ensure that the time candidates spend testing their systems is productive, they are required to devise a test procedure prior to making any measurements. They are expected to identify the measurements that they will make and the equipment that they are expecting to use for making those measurements. It is expected that many candidates will produce tables into which they can write their measurements. Candidates are expected to concentrate on those measurements which directly determine the performance of the system. Planning to measure every conceivable voltage and current within the system is time-wasting and will not be rewarded.

Marks	Guidance
0	There is little or no evidence of any planning prior to testing
1	There is some evidence of planning of the testing procedures and some of the relevant equipment has been identified
2	There is clear evidence of detailed planning of the testing procedures and the relevant equipment has been identified.

Cb

For these marks to be gained, the complete system must function to some extent. Candidates gaining these marks will have made and recorded some measurements on the performance of their system.

Marks	Guidance
0	There is little or no evidence of any testing
1	Measurements made and recorded are trivial or incomplete
2	Basic numerical measurements have been made and carefully recorded.

Cc

For these marks to be gained the complete system must function to some extent. Candidates gaining these marks will have made and recorded measurements on all of the parameters affecting the performance of their system.

Marks	Guidance
0	There is little or no evidence of any anything other than basic testing
1	Most relevant numerical measurements on the system parameters have been made and recorded
2	All relevant numerical measurements on the system parameters have been made and carefully recorded.

Cd

For these marks to be gained the complete system must function to some extent. With the performance of the system now measured, the candidate can assess how far the system meets the original objectives in solving the specific problem. Although this may be guided by the parameters originally derived for the system, it is more important that the system is fit for purpose and solves the original problem. It is difficult to justify the award of a mark greater than 1 if no marks are awarded for Cb or Cc.

Marks	Guidance
0	There is little or no evidence of any assessment of the performance of the complete system
1	An assessment is made but little reference is made to the measurements made of the system parameters
2	A detailed assessment is made of the final system and reference is made to the measurement of the system parameters.

Ce

For these marks to be gained, the complete system must function to some extent. Having assessed the performance of the system, the candidate is now able to identify any limitations in the performance of the system in being able to solve the problem, and also to suggest modifications to the system in order to overcome these. If there are no limitations then the candidate may claim both of these marks so long as full marks have been awarded for Ae, Cb and Cc. Limitations which will not gain credit include: the system does not work, the system needs an on/off switch, etc.

Marks	Guidance
0	There is little or no evidence of any attempt to identify limitations in the performance of the complete system
1	Limitations are identified but no suggestions are made as to how to overcome these limitations
2	Limitations are identified along with suggestions of how to overcome them or there are no limitations of the system and full marks have been gained for Ae, Cb and Cc.

Cf

For these marks to be gained the complete system must function to some extent. The candidate is now able to carry out the modifications and then re-assess the system, repeating measurements where necessary.

Marks	Guidance
0	When there is little or no evidence of any modification of the complete system to enhance its performance
1	When modifications are made, but a re-assessment is not made
2	When modifications and a detailed re-assessment are made of the final system or there are no limitations and full marks have been gained for Ae, Cb, Cc and Ce.

Da

It is expected that the documentation of the work undertaken by the candidate will be in the form of a carefully written, illustrated report. The report should be complete, succinct and free from repetition, and contain sufficient detail so that somebody could repeat the work of the candidate and obtain exactly the same results/outcome.

Marks	Guidance
0	Significant details are omitted from the report and/or the meaning of the report is unclear
1	The report has small omissions, and/or is not succinct, and/or has inaccurate spelling, punctuation and grammar
2	The report is coherent, complete, succinct with accurate spelling, punctuation and grammar.

Db

It is essential that the report contains a complete circuit diagram and clear photographic evidence of the system.

Marks	Guidance
0	No clear photographic evidence is supplied
1	The report contains clear photographic evidence, but does not have a complete circuit diagram
2	The report contains clear photographic evidence and a complete circuit diagram.

Dc

The candidate is expected to produce a summary of all sources of information and help received during this work. This should include:

- People - staff, students, parents, relations etc
- Books - magazines, text books, notes, catalogues, CDs etc. Full details should be given
- Websites/URLs etc - Please note, search engines do not count as a source of information.

Marks	Guidance
0	There is a minimal attempt to give a summary of sources of information and help received
1	There are some details of the sources of information and help but it is incomplete, ie page numbers omitted etc
2	There is a detailed and complete summary of sources of information and help received.

A PROBLEM ANALYSIS AND SOLUTION DESIGN			**0 1 2**
The candidate	a	clearly defined the problem to be solved with minimal guidance	
	b	carried out relevant research from at least 2 named sources	
	c	carried out practical investigations into at least 2 relevant factors	
	d	gave a detailed description of the requirements of the system	
	e	specified at least 3 numerical and realistic parameters	
	f	considered 2 or more alternative solutions	
	g	justified the choice of solution from the others considered	
B SYSTEM DEVELOPMENT			
The candidate	a	devised circuit details of at least one subsystem with minimal guidance	
Ba, Bb and Bc must not to be awarded if less than 3 active devices used	b	correctly calculated a component value for a subsystem	
	c	assessed the performance at least one subsystem, using measurements	
	d	explained in detail how the whole system works (QWCii)	
	e	converted circuit diagrams into a well organised circuit board layout with minimal guidance	
	f	safely constructed 2 or more subsystems of the complete electronic system	
	g	produced a neatly constructed electronic system	
	h	made most of the system function	
	i	made all of the system function with minimal guidance	
C MAKING MEASUREMENTS			
The candidate	a	devised a test procedure for the complete system prior to making any system measurements	
2 marks must be gained for Cb before any are awarded for Cc	b	made and recorded basic numerical measurements on the complete system parameters	
	c	made and recorded detailed numerical measurements on the complete system parameters	
	d	assessed the working parts of the complete system and referred to the measurements made	
	e	identified some limitations in the performance of the complete system and suggested modifications to overcome these limitations	
	f	carried out the modifications and re-assessed the system	
D REPORT			
The report	a	details all stages of the development of the project (QWC i and iii)	
	b	contains clear photographic evidence and a complete circuit diagram	
	c	contains an acknowledgement of all sources of information and help, including a bibliography	
		Centre Mark Total	
		Moderator Mark Total	

Candidate: …… Number: ……

Unit 3 – Summary of marks

The report must contain clear photographic evidence, a completed cover sheet and a Record of Supervision.

If no system hardware exists then the final mark is 0.

A2 Electronics Coursework Guidance

Electronics coursework needs to be set in the context of solving a problem using an electronic system, rather than simply identifying a system that you are going to construct.

The problem to be solved should be focussed on the content of the A2 modules ELEC4 and ELEC5. You should be able to complete the whole coursework within 30 hours. The coursework must be individual - group activities are not permitted. Having identified the problem to be solved, this then forms the aim for your coursework.

The list below gives suggestions of suitable problems to be solved at A2 Level, it is not exhaustive. The key to all good Electronics coursework is a clear and detailed specification. All solutions must contain at least 3 active devices.

Communication

- Send data over an infrared link
- Send data over an optical fibre link
- Send data over a serial cable link
- Convert serial digital signals to parallel digital signals
- Convert parallel digital signals to serial digital signals
- Display information on a large display board
- Measure the signal strength transmitted by a mobile phone
- Receive AM radio transmissions
- Receive FM radio transmissions.

Measurement

- Measure and record (using a microcomputer) environmental conditions
- Accurately measure the value of an inductor
- Accurately measure the value of a capacitor
- Analyse the logic state of several digital signals
- Display graphically the frequencies present within an audio signal
- Digitally store waveforms for display on an oscilloscope
- Measure the distortion introduced by an amplifier
- Measure the impedance of a loudspeaker system
- Measure and record (using a microcomputer) rapidly changing signals
- Measure and record (using a microcomputer) very slowly changing signals.

Music

- Control MIDI instruments
- Generate musical rhythms using a microcomputer
- Generate musical sound effects by delaying an audio signal.

Home security

- Monitor (using a microcomputer) a property for the detection of intruders
- Monitor (using a microcomputer) a property for the detection of fires.

Control

- Enable a microcomputer to control devices via a parallel connection
- Enable a computer to control devices via a serial connection
- Program a microcomputer
- Read and write to Smart / Flash cards
- Control a stepper motor
- Control a servo motor
- Provide a microcomputer controlled variable output voltage for powering other electronic devices.

Commentary on the A2 Marking Criteria

Candidates continuing to A2 will have gained significant experience from their AS Level work and so the demands of the A2 coursework are commensurate with this as well as providing opportunities to revisit some of the skills gained during the AS Level work.

Aa

Candidates should independently select the problem to solve from their own sphere of reference. A paragraph giving a clear description of the problem is expected at the beginning of the report.

Marks	Guidance
0	The supervisor has to help the candidate choose a problem to solve and the candidate provides an inadequate description
1	The candidate makes an independent choice but gives an inadequate description or receives assistance with the choice but gives a clear description
2	The candidate makes an independent choice and provides an adequate description.

Ab

Having identified the problem, the candidate should carry out research to gain an insight into what products/systems are available to aid the solution of the problem. This can be from books, notes, catalogues, websites etc. Full details - pages, URLs etc of the sources must be given both at this point within the report and also in summary in a bibliography at the end of the report. Details of the information gained from the sources must also be given in the report. It is expected that the candidate will consult a minimum of 2 sources.

Marks	Guidance
0	There is inadequate evidence that research has been made from 2 separate named sources
1	There is inadequate evidence documented or when inadequate details are given of the 2 named sources
2	Well documented information from at least 2 separate sources whose full details are recorded.

Ac

As part of their research, candidates are expected to undertake a minimum of 2 practical investigations (not CAD generated) into factors relevant to the problem. For example, many candidates will have no experience of the required loudness or frequency for an alarm, and so a signal generator, amplifier, speaker and sound level meter would enable experiments to be undertaken to determine these parameters. Details of these investigations should be documented within the report. Candidates who are unable to identify any practical investigations should consult their supervisor, who may then contact their Coursework Advisor for the centre.

Marks	Guidance
0	There is inadequate evidence that 2 practical investigations have been made
1	There is well documented evidence for one practical investigation or when inadequate details are given of the 2 practical investigations
2	There is well documented information from at least 2 practical investigations.

There is well documented information from at least 2 practical investigations.

Ad

It is expected that candidates at A2 Level will provide a detailed description of the requirements of their system and so greater emphasis is placed on the numerical parameters for the system. The candidate must provide at least 3 numerical and realistic parameters for the specification of the system. It is expected that one of these will be the range of supply voltages from which the system will operate. At A2 Level, this specification will be compared with the final performance parameters and so it is important that these are as appropriate as possible.

Marks	Guidance
0	An inadequate specification containing less than 2 parameters
1	A specification, where inadequate details are given or when only 2 parameters are specified in detail
2	A detailed specification containing at least 3 numerical and realistic parameters.

Ae

The candidate will have given consideration to the values for the parameters for the complete system and is expected to present the evidence for these decisions within the report.

Marks	Guidance
0	There is little or no attempt made to justify the specification parameters
1	There is some justification for at least 2 of the specification parameters
2	A detailed justification of at least 3 of the parameters specified.

Af

With the system described and specified, the candidate must now identify subsystems with which to construct the complete system. Since there is usually more than one way to achieve a given outcome within Electronics, the candidate will be faced with making decisions about alternative solutions. This can be at system, subsystem or component Level. The candidate is required to give details of one of these decisions, clearly stating the advantages and disadvantages for at least 2 alternatives.

Marks	Guidance
0	Inadequate details given of alternative solutions
1	A description of 2 alternate solutions, where the advantages and disadvantages are not fully given
2	A detailed description of the advantages and disadvantages of at least 2 alternatives.

Ag

Having made a decision on the alternatives, the candidate must give details justifying the decision made. This can include cost, availability as well as functionality, but should not include inadequate knowledge, since it is up to the candidate to gain sufficient knowledge if a particular alternative is included in the choice.

Marks	Guidance
0	Inadequate details given for the choice
1	A weak justification for the choice made
2	A detailed justification for the choice made

It is expected that the candidate will produce a report, in draft form, up to this point before any construction work is undertaken.

Ba

The candidate starts the construction of the subsystems on protoboard and produces the circuit details of at least one of these subsystems with minimal guidance.

Candidates who use fewer than 3 active devices are not eligible for these marks.

Marks	Guidance
0	No significant details of a subsystem OR fewer than 3 active devices within the whole system
1	Incomplete details of one subsystem
2	Full details of any subsystem.

Bb

With a subsystem constructed, the candidate needs to test the subsystem by making and recording at least 2 measurements.

Candidates who use fewer than 3 active devices are not eligible for these marks.

Marks	Guidance
0	No significant details of any subsystem measurements or fewer than 3 active devices within the whole system
1	Incomplete details of any subsystem measurements
2	Full details of at least 2 subsystem measurements.

Bc

Once several subsystems have been constructed, the candidate needs to connect these together to form a system. There can be issues associated with impedance matching etc which can cause problems. It is expected that the candidate will describe an interfacing issue and how it was solved.

Candidates who use fewer than 3 active devices are not eligible for these marks.

Marks	Guidance
0	Inadequate details of any interfacing issues
1	Incomplete details of an interfacing issue and how it was solved
2	Full details of an interfacing issue and how it was solved.

Bd

With all of the subsystems planned, the candidate gives a full and detailed description of how the whole system works. It is for the candidate to select and use a form and style of writing appropriate for the system being described. This may be a suitable place for the candidate to include a full circuit diagram with component values and types.

Marks	Guidance
0	Inadequate details of how the system works and/or there is little evidence of any form or style to the writing
1	Incomplete details of how the system works and/or the form and style of writing is inappropriate
2	Full details of how the system works and the form and style of writing is appropriate.

Be

To gain these marks, candidates will demonstrate that they can produce well organised circuit board layouts from circuit diagrams, where inputs and outputs are well separated, power supply rails are clearly identified etc, with minimal guidance. It is the process that gains the marks. Suitable evidence can be in the form of labelled drawings or labelled photographs. Neatly produced and well-documented layouts are often the key to successful fault finding.

Marks	Guidance
0	A disorganised layout even with guidance
1	A disorganised layout achieved with minimal guidance or a well organised layout with guidance
2	A well organised layout achieved with minimal guidance.

Bf

It is essential that all of the practical work undertaken is carried out safely. Candidates are expected to undertake an assessment of the likely risks to themselves, their colleagues, equipment and components, while constructing and making their system function.

Marks	Guidance
0	An inadequate risk assessment and less than 2 subsystems constructed
1	An inadequate risk assessment but at least 2 subs-systems constructed, or an adequate risk assessment and less than 2 subs-systems constructed
2	An adequate risk assessment and at least 2 subs-systems constructed.

Bg

Even though the circuit board layout may be well organised, if the construction is sloppy and contains long curling wires, then fault finding can be hindered. Candidates are therefore expected to take care when constructing their circuits, with wires and connections being organised and neatly made.

Marks	Guidance
0	A system with unnecessarily long wires covering components so making any modifications difficult
1	A system which has been constructed without sufficient care, some wires are too long and components are not always secured to the circuit board
2	A neatly constructed and carefully organised system.

Bh

These marks reward those candidates who largely work independently and produce fully working systems with just minimal guidance. The Candidate Record of Supervision will be important evidence for the award of these marks.

Marks	Guidance
0	A system which does not fully work or where the candidate received significant guidance
1	A system which has some minor faults but the candidate received only minimal guidance or when the system fully works and the candidate received some guidance
2	A system which fully works and the candidate received only minimal guidance.

Ca

In order to ensure that the time candidates spend testing their systems is productive, they are required to devise a test procedure prior to making any measurements. They are expected to identify the measurements that they will make and the equipment that they are expecting to use for making those measurements. It is expected that many candidates will produce tables into which they can write their measurements. Candidates are expected to concentrate on those measurements which directly determine the performance of the system. Planning to measure every conceivable voltage and current within the system is a waste of time and will not be rewarded.

Marks	Guidance
0	There is little or no evidence of any planning prior to testing
1	There is some evidence of planning of the testing procedures and some of the relevant equipment has been identified
2	There is clear evidence of detailed planning of the testing procedures and the relevant equipment has been identified.

Cb

For these marks to be gained the complete system must function to some extent. Candidates gaining these marks will have made and recorded measurements on all of the parameters affecting the performance of their system.

Marks	Guidance
0	There is little or no evidence of anything other than basic testing
1	Most relevant numerical measurements on the system parameters have been made and recorded
2	All relevant numerical measurements on the system parameters have been made and carefully recorded.

Cc

Unlike candidates at AS Level, those at A2 Level will be expected to justify the accuracy of the measurements that they make on the system parameters. This will include discussion of the accuracy of the measuring equipment, repeating measurements in order to minimise errors etc, together with details of any issues with measuring equipment that may affect results, eg the internal resistance of meters affecting readings.

Marks	Guidance
0	There is little or no evidence of any justification of the accuracy of the measurements made
1	There is some justification of the accuracy of the measurements made, with one discussed in detail
2	There is detailed justification of most of the measurements made on the system parameters.

Cd

For these marks to be gained the complete system must function to some extent. With the performance of the system now measured, the candidate can assess how far the system meets the original objectives in solving the specific problem. Although this may be guided by the parameters originally derived for the system, it is more important that the system is fit for purpose and solves the original problem. It is difficult to justify the award of a mark if no marks are awarded for Cb.

Marks	Guidance
0	There is little or no evidence of any assessment of the performance of the complete system
1	An assessment is made but there is little reference to the measurements made of the system parameters
2	A detailed assessment is made of the final system and reference is made to the measurement of the system parameters.

Ce

For these marks to be gained, the complete system must function to some extent. Having assessed the performance of the system, the candidate is now able to identify any limitations in the performance of the system in being able to solve the problem, and also to suggest modifications to the system in order to overcome these limitations. If there are no limitations then the candidate may claim both of these marks so long as full marks have been awarded for Ad and Cb. Limitations which will not gain credit include:- the system does not work, the system needs an On/Off switch, etc.

Marks	Guidance
0	There is little or no evidence of any attempt to identify limitations in the performance of the complete system
1	Limitations are identified but no suggestions are made as to how to overcome them.
2	Limitations are identified along with suggestions of how to overcome them or there are no limitations of the system and full marks have been gained for Ad and Cb.

Cf

For these marks to be gained the complete system must function to some extent. The candidate is now able to carry out the modifications and then re-assess the system, repeating measurements where necessary.

Marks	Guidance
0	There is little or no evidence of any modification of the complete system to enhance its performance
1	Modifications are made, but a re-assessment is not made
2	Modifications and a detailed re-assessment are made of the final system or there are no limitations and full marks have been gained for Ad, Cb and Ce.

Da

Candidates at A2 Level are expected to be able to design systems to a given specification. These marks are used to assess how successful the candidate has been in achieving this, by a direct comparison of the initial specification parameters with the final performance figures together with a final assessment of whether the complete system is fit for purpose in solving the initial problem.

Marks	Guidance
0	There is little or no evaluation of the complete system against the initial specification parameters
1	An evaluation of the complete system is made against the initial specification parameters
2	A full evaluation of the complete system is made against the initial specification parameters including its fitness for purpose in solving the initial problem.

Db

These marks reward candidates who are able to design a system to meet an initial specification and solve the initial problem.

Marks	Guidance
0	There is little or no attempt to demonstrate that the final system's performance figures match the initial design specification or the system does not match the initial design specification
1	The candidate demonstrates that the system falls just short of matching the initial design specification
2	The candidate demonstrates that the system matches or exceeds the initial design specification.

Dc

It is expected that the documentation of the work undertaken by the candidate will be in the form of a well organised, carefully written and illustrated report. The report should be complete and succinct with accurate spelling, punctuation and grammar. It should contain sufficient detail that some one could repeat the work of the candidate and obtain exactly the same results/outcome. It is essential that the report contains a complete circuit diagram and clear photographic evidence of the system. Failure to include clear photographic evidence will result in the centre being contacted to supply such evidence.

Marks	Guidance
0	Significant details are omitted from the report and/or the meaning of the report is unclear. The candidate will be awarded 0 for this criteria if no clear photographic evidence is supplied
1	The report has small omissions, and/or is not succinct, and/or has inaccurate spelling, punctuation and grammar
2	The report is coherent, complete, succinct with accurate spelling, punctuation and grammar.

Dd

The candidate is expected to produce a summary of all sources of information and help received during this work. This should include:

- People - staff, students, parents, relations etc
- Books - magazines, text books, notes, catalogues, CDs etc. Full details should be given
- Web sites/URLs etc, nb search engines do not count as a source of information

Marks	Guidance
0	There is a minimal attempt to give a summary of sources of information and help received
1	There are some details of the sources of information and help but it is incomplete, ie page numbers omitted etc
2	There is a detailed and complete summary of sources of information and help received.

Candidate: …… Number: ……

Unit 6 – Summary of Marks

The report must contain clear photographic evidence, a completed cover sheet and a Record of Supervision. If no system hardware exists then the final mark is 0.

A	**PROBLEM ANALYSIS AND SOLUTION DESIGN**		**0, 1, 2**
The candidate	a	clearly defined the problem to be solved with minimal guidance	
	b	carried out relevant research from at least 2 named sources	
	c	carried out practical investigations into at least 2 relevant factors	
	d	specified at least 3 numerical and realistic parameters	
	e	justified the values of the 3 numerical parameters	
	f	considered 2 or more alternative solutions	
	g	justified the choice of solution from the others considered	
B	**SYSTEM DEVELOPMENT**		
The candidate	a	devised circuit details of at least one subsystem with minimal guidance	
Ba, Bb and Bc must not to be awarded if less than 3 active devices used	b	made and recorded 2 or more measurements on at least one	
	c	explained how 2 or more different subsystems were interfaced together	
	d	explained in detail how the system works. (QWCii)	
	e	converted circuit diagrams into a well organised circuit board layout with minimal guidance	
	f	safely constructed 2 or more subsystems of the complete electronic system	
	g	produced a neatly constructed electronic system	
	h	made all of the system function with minimal guidance	
C	**MAKING MEASUREMENTS**		
The candidate	a	devised a test procedure for the complete system prior to making any system measurements	
	b	made and recorded detailed numerical measurements on the complete system parameters	
	c	justified the accuracy of these measurements	
	d	assessed the working parts of the complete system and referred to the measurements made	
	e	suggested modifications to overcome the limitations in the performance of the complete system	
	f	carried out the modifications and re-assessed the system.	
D	**EVALUATION AND REPORT**		
Ad and Ae must have scored 2 marks each	a	The candidate evaluated the performance of the final system against the initial specification	
Cb and Cc must have scored 2 marks each	b	The initial specifications and final performance agree very closely	
	c	The report details all stages of the development of the project. (QWC i and iii)	
	d	The report contains an acknowledgement of all sources of information and help, including a bibliography	
		Centre Mark Total	
		Moderator Mark Total	

Candidate's Record of the Supervision of Coursework

NAME:……

CANDIDATE NUMBER:……

On each occasion when you and your supervisor discuss your coursework, details of the discussion should be recorded. The record should begin as soon as you start on the coursework, ie when the form of the experimental project is being chosen and should be completed when the written report is submitted to your supervisor for assessment.

Date of discussion	**Content of discussions; advice, guidance and help given by the supervising teacher**
	Coursework problem agreed with supervisor
	System demonstrated to supervisor
	Final system report submitted to supervisor

I certify that the above is a record of the candidate's work.

Supervisor's signature ….....

Name (print) ……

Date ….....

Active Devices

An active device is capable of producing power amplification at a frequency greater than 20kHz and includes:

- Transistors, bipolar and FETs
- Logic gates
- Op-amps
- Thyristors, triacs.

An electronic module or IC containing active devices can only be counted as one active device. Eg a:

- Counter module or IC
- Voltage regulator module or IC
- Radio module or IC,PIC/AVR module or IC
- etc

Coursework Containing Less Than 3 Active Devices

1 Coursework with no active devices is not Electronics

2 Coursework with less than 3 active devices will be treated as if it has not been constructed using subsystems and so will be penalised in section B.

Radio and Transmitter Modules

Deregulation has resulted in a wide variety of radio modules being available in HZ bands:

173; 315; 433; 458; 868; 916; as well as the 2.4GHz Blue Tooth modules.

These modules can count as one active device. The transmitter modules can be used so long as there is clear evidence that they have not been modified and are operating with legal aerials, ie ¼□ whips or helical.

All other radio transmission is specifically forbidden unless the candidate produces appropriate Radio communication Agency licenses, certificates of conformity etc. The onus is on the candidate to demonstrate compliance not for AQA to demonstrate non-compliance.

High Power – High Voltage coursework

The maximum voltage occurring in any coursework should not exceed 50V.
The maximum power used in any coursework should not exceed 100W.
No coursework should involve circuitry for the processing or direct utilisation of the mains supply. If in doubt the Coursework Adviser should be contacted.