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Electronics 1431/2431

ELEC3 Practical System Development

Report on the Examination

2009 examination - June series

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General Comments

This is the first year that this revised project (controlled assessment) specification has been used and it was pleasing to see that, for the majority of established centres, the scheme presented few problems, with the requirements being correctly interpreted and the work of their candidates being accurately and consistently assessed.

The project assessment scheme used for ELEC3 requires candidates to produce a report describing how they designed and constructed an electronic system to overcome a problem or satisfy a need. The project should be of an extended nature, as it is a complete module in its own right.

The revision to the project assessment scheme focussed on reducing the number of criteria from 40 to 25, but making each criterion worth up to two marks.

A programme of Standardisation Meetings for the new project specification took place in January and February 2009, with representatives from over sixty centres attending. A similar programme will be provided for the A2 project assessment scheme (ELEC6), which is different to that for AS, and centres are advised to send a representative to these meetings. Details of these will be available from the Subject Officer at AQA.

Only a few arithmetic errors in the centre administration were noted this year, where supervisors had carried out the summation of candidate marks incorrectly. However, this year there were again many centres not completing the administration paperwork correctly before forwarding it to their moderator. This was not only a nuisance, but also delayed the moderation of the centre's marks. In particular, it is the responsibility of the supervisor to ensure that all of the Candidate Record Forms are completed correctly and signed by the candidates and that the Centre Declaration Form is correctly completed and countersigned by the Head of Centre/Examinations Officer.

It is also the responsibility of the supervisor to ensure that the required work reaches the moderator by the **15th May**. It is unacceptable for work to arrive after this date, especially when the Candidate Declaration Sheets are dated well after this date, since this could be construed as attempted malpractice. The reports should also be sent by normal post and not Recorded or Special Delivery requiring a signature, as this often delays the delivery of the materials to the moderator.

It is also the responsibility of supervisors to ensure that internal standardisation occurs within a centre when there are several teachers assessing the candidates' work.

ELEC3 – Practical System Development

The AS subject specification states that project should be based on at least three active devices and should be commensurate with the content of ELEC1 and ELEC2. An active device is anything that can provide power amplification at a frequency greater than 40kHz. It should be noted that the assessment scheme does not award additional credit for those candidates who produce very complex projects. This is intentional, as it is the process of producing, testing and evaluating an artefact that is being assessed. The artefact produced is just the vehicle used for making the assessment. Supervisors are required to approve the projects of their candidates, and, when doing so, they should consider whether the projects are of the correct standard and contain at least three active devices. Supervisors should also consider whether individual candidates have the ability to successfully complete the work. A candidate should not proceed with any project that does not have the approval of the centre supervisor.

Issues noted for the previous specification have continued this year and are again brought to the attention of all centres. It is essential that all centres are able to ensure that they can provide clear photographic evidence of the existence of the hardware for a candidate's project. It is very difficult to justify any marks at all for candidates when there is no evidence of hardware, even when a report is written, since the report is essentially the description of the work involved with the production of the electronic system.

Also of concern is the number of candidates who do all of their circuit design using software and do not do any hardware construction at all until the very end. Such candidates are excluding themselves from the Ba, Bb and Bc marks. If candidates then use software to produce a printed circuit board (pcb) design, it is difficult for them to gain the Be marks. Some candidates were also found to be making their system measurements from their virtual systems, so excluding themselves from Ca, Cb and Cc marks.

Supervisors are required to annotate the work of their candidates when they assess it. This should consist of the criterion code plus the mark next to the place in the report where there is the evidence, e.g. Ac2, Ca1 etc. If the supervisor believes that the evidence within the report is not sufficiently clear, then an added comment of explanation next to the criterion code should be made. Annotation for the B criteria was often sparse and needs to be more detailed in future.

Different sections of the marking scheme caused difficulties for different centres. The following sections describe the project process and how the criteria link to this, together with some of the common issues noted this year. They should be read and noted in conjunction with the subject specification and the project Support Booklet.

For Aa marks, candidates are expected to independently select and then give a clear description of the problem that they are going to solve using an electronic system at the beginning of the report. It is expected that the description will be a short paragraph but will not contain details of either the circuitry or the components that are going to be used, as this would pre-empt the research. Centres are reminded that group projects are prohibited and that all of the candidates should do projects that are completely unrelated.

Having identified the problem to solve, the candidates are then expected to undertake research to help them determine the parameters for their electronic system. Details of research from at least two books, catalogues or the Internet are required for Ab marks, and they must be specific, including page references, URLs and also a brief summary of the information obtained from each source.

Candidates are also required to undertake practical research to help determine their system parameters. For the Ac marks, candidates should give details of at least two investigations/experiments that they have carried out, together with their conclusions. Trying a circuit for the first time, either practically or virtually, is not sufficient to qualify as such an investigation.

Having completed their research, candidates should be ready to design their electronic system. The marks for Ad are gained by the candidates giving a detailed qualitative description of their system. It is expected that such a description will be a short paragraph and will contain information as to how the system will be used to solve the original problem identified. This may include the controls for the system, the power source, together with how the candidate believes that the system will solve the initial problem. At such an early stage in the project, it is reasonable for the candidates to revise these initial ideas as their project develops.

With the general design of the system complete, candidates are required to identify specific operating parameters for their system. In order to gain both marks, they will need to give at least three numerical and realistic parameters for their system. It is expected that these will include the range for the supply voltage with which the system is expected to operate, together with a realistic estimate of the operating current. It should not then be too demanding for candidates to identify at least one other parameter, though moderators were surprised by just how many candidates failed to do this and so failed to gain at least one mark.

It is unlikely that there is a unique solution to any electronic system design and so candidates, for the Af marks, are required to consider and give details of realistic alternatives within their system. For example, a system that requires a timing period of 10 minutes could be constructed from a monostable or a counter circuit. Candidates would be required to give circuit details of both possibilities for the Af marks. All too often, candidates either gave insufficient details or described alternative problems rather than focussing on their chosen system.

Having identified the alternatives, then for the Ag marks, candidates are required to make a reasoned decision as to which of the alternatives they are going to use. Where possible, these decisions should be made on the basis of electronic functionality, e.g. lower power consumption, more accurate timing etc., rather than lack of availability. Insufficient knowledge is not considered as an adequate reason, since the alternative should not be considered if the candidate has inadequate knowledge.

With the system designed, the construction should then start. Candidates should, from the outset, be aware that their systems must contain at least three active devices. Failure to do so will exclude them from all of the subsystem marks (Ba, Bb and Bc) and is likely to lead to a disappointing report.

It is expected that candidates will be able to provide circuit details of at least one subsystem, with minimal guidance, from their course notes and begin construction on protoboards. It is found that, when supervisors insist that candidates hard wire circuits, their circuits often do not work and their overall project mark is depressed. It is expected that most candidates will be able to score at least one mark from Ba.

To gain both of the marks for Bb, candidates must document how they calculated a relevant component value. All too many candidates failed to gain both of these marks because they chose to justify a component value by substituting it into the formula to show that it gave the required time period/frequency etc.

With a subsystem built, it now needs to be tested. The Bc marks are for this testing and for giving details of at least two measurements from a subsystem. Many candidates gave only one measurement and so forfeited a mark. These marks can be gained on any subsystem, but there must be two measurements from a single subsystem to gain both of the Bc marks. This often caused problems for candidates using templates, since, once they had used their 'Bc space' inappropriately, there was no further opportunity to record the measurements from other subsystems.

The Bd marks are for giving a full and detailed description of how the system works. It was common to see candidates attempting to do this without having produced a full circuit diagram of their system. Such circuit diagrams should contain details of the component values and types.

One of the most demanding parts of building an electronic system is translating the circuit diagram into a well organised and effective component layout on the protoboards. To gain the Be marks, candidates need to demonstrate their ability, and this is most easily achieved with clearly labelled diagrams or photographs of their protoboards. Effective component layout is usually key to a successful system and so supervisors may choose to guide less able candidates but then only award a single mark in this category.

Candidates are expected to consider and document the risks they are likely to encounter when undertaking practical work, and identify ways of reducing these risks to a safe level. They should do this also for the components and the equipment that they use, as well as their colleagues. Such documentation, together with at least two subsystems constructed, are required for the award of both marks for Bf. The documentation of the safety considerations was often omitted by candidates.

In order to find faults within a system, it is important that it is constructed neatly, with wires being no longer than are needed to join the various parts of the circuit together. This is reflected in the marks for Bg, and any system that contains long, looping wires, or where modifications are difficult to make, is not considered to be neat.

It is important that the systems constructed by candidates work, and this is assessed in the Bh and Bi marking criteria, which should be judged together. The judgements range from 'little of the system works despite significant supervisor assistance' through to 'the system works fully and the candidate received only minimal guidance'. No marks should be awarded for Bi unless both marks are awarded for Bh.

With the system completed, a test plan should be devised which focuses on how the system parameters are going to be measured, including the equipment that is going to be used. In order for the time spent testing to be productive, it is essential that the testing plan is developed *before* any testing takes place. The criteria for Ca are used to make an assessment of this plan. This still seems to cause some candidates and centres difficulties, with marks being awarded for these criteria when there is no evidence that a plan was devised prior to the commencement of testing.

The effectiveness of the testing is assessed by the criteria for Cb and Cc, which should be judged together. The judgements range from 'there is little or no evidence of testing' through to 'all relevant numerical measurements on the system parameters have been made and carefully recorded'. No marks should be awarded for Cc unless both marks are awarded for Cb. The key to gaining good marks for this section of the report is a good initial specification for the system since this will focus the candidates into making relevant and detailed measurements on their system. Measuring every conceivable voltage and current in the various subsystems is inappropriate for gaining the Cc marks, and should be discouraged by supervisors.

With the system tested and measurements carefully recorded, candidates should then assess their system to see if it is fit for purpose and solves the original problem. This will involve reference both to the measurements made on the system and also to the parameters for the system, and is judged by the criteria for Cd. It is difficult to justify two marks here if the original system parameters are weak and there is little testing of the system.

It is likely that the performance of the system, once working, will not match the original parameters and so the criteria for Ce assess the limitations and possible solutions identified by candidates. Frequently these marks are inappropriately awarded by supervisors who give credit to candidates describing how they made their system work or how they identified improvements to their system which changed the original specification. Marks should only be awarded when clear limitations in the performance of the working system are identified together with possible solutions.

There will be occasions when a candidate constructs a system that works fully to the original specification and so there are no limitations. In such cases, supervisors should award both marks for Ce (and also Cf) so long as full marks have been awarded for Ae, Cb and Cc, i.e. the system has been fully specified and tested.

Having suggested modifications to the system to make it work more closely to the specification, candidates should now carry out the modifications and then re-test the system. The marks for Cf are used to judge the evidence for this and were often incorrectly awarded for a candidate making a non-working system function.

The project is assessed through a carefully written and illustrated report and should contain sufficient detail to enable some one else to repeat the work and obtain *exactly* the same results/outcome. The criteria for Da record the effectiveness of the report together with the overall quality of written communication. It is unusual for supervisors to mark harshly, but it was noted this year that many candidates were awarded 0 marks for Da despite having produced reasonably competent reports.

There is a tendency for candidates to print, and include within their reports, copies of data sheets. In some reports the number of pages of data sheets significantly exceeded the size of the report itself, and this should be avoided, as it gains no additional credit and just adds to increased postal costs. It would be much better for candidates to just reference the URLs of the data sheets they use.

The criteria for Db are simple. For two marks to be awarded, there must be a complete circuit diagram and clear photographic evidence of the complete system included within the report.
Clear photographic evidence of the complete system is an essential requirement, as it is the only evidence that any hardware exists. Failure to produce such evidence by candidates will lead, in the first instance, to supervisors being contacted to supply the required evidence, but could ultimately result in the candidate being awarded zero marks for the entire project.

It is important that supervisors check that appropriate photographic evidence is included in each report.

To reduce plagiarism, it is important that candidates produce a summary of all of the sources of information and help that they have received during their project. This is assessed through the criteria for Dc and should be located at the end of the report. It is expected that full details of sources will be given by candidates, particularly websites, where a full URL is required.

There are many instances of sparse reporting of consultations between the candidates and supervisors on the Record of Supervision sheets. A correlation was noticed between this and the quality of the project from some centres – an issue which needs to be addressed by some supervisors.

The majority of reports were word processed, with the quality of the graphics and production being excellent. Candidates need to ensure that reports are spellchecked before printing.

It is helpful if all report pages are:

- numbered,
- contain the name and number of the candidate in the header or footer,
- stapled together or secured with treasury tags and
- not inserted into plastic wallet folders or large loose leaf folders.

The last point will save many centres a considerable amount of money in postage.

Several centres are experimenting with a template into which their candidates produce their reports. While this technique can be of value to some candidates, it can stifle the prose writing opportunity, so leading to the loss of some of the Quality of Written Communication marks. It is also important for any centre developing such a scheme that they base their template directly on the criteria of the specification. Failure to do this could result in the candidates penalising themselves quite severely.

Centres should be advised that candidates are likely to produce reports worthy of higher marks if they follow directly the project marking grid which can be obtained from AQA, along with other information on project.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the **Results statistics** page of the AQA Website.