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General Certificate of Education

Electronics 5431/6431

ELE3 Coursework

Report on the Examination

2007 examination - June series

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This is the seventh year that this coursework specification has been used and 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. As a result, the contents of this report are similar to the report of the previous year.
The coursework assessment scheme used for ELE3 and ELE6 requires candidates to produce a report describing how they designed and constructed an electronic system to overcome a problem or satisfy a need.
The coursework should be of an extended nature as it is a complete module in its own right. With this scheme, any marking statement for which there is sufficient evidence is awarded a mark.

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 the moderators. This not only was a nuisance, it also delayed the moderation of the centre's work. 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 counter signed by the Head of Centre/Examinations Officer.
It is also the responsibility of the supervisor to ensure that the required work (or marks) reach 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 same assessment scheme is used for both ELE3 and ELE6 and so most of the issues will be common to both modules. The only difference for ELE6 is that criteria Fa, Fb and Na contribute towards the quality of English marks.

The subject specification states that coursework should be based on at least three active devices and, for AS, should be commensurate with the content of ELE1 and ELE2. An active device is anything that can provide power amplification at a frequency greater than 40kHz. The work from some candidates at centres was barely acceptable and those centres will be advised that in future such work may well be disqualified as failing to be of the appropriate standard. It should also 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 be able 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 first time last year 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 evidence of the existence of the hardware for a candidate's coursework. 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 increasing 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 possibly all of the E marks but certainly the Ed and Ee marks. If candidates then use software to produce a printed circuit board (pcb) design, it is again difficult for them to gain the G marks. Some candidates were also found to be making their system measurements from their virtual systems, so excluding themselves from any J marks.

There were specific sections of the marking scheme that again caused some centres problems. Most of these continue to occur each year and so no apology is offered for repeating some of the content of previous reports. The comments below should be read and noted in conjunction with the subject specification.

The vast majority of candidates clearly defined their own coursework problem to solve and so were awarded mark Aa. However, it is much more difficult to justify the award of this mark if the supervisor gives the candidates a choice from a limited number of project titles or even worse told the candidate what to do. It should be remembered that the work of each candidate must be completely independent. Group projects are prohibited, and it is good practice for all candidates to do projects that are completely unrelated. Where several candidates undertake the same project (either name or nature) or are told what they will do, the Aa mark cannot be awarded.

For the Ba mark to be awarded, not only must details (page number, URL, etc) of the source of the information be stated, but there must be at least two sources referenced. This year saw a further increase in the amount of irrelevant Internet information included in reports. These ranged from those candidates who included large numbers of Internet sites which had little to do with the project, to those who printed out the contents of what seemed to be every Internet site that they had visited. In some cases this 'paper bloat' was significantly larger than the report itself and gained no additional credit.

There must also be at least two investigations carried out by the candidate in order to gain the mark Bb. These investigations must be relevant to the project and be practical in nature e.g. determining the output voltage from a guitar etc. Only in exceptional circumstances, when there are no practical investigations possible, is it acceptable for candidates to research different components or circuits. Many centres are still falling foul of this.

Poor specifications in section C disadvantaged many candidates. Three numerical and realistic electrical/electronic parameters are required to gain all of the C marks. Failure to do so will severely limit the candidates access to other marks within the scheme. Without a sufficiently detailed specification to gain the mark Cc, mark Mb cannot be awarded. It is also not appropriate for any candidate who does not gain the Cc mark to claim that his project works perfectly and so gain all of the section L marks. Parameters of the form, "current consumption less than 5 amps and a supply voltage of 3 to 18 volts" are not defined sufficiently to gain credit. Neither were the parameters of those enterprising candidates who specified current, voltage and then multiplied them together to give a power parameter as the third.
It is also important that appropriate parameters are specified. It seems bizarre that candidates can make light or sound detection systems without specifying the light or sound levels at which they are to operate. Supervisors should also note that the specifications must be electrical/electronic in nature. The physical sizes, weight or proposed colour are not appropriate as parameters for the specification. This is an issue that some supervisors still need to address.

Many candidates were successfully able to gain the D marks although there were a number of centres, this year, which incorrectly credited candidates with these marks, when the candidates had considered completely different projects. The D marks are for considering an alternative way of producing either a different electronic solution or part of a solution to their problem identified at the beginning of their report.

The marks for section E can only be justified if there is clear evidence (e.g. a 'System diagram') to show that the work was carried out in subsystems. This penalised heavily those few candidates who insisted on following a circuit from a book or magazine without any modifications at all. While supervisors must ensure that all candidates use at least three active devices, it should be noted that any candidate who only using one active device will automatically forfeit all of the marks in this section.
Many candidates used CAD systems to develop their subsystems. While these computer programs are very helpful, there is a tendency for the candidates to not develop good electronic practices. The most obvious of these is the tendency for candidates to keep trying different component values in their virtual circuits until they find ones that function, instead of actually doing the required calculation and then checking that it works in their virtual circuit.
In an attempt to gain mark Eb, many candidates substituted their empirical values into a formula and showed that it gave the required value. This is a "reverse calculation" and is not sufficient for mark Eb to be awarded.
Marks Ec, Ed and Ee are dependent upon the candidate providing clear evidence that they have worked on a real subsystem. There must be more than one measurement made for Ed and they must be real measurements taken from a real circuit. Virtual measurements are not acceptable for this mark.
In order to gain mark Ef there must be sufficient evidence to show that the issues of interfacing of one subsystem to another have been considered. Normal circuit arrangements, e.g. series resistors for LEDs and protection diodes across relays, or even a connecting wire, are not acceptable for the award of this mark. However, it would be acceptable to award the Ef mark to a candidate who successfully interfaced an op-amp operating from a dual power supply to a logic gate.

In order to gain the marks Fa and Fb, there must be a clear description of how the *complete* system works. Mark Fb can only be awarded if all reasonable detail is included. A complete circuit diagram is essential for this mark. The mark Fc should only be awarded for a relevant calculation on the complete system. This could include an overall gain calculation, an overall truth table, a bandwidth calculation for the complete system, etc., or alternatively a calculation of power consumption or battery life.

The marks for component layout, Ga and Gb, are for the process of the candidate actually producing the circuit board layout from the circuit diagram. A witness statement from the supervisor and clear photographic evidence is sufficient for the award of these marks. Clearly, any candidate who uses a published layout will forfeit the G marks. There is a similar issue with candidates who design their systems using a software package and then use software to produce a pcb design for their system. This practice is to be discouraged, and candidates will not be able to gain marks for G unless there is clear evidence that they have had to do some modifications to the pcb design. Centres are reminded that candidates are often disadvantaged if they hard wire their systems directly onto pcb.

The easiest way for a candidate to produce evidence for mark Ha is to carry out a Risk Assessment of the planned work, although a witness statement from the supervisor will also suffice. However, there were many examples this year of candidates being awarded the Ha mark but who described in their reports how they had destroyed transistors, LEDs etc and so had not worked safely.
There was also evidence this year of several candidates for whom there had been some involvement with voltages in excess of 50 V. Candidates are specifically forbidden to either make any use of mains voltages or to generate any voltages in excess of 50 V.
The mark Hb can be awarded if two or more subsystems are constructed, whether they work or not. This mark cannot be awarded if a candidate only uses one active device.
For the mark Hc to be awarded, the constructed circuit must be neat. The best form of evidence for the award of this mark is a clear photograph. Circuits containing long looping wires are **not** neat.
Marks Hd, He and Hf are awarded depending on how much of the system functioned and with how much assistance. Mark Hf should only be awarded if the involvement of the supervisor was minimal in the construction of the system and it being made to function.

Candidates are required to devise a test procedure for their complete system before they actually start the testing. Not only is this good practice but it also prevents time being wasted and measurements being missed. The I section marks were often incorrectly awarded to candidates who made measurements without there being any evidence for a plan prior to the tests being made.

With the system complete and the test plan produced, the complete system should be tested. If the complete system does not function at all then it is difficult to justify the award of any marks for section J. All systems should have current consumption measurements made along with the range of sensible voltages over which the system can be expected to operate. Any amplifying system should have measurements of gain and frequency response. Any random number generator (dice etc.) should have measurements made to show that it is random. Any frequency generator should have measurements made to show the effect of changing the supply voltage and temperature. Any sensor circuit should have measurements made to show the effect of a change in supply voltage.
Mark Jc should only be awarded if the supervisor considers that all reasonable measurements have been made. In an unsuccessful attempt to gain this mark, candidates are still making every conceivable voltage and current measurement around their circuits, but often failing to measure an important system parameter, e.g. the light level at which the circuit operated. Candidates should focus their attentions on the important measurements which actually affect the performance of the complete system. There were a few examples of candidates who performed calculations within their section on measurements and who then tried to suggest that the results of their calculations were in fact measurements! Once again those candidates who made virtual measurements on their virtual circuits were awarded virtual J marks, which did not contribute to their real mark totals.

The assessment of the complete system needs to consider the measurements made and their appropriateness to the original problem to be solved. Mark Ka can be awarded for a relevant assessment of the complete system, but mark Kb should only be awarded when there is specific reference to the measurements made in section J. This assessment stage should allow limitations to be identified and considered.

The limitation of the 'system not working at all' is not appropriate for the award of mark La. With the limitations of performance of the complete system identified (La), modifications can be considered (Lb) and then carried out (Lc). If a candidate's work really is perfect and is without limitations, then all three marks in section L can be awarded but only if mark Cc is also awarded and sufficient measurements have been made to justify this conclusion.

With modifications made, fresh measurements should then be made to confirm the improved performance and then the system should be evaluated against the original specification. Evaluation requires numerical parameters and measurements. It is difficult to justify the award of mark Ma if there are no numerical parameters in the specification. If there are no marks awarded for J or Cb and Cc then it is difficult to justify the award of any marks at all for M.
Mark Mb can only be awarded if there are at least three numerical parameters in the specifications and they are in very close agreement with or are exceeded by the performance figures of the system.

The report itself generates the majority of the evidence for the award of marks and so it is in the candidates own interest to ensure that it is a full account of all of the work undertaken.
Mark Nb should only be awarded if all stages of the development of the system are detailed and there is a complete circuit diagram.
To gain mark Nc, there should be a detailed list of all of the sources of information and help used. This aids both the supervisor and moderator in assessing the work and saves having to pick out references from within the body of the report.

Photographic evidence is essential as is a signed Declaration/Cover sheet. Failure to include either will result in the centre being requested to provide these materials. Fewer centres, this year, failed to provide all of the documentation required and had to be contacted by the moderator. It is also expected that the coursework reports will contain a photograph of the completed electronic system. Several candidates this year included inappropriate photographs of their work, showing either systems that could not possibly work because there were connections missing (e.g. power supply connections to logic ICs), or of completely different systems to that in their circuit diagrams. This invariably leads to marks not being awarded and in some cases moderators contacting supervisors to obtain further clarification of the situation.
The reports *must* be annotated by supervisors to show the evidence for the award of the marks. This ranged from some excellent annotation, where there was no doubt at all as to the evidence, to those centres that had their work returned to be annotated and remarked.

The biggest single cause of candidates not producing working projects this year appeared to be bad planning resulting in the candidates having insufficient time to either complete the circuit or make it function. There were, of course, the usual favourite electronic problems that perplexed the candidates. Of note were those logic circuits where unused CMOS inputs had not been connected to 0V, those NAND gate astables which used electrolytic timing capacitors; the 741 type op-amp circuits operating from a single supply and switching LEDs directly from their outputs; and those 741 type op-amp circuits operating from a single supply but with their non-inverting input connected to 0V.
This year again saw an increase in 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 coursework 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. It is helpful if all report pages are numbered and contain the name and number of the candidate in the header or footer and the reports are stapled together rather than held loose-leaf in a plastic wallet. With all of the IT skills possessed by candidates many are still 'forgetting' to press the spell check icon before printing their reports!

Several centres are experimenting with a template into which their candidates produce their reports. 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 coursework marking grid.

Mark Ranges and Award of Grades

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