GCE EXAMINERS' REPORTS

GCE (LEGACY) ELECTRONICS AS/Advanced

SUMMER 2018

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ELECTRONICS

General Certificate of Education (Legacy)

Summer 2018

Advanced Subsidiary/Advanced

ET1

General comments

This examination had a very small entry and therefore it is very difficult to draw inferences from the statistics. It proved to be a very accessible paper, marks were between 9 and 59.

Specific comments

Q1. (a) Mostly very well done with the only frequent error caused by the omission of the bracket on the $\left(B+\overline{A}\right)$ term.

(b) The first marking point for correct application of DeMorgan's theorem was awarded even when double bars were left over the terms but not when the sign for the operator was incorrect. The second mark for simplification was allowed even if $A.\overline{C}.A$ was seen. Repeated errors that led to a correct answer were not credited and the final mark for identifying B as the redundant gate was only awarded after correct analysis.

Q2. This question proved to be the best answered on the paper.

(a) (i) A few candidates attempted to simplify the expression, despite being told not to, and introduced errors.

(ii) The Karnaugh map and simplified expression were usually done correctly even if part (i) was wrong.

(iii) Most candidates drew the 4-gate solution. Those that added a separate NOT gate from A to each AND gate still gained full credit as minimum solution was not requested.

(b) This part was very well answered with only one script showing the single input NAND gate symbol which cost one mark.

Q3. (a) and (b) Both very well answered. The expression mark and the multiplexer connection mark could be gained as error carried forward marks from an incorrect table.

(c) Many more mistakes were seen with the LED subsystem drawing. To gain the first mark the LED had to be capable of operating and the second mark was for it operating when Q was at logic 1. Missing resistors, silicon diodes or unrecognisable symbols and incorrect orientation or position of components were all quite common errors.

Q4. (a) The counter diagram is a standard question and so it was rather surprising to see a lot of errors including Q connected to D and the pulse generator connected to the resets.

(b)(i) This was well answered even the more difficult Y column.

(ii) The timing diagram for A was usually correct. Errors were more frequent for B and C with marks available for both duration and timing of the pulses. X and Y were taken as ecf from table if applicable.

(c) The conversion of frequency to time and then duration of the C pulse was poorly done with 8s being common answer, presumably because C was 8 cm on the graph paper. Working was generally not shown and so some students may have forfeited a mark for a correctly calculated time period but did not show it.

Q5. (a) Once again, a standard question that was frequently answered incorrectly. To add a propagation delay was not enough for the mark.

(b) A lot of mistakes in the drawing of a transition gate with many candidates drawing a bistable instead even though this was already drawn and labelled below. Those that did partially remember the circuit often drew an even number of NAND inverters or failed to draw the correct interconnections, especially the first branch.

(c) The latching effect of a bistable is not well understood and only a small minority of candidates gained the three marks available. The last mark was the most commonly awarded of the three.

Q6. (a) It looked like a lot of candidates guessed the answer and then tried to justify it, often incorrectly. To get the mark candidates either had to compare the slew-rates and identify S as the higher of the two or do both time calculations. This latter approach was rarely seen. I'm guessing a lot of candidates see slew-rate not as the gradient but as the time to reach saturation and hence choose the lower slew-rate thinking it takes less time!

(b) The first mark needed both a downward slope and the correct starting time. To gain the last mark there had to be negative saturation seen even if the graph was incorrect in other ways such as a step-change or a sinusoid.

(c) (i) Most deduced the gain correctly from the graphs. The sign was ignored as the inverting amplifier mark was awarded later.

(ii) and (iii) These two parts are usually marked together as many candidates put the resistor values directly onto the diagram without the need for calculation. A non-inverting amplifier scores only one mark for the negative feedback resistor but could gain ecf. marks for the resistor values if they are consistent with the gain identified in part (i). As always there were a lot of diagrams showing positive feedback and other connection errors.

Q7. This proved to be the most difficult question on the paper although all candidates attempted it.

(a) Gains of 40 and 0 were common answers as well as some completely random numbers.

(b) Generally well answered although a significant number chose the start of the roll-off as the frequency range. A lot of mistakes were made with the calculation of the maximum input voltage including giving the power rail voltage of 15 V or using $30 \times \sqrt{0.7}$. Rounding up the answer results in the input going into saturation.

(c) I suspect a lot of guesses with these three answers. The unchanging gain-bandwidth product was not understood by many.

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ET2

General comments

The overall performance of candidates was comparable with that of previous years despite the small entry. The paper proved to be accessible for candidates of all abilities with an attempt rate per question ranging from 95% for question 2 to 100% for questions 1,3,4,5 and 6.

Specific comments

Q1. This was highest scoring question on the paper with a mean mark of 4.7 out of 6.

Part (a) proved to be a gentle introduction which most candidates took full advantage of.

A number of candidates struggled with part (b). In particular they failed to realise that the total resistance calculated in part (a) was required to calculate I_1. Despite this oversight candidates earned ecf marks in the remainder of the question.

Q2. In part (a) most candidates were able to calculate at least one of Voc or Isc although Ro was often an ecf mark.

In (b) a common error was to correctly calculate the voltage drop across Ro but fail to subtract the answer from Voc.

In part (a) a small number of candidates got the correct threshold values the wrong way around.

Most candidates drew the output graph correctly in part (b). However common errors included the incorrect amplitude or additional switching points. It would assist candidates if they drew horizontal and vertical lines corresponding to the switching thresholds on the graphs.

Q3. In part (c) most candidates were able to complete the circuit diagram of a Schmitt astable but only the better candidates were able to calculate component values.

Q4. This was the second highest scoring question on the paper with a mean mark of 5.1out of 7.

Part (a) was well answered but a number of candidates had difficulty completing the circuit diagram for a full wave rectifier in part (b).

Q5. A common error in part (a) (i) was to either use the formula for a charging capacitor or simply just calculate the time constant of the RC network.

In part (a) (ii) a significant number of candidates drew the buzzer between the NOT gate output and the 0V rail.

In part (b) the most common errors were incorrectly rearranging the formula and not changing the 1 minute delay into seconds.

Part (c) was quite well done except that a number of candidates failed to subtract the LED voltage from the supply voltage. Most candidates realised that the preferred value needed to be larger than their answer to part (i).

Q6. Most candidates managed to draw the graph and chose a suitable scale for the axes. Very few candidates used the gradient to determine h_{FE}.

Part (b) was well answered.

Only the better candidates were able to make a reasonable attempt at part (c).
The most common error was not subtracting 6.5V from the supply voltage to calculate the collector current.

Q7. In part (a) many candidates failed to subtract 6.2 V from the 15 V supply voltage.

The most common mistake in part (b) was to add the10 mA rather than subtract it from the answer to part (a).

A small number of candidates successfully completed the first step of part (c) and calculated the voltage drop across the resistor. Only the most able candidate went on to complete the second step and subtract the 11 V from the supply voltage.

Very few candidates were able to draw the required graph for part (d). The most common error was to draw a graph that rose steadily from zero. Answers required a horizontal line at 6.2 V until I = 390 mA, then a gradual downward slope thereafter. The graph should have passed through the point (500 mA, 4 V).

Q8. This was the lowest scoring question on the paper with a mean mark of 3.4 out of 7.

In part (a) (i) some candidates drew the symbol for a variable resistor rather than a thermistor. Only about half of the candidates provided the correct orientation of the temperature sensing sub-system. Very few candidates were able to both identify that a diode was required and place it in the correct position on the circuit diagram.

In part (b) many candidates didn’t realise that the voltage divider formula was required and simply wrote down the supply voltage as the answer.

Part (c) was very poorly answered with many candidates failing to attempt it. Very few candidates used the 72 W rating to calculate the current drawn by the fan. A common error was to use the supply voltage to calculate the power dissipated in the MOSFET.

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ET3

General Comments:

Due to the very small entry for ET3 during this final year of the specification no overall trends could be discerned.

For centres that require further guidance on the marking of ET3 coursework please refer to the GCE E3 examiners' report from 2017.

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ET4

General comments

The paper performed well with a wide range of marks from 4 to 50 out of the maximum of 50 marks were recorded. It was very evident this year that very few questions were being omitted by candidates which is an improvement on previous years. There is also some evidence that candidates are able to identify and use standard multipliers in formulae more confidently than in previous years.

Specific comments

Q1. Most candidates identified the Schmitt function as inverting. In part (b) whilst most correctly drew the switching characteristic, errors between inverting/non-inverting action, incorrect switching thresholds and incorrect saturation values were all observed but it was normal to see just one of these errors present nearly all candidates scored 2/3 for the switching diagram.

Q2. In part (a) the majority of candidates correctly drew a line spectrum with the correct carrier and side band frequencies. A minority of candidates clearly did not understand a frequency spectrum diagram as they attempted to draw a modulated carrier and scored no marks.

In part (b) again the majority of candidates produced the correct banded spectrum as opposed to the line spectrum in (a). However in (b)(ii) a significant number of candidates failed to realise that the frequency of the signal had changed in (b) giving the incorrect answer of 24 kHz instead of the correct answer of 34kHz.

Part (c) was generally unsuccessful for many candidates as they did not appear to have the knowledge of how to determine the frequency of the carrier and modulating waves from the AM signal provided so success here was limited in parts (i) and (ii). More candidates were able to determine the modulation depth correctly and gained a mark here, but only a minority scored 3 on this part of the question.

Q3. This question was all about radio receivers.

In part (a) candidates scored 3 or 4 marks out of 4 with most of the errors coming from only giving one component for (iii) instead of the two needed to form a tuned circuit.

Part (b)(i) was completed well by the vast majority of candidates. Where errors were made it was not differentiating between IF and AF sections of the strip. Part b(ii) was poorly done with very few candidates being able to identify the parts of the superset that improved sensitivity (IF strip) or selectivity (tuned RF amplifier) so whilst candidates know the names of the different parts they are unsure of their purpose or benefit.

In part (b)(iii) most candidates were successful in identifying the four frequencies present at the output of the mixer. A minority of candidates gave generic responses instead of actually determining the actual frequency signals present for the given carrier frequency and local oscillator output and scored no marks. A few other candidates managed to get three of the four frequencies correct gaining 1 mark. A handful of candidates however were unable to get even one frequency correct even though two of them were given in the question.

In (b)(iv) the candidates that score well on (b)(iii) had no problem identifying the intermediate frequency. For those that couldn't work out the four frequencies in (b)(iii) success in this part of the question was severely limited.

Q4. In part (a)(i) the vast majority of candidates were able to correctly label the start, parity and stop bits. Only a handful of candidates are now unable to identify the start bit. In part (a)(ii) a small number of candidates gave the binary ASCII code instead of the required character "I" and lost a mark.

In part (b)(i) most candidates were able to determine the correct parity bits for P_0 – P_4; a small number of candidates used the incorrect parity and had all parity bits inverted and gained an ecf mark.

In part (b)(ii) most candidates correctly identified the three parity bits that failed i.e. P_1, P_2, & P_3. A small minority of candidates gave D_5 as the answer to the failed data bit but as the parity bits were required gained no marks. Virtually all candidates that identified the correct parity bits that failed used this information to identify the failing data bit and write down the full corrected solution. A small minority changed several bits in the answer, who clearly didn't understand the concept of error detection and correction gaining no marks.

Q5. Part (a) proved to be a very good question for candidates with nearly all candidates gaining at least three of the four marks available, with inaccuracy in the drawing of the PPM and PWM waves being the main cause of error.

Part (b) proved to be more difficult with a large number of candidates being able to determine that at least 20,000 levels were required to provide the necessary resolution. Some candidates left this as their final answer, whether because they thought this was the answer or because they did not know how to determine the number of bits needed is not clear, but they gained 1 mark for correct determination of the number of levels. A small number of candidates calculated the number of bits provided by 14 and 15 bits but for some reason chose the lower, incorrect answer, possibly because it was the closest to the required answer, showing a lack of understanding.

Q6. The op-amp Schmitt trigger has caused many problems over the years, however the number of no attempts have fallen dramatically over the last few years. Success rate is also growing now with the majority of candidates now scoring full marks. A small number determine the thresholds the wrong way around however the number of completely incorrect answers is now very low, where in years gone by this would be as high as 50% so there are very positive signs of improvement here.

Q7. The filter question was on the whole well done by most of the candidates. In part (a) nearly all candidates were able to determine the reactance of the capacitor using correct multipliers. A minority of candidates used the incorrect formula and obtained the incorrect answer.

In part (b) all but the weakest candidates either had the correct answer or an ecf from an incorrect answer from (a).

In part (c) again the majority of candidates were able to use the correct formula and multipliers to gain the correct answer for the break frequency. A minority of candidates used the incorrect multipliers leading to an incorrect break frequency.

Part (d) is where candidates had the greatest difficulty. All manner of issues were present here that caused candidates to lose marks so all of the following errors were seen that resulted in the loss of either one or both marks.

- Characteristic of Low Pass Filter drawn not high pass.
- Characteristics of ideal filters with vertical cut off
- Lack of understanding of log graph paper
- Incorrect location of the break frequency
- No use of 70% point of max gain at break frequency.
- Slope falling all way to zero so input would be allowed through for some low frequencies.

This part of the question certainly proved to be the most difficult and accounted for the majority of the marks lost by candidates in this question and will be an area for consideration for future teaching especially how to scale a logarithmic axis.

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ET5

General comments

Once again, some outstanding performances pushed the mean examination mark still higher.

The usual problems persist. Illegible handwriting is a very worrying issue for students at the end of their secondary education. Once again, candidates were expected to know and be able to draw correct circuit symbols. The npn transistor was a common problem area in this respect.

Specific comments

Q1. As usual, this question was well-answered, with the majority of candidates scoring full marks.

In part (a), some believed that $\overline{B . A}$ is the same as $\overline{B} . \overline{A}$. Some drawings were difficult to follow and must have made checking difficult for the candidate.

In part (b), (i) was usually correct but mistakes in (ii) and (iii) fortunately triggered 'error-carried-forward' marks.

Q2. Questions on active filters are usually very well answered, but not so this year. Some confused active and passive filters, wrongly identified the type of filter shown in the graph, misunderstood its effect on a sine wave signal and failed to design an active filter circuit.

Part (b)(iv) produced some strange ideas. Active filters " … have a break frequency…" for example.

In part (c)(ii), many candidates used the voltage gain formula correctly, but ignored information about the break frequency. A common answer, as a result, was a feedback resistor of 20 kW and input resistor of 1 kW.

Q3. Most answered part (a)(i) successfully, though some omitted the '–' sign. Part (a)(ii) produced a mix bag of modifications. Many tried to incorporate thermistors. Where a dummy strain gauge was included, many failed to elaborate on why the modification would work.

In part (b), most circuit diagrams were correct, but many had the 'P' and 'Q' labels the wrong way round. Some simply ignored that part of the question. The answer to (iii) took into account 'error-carried-forward' where possible. The answer of 1500 V was particularly disappointing.

Q4. Part (a) - The vast majority of answers referred to a possible time delay were the smoke alarm polled and gained the mark.

Part (b) - A minority scored full marks here. Many answers were only partially correct.

Part (c) - It appeared that many had had limited knowledge programming a microcontroller. For example, an instruction “bsf PORTA,2,3,4” shows limited understanding of the instruction set. A common mistake in (iii) was to assume that if the contents of the working register are moved, using ‘movwf’, then the working register is empty.

Q5. Parts (a), (b) and (c) were usually well-answered, though some emitted the ‘-‘ sign.

Part (d) circuits were often spoiled by clutter and incorrect circuit symbols. Many included a third op-amp, connected as in the voltage regulator subsystem. Some also added a zener diode. These were penalised.

Q6. Part (a) caused problems. Candidates often had label **X** correct, but **Y** wrong, as both used the V_C signal, with the thyristor switching off when $V_C = 0$, or vice-versa, with both labels using the V_S signal. The estimate of phase shift, required for (iii) brought out some strange ideas!

Part (b) required correct amplitude and correct phase for two marks. Most candidates scored at least one.

Part (c)(i) was usually correct, but the explanation brought out vague waffle from many candidates.

Q7. Most knew the correct names for discs **A** and **B**, but needed both to be correct to get the mark.

Part (b) was not answered well, with many answers too vague.

Most seemed to know why Gray code is preferable in this situation but failed to formulate sufficiently detailed answers. In (ii), for example, the examiners were looking for an erroneous output, expressed as “X = …, Y = …, Z = …” and a description of where the error could occur, e.g. as the opto switches move from the ‘111’ segment to the ‘000’ segment. This level of detail was rare.

Q8. Many, but not all, knew the advantage of multi-stage amplifiers linked with decoupling capacitors.

Some answers to part (b) (i) were illogical. Point Z can sit at only **one** voltage. This is equal to the voltage at **X** minus 0.7V OR the voltage at **Y** plus 0.7V. Most candidates failed to see this relationship. The quiescent voltage of the signal in (ii) should have been equal to the voltage at **Z**, given in (i).

Part (c) was rarely answered correctly. The majority assumed that the resistors should have the same resistance. One, logically challenging, answer required that “they must have double the resistance of each other”.

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ET6

General comments

Thank are extended to centres for their effort in both organising candidates' work for moderation and the online recording of centre marks.

Candidates produced a very good range of projects, which included several outstanding solutions. All the candidates in a very small number of centres produced projects that tended to consist of several unrelated and separate circuits. A project should consist of number sub-systems that have signals that are transferred from one sub-system to another.

The majority of centres provided both excellent annotation and excellent photographic evidence. A small number of centres still persist in providing no annotation. The assessment of the work was within tolerance in the majority of centres.

Specific comments

The following points are made to highlight several of the more misunderstood criteria contained in the Coursework Mark Booklet.

Initial specification:
Several centres gave credit for power supply voltage/current requirements even when there was no justification provided for the values chosen.

Design specifications should contain a range of both qualitative and quantitative terms based on their analysis of the problem and contain detailed realistic electronic parameters.

Project planning and research:
Marks are consistently over awarded in this section for candidates' responses which were weak. Much of the research was quite superficial. It is expected that candidates will make use of their theory notes and information provided in the WJEC notes as a matter of course. Searching the internet/text books for the circuit diagram and frequency formula of a 555 astable/monostable as well as readily available datasheets is not relevant research.

Project development:
Alternative sub-systems must be viable/practical for the chosen application. As mentioned in previous reports centres are routinely giving candidates credit for suggesting the use of a microcontroller as an alternative for a number of sub-systems without providing any detail of a flowchart based or PIC based program that would I provide an alternative sub-system.

Evaluation:
The evaluation should compare the system against the design specification and make suggestions for improvement to access the full range of marks.

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