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Electronics ELEC5

(Specification 2430)

Unit 5: Communications Systems

Report on the Examination

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General Comments

ELEC5, the Communications Systems paper taken for the third time this year again resulted in candidates gaining the wide spread of marks as is becoming usual for this paper. The marks this year ranged from a minimum of 5 marks up to three candidates scoring 75 out of a possible 80 marks. The paper obviously proving to be a little more demanding at both ends of the ability range this year.

As always, the content of this paper was broadly similar to that of previous years, given that the aim is to cover as much of the specification as possible every year.

All questions on the paper were proved accessible to some candidates, since maximum scores for every section were noted somewhere. Judging by the number of candidates gaining marks this year of 75; this was a challenging paper even for the most able candidates. The fact that many candidates attempted to provide answers to the questions, particularly the last question, demonstrated that there was adequate time for the paper to be completed this year.

Question 1

This first question on a generalised communications system was intended to be an accessible question to provide all candidates with an opportunity to make a positive start to the paper.

(a) The correct responses to this question varied from almost 60% to nearly 90%. Many concise, correct answers were noted, but for part (i) some unnecessarily complex descriptions of a carrier wave were seen when just a name was sufficient.

Part (ii) was found the most difficult with some candidates naming or describing a medium rather than giving a possible type of signal.

(b) Many correct answers were seen for all parts (i) to (iv). In part (i) the demodulator was by far the most common incorrect answer. As might be expected part (iii) was found the most straightforward. As correct answers to part (iv) there were almost as many “carrier generators” as “receivers”. Several candidates incorrectly named the modulator or demodulator. A significant number thought a tuned circuit could be found in an output transducer – perhaps chosen because it was the last subsystem given in the diagram.

Question 2

This question was about the superheterodyne (superhet) radio receiver and associated problems with this type of receiver. There are areas here where candidates had difficulty in providing mark worthy answers.

(a) Less than 50% of candidates could label the diagram completely correctly even though the second blank box could have been given credit for being labelled as the demodulator or detector.

(b) Part (i) was well answered; over half of all candidates knew what AGC stood for, but very few indeed could explain correctly its purpose or action in part (ii), just over 5% in fact. There were some attempts to paraphrase “automatically control the gain” but these did not gain credit.

Both the purpose and the action were often explained with little clarity. It was not unusual for the purpose to be given as "to keep the gain constant". Some candidates gave a clear explanation of the action despite the purpose being hazy.

(c) Many correct answers were seen here but a significant number subtracted and gave a local oscillator frequency lower than the signal frequency despite the instruction.

(d) Part (i) was found difficult with few really clear answers. Those who pre-empted the calculation in (ii) were able to use the figures to illustrate what they were trying to put into words. Some who went on to give a correct answer in part (ii) still joined those who gave poor selectivity, crosstalk (or even crossover) interference as the reason.

Question 3

This question based on a current application of RFID ICs provided the platform for some basic work on resonant frequency, dipole aerials, Q-factor and data rate proved difficult for many. The only well answered section was (c) where the formula was given in the question. The heavy mathematical content must have proved difficult here.

(a) There were some completely correct calculations but also many attempts to use $X_L = 2\pi fL$ and $X_C = 1/2\pi fC$. Some candidates made an error by substituting 20 pF as 20×10^{-9} and several missed out the unit. Some scored full marks but did not show much working so would have gained little if they had made an error using their calculator.

(b) This was a higher scoring section with over 40% of candidates showing correct calculations and explanations – though some others did not notice the need for an explanation. Most explanations were to do with space considerations but a few other good answers considered range and security.

(c) This was well answered. A few candidates were confused by Δ (one wrote that it could not be found on his calculator). Some gave units for Q (none needed) and a few others made numerical errors.

(d) This was found very difficult, only just over 20% of candidates scored both marks here. The more able who converted bytes to bits usually went on to obtain both marks but most did not make this conversion.

Question 4

This question on digital communication using broadband internet services met a generally good response except for the calculation required in section (d) where only a tiny few could provide a completely accurate answer.

(a) The vast majority of candidates (nearly 90%), gave the correct answer with a correct unit. Only a very small number did not attempt the question.

(b) This was very well answered with the majority of candidates realising that a fractional number of channels would not be possible. Showing working is essential on calculations, as stated on the front cover of the paper.

(c) There were many correct answers for this. Many candidates showed by their working that they were keeping track of powers of 10. Some were less rigorous but did convert to Mbps at the end to show they were aware of the exponent issue. Others ignored the fact that they were out by several orders of magnitude and lost marks. (Some multiplied or divided by 1024 and ignored the effect this had on the exponent.)

(d) This was found very difficult by the majority of candidates as noted earlier, and was not tackled methodically. Handling the 3 extra bits and converting Gbytes to bits was found to be difficult. Most knew to divide by the rate of transfer to find a time.

(e) Most candidates knew that there was lower bandwidth for uploading but did not give values. Some candidates confused frequency with frequency range. Some seemed to use previous questions on this paper to gain ideas and became confused with parity bits etc.

(f) Many candidates gave a good answer here, demonstrating the experience of youth in the use of internet services and indicating perhaps that they all seem to spend many hours downloading from various sources, rather than originating material and uploading it.

Question 5

This question on the application of an audio amplifier IC included synoptic material as well as providing a vehicle for examining filters. It met with a generally good response with the exception of two sections as described below.

(a) This section was answered well with over 60% of candidates gaining both marks. Some candidates however wrongly stated that seeing negative feedback determined the application.

(b) Generally a good response was noted here. A small number of candidates lost marks by answering that the filter was “active” instead of the type of passive filter required. In part (ii), if candidates chose the correct equation they usually went on to obtain the correct answer and coped well with exponents. Some tried to use the reactance equation from the data sheet.

(c) There were only a small proportion of good, clear answers for this. Some recognised the effect on stability and some that the components would conduct high frequencies to zero volts. Most thought the components formed a filter (all types being suggested). Decoupling and reducing noise were other common answers.

(d) Some very good answers were noted here. Some candidates who quoted the gain equation made it clear that R_4 was equivalent to R_F etc. Others left this uncertain. Some even correctly referred to the reactance of C_2.

(e) Finding two valid factors amongst the answers offered here was found quite difficult. Common incorrect answers were gain, input signal and component tolerance.

Question 6

This question on the mobile phone network included an opportunity for an extended piece of writing. Again candidate's familiarity with the use of mobile phones stood them in good stead on some of the more general issues. One could only wish that more of them would have been better able to use the various technical terms accurately.

(a) There were some complete and clear answers but many were expressed poorly with the meaning unclear. Less than 20% of them gained full marks here. A significant number thought that the radio signal from the phone to the base station was analogue and that the base station performed the conversion. Separation of uplink and downlink was frequently overlooked.

(b) TDM was not widely known for part (i), only just over 30% answered this correctly. Often FDM or just multiplexing was offered. Parts (ii) and (iii) were generally well answered, but in part (iv) a few thought multiplexing was the solution, but this part was generally well answered. In part (v) it was not always made clear that there is a cell structure and that there is frequency re-use but this was generally well answered in the main.

(c) Candidates general knowledge of the operation of the mobile phone network came into play here and some two-thirds of them managed to gain both marks here.

Question 7

This novel question went further than had been done before into optical communication, following the recent trend of developments in this area at several levels. There was also another opportunity for a piece of extended writing in this question which proved an arduous task for some, especially as it was on the outer back cover of the paper. From the response to this, it was obvious that the majority of candidates had time to answer the paper, as most made an attempt here.

(a) In part (i) most candidates gave the correct answer with only a few "negative bias" or "forward" answers given and not awarded credit. In part (ii) nearly all those who started with V = IR obtained the correct answer. Nearly all gave a correct unit. Those who did not succeed were usually attempting an unnecessarily complex process. In part (iii) many correct answers were seen. Not all those who obtained the correct value for current could find the voltage. Some were given the voltage mark even though they had used the wrong value for current. Most gave the correct units.

Some use of T = 1.1 RC in part (iv) were seen, but many correct answers also. A significant number substituted correct values but made calculation errors. A few gave the unit as FΩ but seconds are preferred for time. Part (v) was found quite difficult. The more able realised that bias was the issue. Many brought in 95% amplitude from the data in the question.

(b) Some good answers were seen here, but less than 20% of candidates were awarded all five marks with a wide spread of marks lower than the maximum. Some candidates confused the terminology. It was widely thought that TIR occurs for rays incident at more than the critical angle. Many candidates described dispersion and received no credit for the points made.

It is not good practice to refer to optical fibres as wires. (Students who have handled fibres are less likely to do so.) A few talked about “ohmic losses” and “resistance” and lost credit.

The fact that most candidates completed the paper and indeed most of the final question however poor the response, indicated again that there was sufficient time to complete this years’ paper in the allotted time.

Mark Ranges and Award of Grades

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