Exam Feedback: EEE204 January 2011

General Comments: These are not significantly different from last year. A reasonable attempt at EEE204 very few people scored very low marks. As last year, and, sadly, every year, many marks were lost because of silly numerical errors and whilst each error only loses one mark, some of you were totting up quite a few that you could ill afford. The two main problems that some of you have are disorganisation and explanation. These are perennial problems so the comments that follow were also in last year's feedback comments. Some of you presented very messy work that was hard (in some cases impossible) to interpret and in a few cases you confused yourselves by failing to take an ordered approach to your questions. If you are doing an analysis, you need to draw a circuit diagram – how else can I credit correct formulation of equations describing the circuit? You need to explain briefly (three or four words is usually enough) what you are doing so that I can follow your thinking – if I just see a set of numbers or equations you leave me in a position of having to guess whether or not you are intentionally doing the right thing. Don't be frightened to draw diagrams to help you think things through.

Q1: In part **(i)** about half of you managed to handle the idea that the circuit involved an op-amp and got correctly lf gain = 1 and hf gain = $(R_1 + R_2)/R_2$. Of those who got it wrong, the majority simply redrew the circuit without the op-amp and ended up with the reciprocal of the right answer. Many of those who got it wrong then proceeded to work out the transfer function of part **(ii)** correctly but didn't bother to check consistency between parts **(i)** and **(ii)**. In part **(iii)** I got a range of sketch shapes – the most common error was from people who said in part **(i)** lf gain = 1 (correct) and hf gain = $R_2/(R_1 + R_2)$ (incorrect) and then proceeded to draw a pole zero response of the correct shape but that started with lf at $20\log[R_2/(R_1 + R_2)]$ and finished at hf at 0dB. 0dB should have been the lf gain. In part **(iv)** it was the hf gain multiplied by 500kHz that was needed – many people used the lf gain. The slew rate question is usually a banker – especially with a sinusoid – but I was surprised how many people proved that slew rate = $V_P\omega$ was the equation needed and then, by using wrong numbers, demonstrated conclusively that they didn't know what those terms meant! Part **(v)** was not well answered. Most people had brain switched off and did not therefore recognise that since offsets are dc effects, C is an open circuit and the op-amp effectively has a single feedback resistor, R_1, from output to input. The offset voltage at the output is then simply $v_{os} + i_b^- R_1 = v_{os} + (i_b + i_{os}/2)R_1$. I did warn you that if I asked you about offsets, the question would be easier than the class example . . . but that does mean that you need to understand what you are doing.

Q2. There were mixed responses to part **(i)**. The biggest problem was caused by the last part which was looking for mention of parasitic – ie the L and C associated with R and the L and R associated with C. Many people talked of X_C approaching zero at high frequency – true, but to be expected even from a perfect capacitor. Part **(ii)** was supposed to be a banker and was done successfully by most. Part **(iii)** asked you to ***evaluate*** ω_n and q for the function given in part **(ii)**. A significant number derived expressions but didn't evaluate and thereby lost marks. In part **(iv)** the most common error was in converting $1/(\omega_n q) = 2C_2R$ into an expression for q. I took particular trouble to warn you of the algebraic trap caused by $\omega_n = 1/(LC)^{0.5}$ and trying to do too much in one step but many of you forgot or ignored my warning and paid the price. Part **(v)** was looking for "unity gain buffer" – a handful of you got it. Part **(vi)** was asking whether you could remember the circuit of a buffer and of a Sallen and Key circuit and put the two together appropriately – three marks to sort out the very good from the much rarer excellent.

Q3: This question was attempted reasonably well – over half of you managed the first two parts without problems. Those who had problems made mistakes like forgetting to square the potential dividers operating on the various noise power sources. About half of you realised that you needed to find the noise temperature of R_{Th} in order to use the kT/C relationship. In part **(b) (i)** many people were unable to start the process which was asking you to produce a standard proof. Part **b (ii)** was straightforward. The gains had to be converted to linear power ratios by $A_p = 10^{(\text{gain in dB}/10)}$, the /10 being because it was a power ratio. Then it was simply a matter of evaluating overall F for the two possibilities and choosing the best or, alternatively, working out one case and making an argument why the other option must be worse.

Q4: A relatively small fraction of you attempted question 4 but most of you that did attempt it made reasonable attempts. Most answers to part **a (i)** and **(ii)** were correct. Part **a (iii)** required a bit of description which could be done largely by diagrams. The two key ideas were that pwm is a fixed frequency pulse train where the width of the pulses is proportional to the amplitude of the modulating signal. The signal is thus coded as the average value of that pulse train and can be extracted by low pass filtering. Some people drew sketches of a pwm waveform that showed no sign of any relationship between pulse width and signal input – a diagram is worth 1000 words only if it is carefully drawn! Most people managed **b (i)** although some people turned brain into "off" mode and used the expression for dissipation given at the end of the question to calculate the load power. Part **b (ii)** was done well by most. In both parts **b (i)** and **(ii)** a significant minority said power = V_P^2/R when it should be V_{rms}^2/R which for a sinusoid is $V_P^2/2R$. In part **b (iii)** there was a variety of opinion about what constituted the average value of a half wave current waveform – the most assured attempts drew a diagram of the waveform to guide their thinking. And now a pat on the back - part **b (iv)** on heatsinking saw the best attempts for many years my advice about it being applied common sense obviously paid off. Most people drew a thermal flow diagram to aid their thinking and reaped the benefits.