Exam feedback for EEE117 "Electrical Circuits and Networks" 2013-2014

General Comments:

For this module 80% of the marks come from the exam, 10% from homework (5% Sem1 and 5% Sem2) and 10% from midterm tests (5% Sem1 and 5% Sem2). Invariably students who did not attempt the homework exercises did poorly in the exam. Homework exercises are there to encourage you to engage with the course at an early stage and the feedback provided allows you to see where you went wrong or to seek clarification. A couple of candidates answered more than the required 4 questions – only the first 4 in order of appearance are marked so remember to cross out any you do not want the examiner to consider.
The first three questions were attempted reasonably. As last year, the biggest single problem I think you have is failure to draw out circuit diagrams. If you are doing an analysis and writing equations with I_1s, I_2s and V_1s and V_2s etc, how can I identify a correct statement (and hence allocate appropriate marks) if you don't provide me with the information I need? Furthermore, the diagram will help to keep you focused on the problem. Similarly, go through the whole process. In nodal analysis, define the currents entering the node and write the current sum equation before writing the currents in terms of voltage differences and impedance - the process guides your thinking and helps you to organise your work. Finally, in most cases of network analysis - certainly at dc, it is easy to use your answers to check that sum of currents at a node = 0 or that sum of voltages around a loop = 0. This year several of you checked your simultaneous equation solutions – well done, checking is good engineering . . . . so **check check check!**
For the last three questions many candidates did not show sufficient intermediate steps or method; always clearly show the method you have used – if you get the wrong answer you will at least get some marks if you used the correct method.
Quite a few candidates failed to complete the front cover indicating which questions had been attempted – this puts the marker in a bad mood as they have to go through the script to check. A marker in a bad mood may not be as generous in their giving of marks!

Question 1:

Part (a), most people managed the effective resistance but for the current through 15 Ω some tried to use the current splitting formula but got it wrong BEWARE OF FORMULAE! The current splitting rule is not straightforward for three parallel resistors. Power in 5 Ω was done by most. Part (b), good attempts here. One or two had obviously not tried to do an unseen nodal before (I did warn you) but most problems were caused by arithmetic errors. Part (c) was probably your weakest effort in Q1. The position of I was important – you have to use transformations that leave I explicitly in the circuit. Some of you combined the 3Ω and 5Ω resistors to make a Norton to Thevenin transformation. As soon as you did that you obliterated I, the current of interest. The superposition checks were disappointing. The main problem that people had was not taking sufficient care in drawing the partial circuits – they were often subminiature and quite incapable of being annotated. Circuit diagrams help you organise your thinking.

Question 2:

Part (a) was a bit disappointing – you needed to know that at resonance the circuit was resistive and that provides the relationship between ω, L and C and allows R_L to be deduced by potential division. For Q you needed to remember that $Q = |V_C|/|V_I|$, V_C can be expressed in terms of I and X_C and V_I can be expressed in terms of I and $R+R_L$. I thought you might find this easy – it was more or less a repeat of the passive circuits lab. Good to know the labs are so effective! R_L is frequency dependent because of the "skin effect". Part (b) was done pretty well. A few of you are still not sure what a node is – V_A is the voltage of a single node with four branches from it; some of you had two nodes, some of you just ignored the "j"s – just didn't like the look of them I suppose. In working out the power in the 10Ω it was necessary to work out $|20-V_A|$ where V_A is a complex number – you can't use $20 - |V_A|$. Part (c) was done well. The main tricky bit here was to remember that the rms I had to be converted to peak to get the peak energy stored.

Question 3:

Mixed attempts at part (a) but much better than last year. Most of you got the $t = 0^-$ conditions correct. At $t = 0^+$ about half of you had problems. Few of you drew a $t = 0^+$ equivalent circuit, which was a pity because the evidence suggested that it would have been helpful. Some of you were commendably disciplined and wrote down I_L and V_O ($=V_C$) straight away under the $t = 0^+$ bit – well done. Part (b) was done well by all who could remember that impedance, Z and admittance, Y are related by $Y = 1/Z$ which, unfortunately, was by no means all of you. All who remembered what admittance was did well on that section (some gave admittance the symbol A but that was OK by me). Most managed the "show that" bit of part (c). As last year, there was a variety of sketches ranging from two axes and a nervous curved line with no annotation to very good completely labelled and carefully drawn sketches. The straight line constructions are the key to Bode plots and if you start with these, the rest will follow. If you remember, I always started with the straight line asymptotes because they provide such a good framework.

Question 4:

Attempted by approximately 60% of candidates. Most students made a reasonable attempt at this question, although several candidates missed parts of sections – always go back and reread the question to ensure you have not missed anything.
Generally part (a) was well answered. Some candidates referred the load to the primary and then solved for the current; this is fine but don't forget to refer the current back to the secondary. In part (a)(ii) there was some confusion about which voltages and currents to use – this can often be avoided if a sketch is drawn. In part (b) most candidates correctly referred both secondary winding R and X and also the load to the primary side, although several forgot to refer the load. Once again remember to refer the current and load voltage back to the secondary as the question asks for the *actual* load current and voltage.
In part (b)(ii) most candidates realized that they needed to add on the magnetizing current but either forgot it has an associated phase angle, or took the angle as positive. (Remember for a lagging power-factor circuit the current lags the voltage (i.e. phase angle is negative. Part (b)(iii) caused the most problems. The easiest way is to calculate the output power using I^2R. Several candidates used VI cos(Φ) with the overall voltage – this would also include the winding (copper) losses. Another common error was to include the iron losses in the efficiency calculation, but forget the copper losses, or vice-versa. Most candidates supplied a reasonable answer for part (c).

Question 5:

Attempted by approximately 36% of candidates. The main problems in this question were to do with confusing line and phase values, mixing up S, P and Q, and using total values when phase values were required and vice-versa. The main problem in part (a)(i) was using the line voltage rather than the phase voltage when calculating the current and the different power formulas when using line or phase values. Part (a)(ii) caused major problems and many candidates simply omitted it. Those that did attempt it usually correctly calculated the output power but either forgot to convert the speed to radians per second or didn't know how to. In part (b)(i) the main source of mistakes was mixing up KVA and KVAR particularly for load 3. Some candidates even used cos(0.75) – the power factor (in this case 0.75) is already the cosine of the angle. In part (c) the common mistake was forgetting to divide the total Q value to a per phase value for calculating the reactance of the capacitor.

Question 6:

Attempted by approximately 82% of candidates. The majority of candidates managed part (a) without too much difficulty. The most common error was incorrectly calculating the length of the flux path, L. This should be 60cm not 15cm as there are 4 sides to the square. Again part (b) was well attempted and most candidates successfully calculated the total reluctance as the sum of the reluctance of the iron and the airgap. The length of the iron path changes slightly from the value in part (a), but hardly has any effect on the overall reluctance, however if using the same value as found in part (a) I would expect students to include a brief statement to this effect. Part (b)(iii) was skipped by most candidates and the remainder came up with a variety of ideas. Core materials (e.g. iron and steel) have non-linear B-H characteristics so an inductor without an airgap would have an inductance which would vary with the level of current in the coil. In part (c)(i) most candidates totally forgot all about AC circuit theory and only considered R when calculating current. The inductance has a reactance which is comparable in magnitude to R at the supply frequency (126Ω compared to 70Ω). This also means the formula $V_{rms} = 4.44\, f\, N\, \Phi_{max}$ will not give the correct answer. In part (c)(ii) the rms current is required when calculating the power dissipation (= $I_{rms}^2\, R$) whereas for the peak energy stored the peak current is needed (= $0.5\ L\ I_{pk}^2$). Only a handful of candidates did part (d) correctly. Use $V = L\ di/dt$. Since the supply is DC the current before the switch is opened is determined solely by the resistance.