Feedback for EEE117 Session: 2014-2015

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.
In general scripts were untidy, poorly annotated and very difficult to read in places. This was also true of the homework submissions – you are training to be professional engineers so start taking some pride in your work!
Most candidates did not show sufficient steps or quote equations being used which meant it was difficult to award part marks for method if the final answer was incorrect. The same comment applies to circuit analysis problems; if you don't draw a circuit diagram AND label your variables it is impossible to give credit for working because we have no way of telling what the terms in the analysis mean. Many marks were lost by this omission. Another annoying practice that has come about in the last few years is the use of fractions rather than decimals – this may be the default of certain models of calculator but it is your responsibility to express values in the standard engineering notation please. If you don't know what this is, ask your tutor.
A few candidates failed to complete the front cover indicating which questions had been attempted (much improved on previous years so perhaps this message is getting through) – this is extremely inconvenient for markers – it slows down the process considerably.

Question 1:

Attempted by approximately 90% of candidates. The response to Q1 was disappointing. In part (a) about two thirds of you managed to get the right answer by superposition. For the most part, those who didn't get the right answer some couldn't remember how to treat sources in a superposition exercise (no excuse for this), some couldn't perform the relatively straightforward analysis of the partial circuits (lack of practice in the early part of the module) and one or two decided to use loops or nodal analysis as the primary solution method which was not what the question demanded. Part (b) was done successfully by about half of you. Many people performed another superposition analysis, this time with three sources which was OK but not really necessary. The circuit was identical to that of part (a) with the exception of the current source so all that was needed was the 5Ω current contribution due to the 5 A source. Some people tried to convert the 5A source into a voltage source using a Norton to Thevenin transformation – a small number were successful, those who weren't were let down by their analysis skills. Part (c) was poorly done – only a handful knew what they were doing. Most attempts lost sight of the terminals A and B and worked out Thevenin equivalents for other terminal pairs. There was a variety of circuits presented as Thevenin, the commonest was something containing two resistors and two sources; Thevenin would not have been impressed. Most people shunned the easiest way of finding R_{Th} – ie, replacing the voltage sources with short circuits (0Ω links), looking into terminals AB and working out the resistance seen. Some tried to derive the Thevenin equivalent by successive transformations but most fell by the wayside because the terminals AB were absorbed into transformed components. A correct version of the successive transform approach is given in appendix 1. Part (d) was done reasonably well. If the answer was consistent with previous answers marks were given. If the answer just said "receiving" or "delivering" and there was no answer to part (c), the statement was a guess and no marks were given. Part (e) was not well done – a depressingly small number of people knew what a Norton equivalent circuit looked like – there is no excuse for this.

Question 2

Attempted by approximately 61% of candidates. Part (a). part (i) was done well by most people although some were unsure as to the impedance of a capacitor and some were getting confused between series and parallel circuits. Most people who showed the resonant frequency relationship got the marks, despite some careless statements about the resonance condition (more later). Part (ii) was done well enough by most, the commonest mistake was to sketch a curve that indicated maximum Z at resonance – nonsense, of course. Part (iii) was again well done by most. Common errors were 90 degree angle between V_L and V_C and sketching a current phasor diagram with I_L vertically upwards and I_C vertically downwards. In a series circuit, the current is the same through each element so will be identical in magnitude and phase. Part (iv) Many people could use the definition given to get an expression for Q factor. Some left it as $\omega L/R$ which is strictly not what the question asked for because ω is not a circuit parameter. Those who put ω_r got the marks as did those who expressed ω_r in terms of L and C. ω_r is a circuit parameter because it is defined in terms of L and C, ω is determined by the signal source. Part (v) was managed by most – errors consisted mainly of silly arithmetic slips caused by disorganized and scruffy answer layout or by the tendency of some to write $1x10^7$ as 10000000 or $3x10^{-6}$ as 0.000003 . . . . USE ENGINEERING NOTATION!
Part (b) part (i) Biggest problems here were: uncertainty as to how to handle ZC, inability to write down the impedance of a three element circuit consisting of two parallel arms (lack of practice) and problems manipulating

complex expressions. Part (ii) The main problems here were associated with some lazy thinking about resonance. Most had some idea that *j* terms vanished. Some just crossed out the *j* terms, said $Z=R$ at resonance and proceeded to use the real part of Z to find f_r – this is wrong. THE SUM OF THE j TERMS EQUATE TO ZERO AT RESONANCE and $Z=R$ is true only for the special cases of ideal series and ideal parallel resonant circuits. It is the process of equating the sum of the *j* terms to zero that yields the expression for ω_r. In order to do this the *j* terms in Z must be all in the denominator OR all in the numerator. Generally if there are *j* terms in both numerator and denominator it is easier to rationalize Z to get *j* terms in the numerator only.

Question 3:

Attempted by approximately 37% of candidates. The answers to this question were disappointing. Part (a) There is plenty of practice available for this sort of question but few seem to have used it. The $t = 0^-$ values were generally done well but for $t = 0^+$ the situation was less rosy. No change in I_L or V_C during the transient. Some people actually wrote down I_L remains the same and promptly computed a new value for it! Most of the wrong values calculated arose because of misapplication of Kirchoff's current law at $t = 0+$. More practice needed – especially for those who might be interested in power electronics in future years. Part (b) flummoxed most people. When the switch closes, the initial charge in C1 is redistributed between C1 and C2, but the total charge is unchanged. Energy is needed to move the C1 charge through the resistor. At t = ∞, no current will flow so VC1 = VC2 and will equal the voltage expected across a capacitor of value C1 + C2 which contains the initial charge in C1. Thus final energy can be evaluated. Some people realized that the charge would redistribute, one person worked the Q out correctly. Part (c) was done well by those who had revised and practiced the process and it was quite clear who had not tried to do a question of this type without the solutions next to them. Part (d) was done by most without problem.

Question 4:

Attempted by approximately 74% of candidates. Generally most candidates correctly calculated the turns ratio in part(a), but some struggled with the VA. Some of the confusion stemmed from how to cope with 6 bulbs in parallel – simply assume a single load of 120W rating. In part(a)(ii) the main problem occurred in finding the primary current – remember the ratio of Ip / Is is the inverse of the turns ratio (= Ns/Np). Part (b)(i) was quite well answered although many candidates omitted the magnetizing branch or did not correctly calculate the referred quantities. In part (b)(ii) the main source of error was to forget to include the magnetizing branch current and remember this has both magnitude and phase. In part (b)(iii) some candidates used the value of current calculated in the previous part, rather than the current in the load branch (i.e. you should not include the magnetizing current here). Part (b)(iv) was reasonably well answered, but in part (b)(iv) most candidates forgot to include the iron losses in their loss calculation. Part (c) was usually ignored!

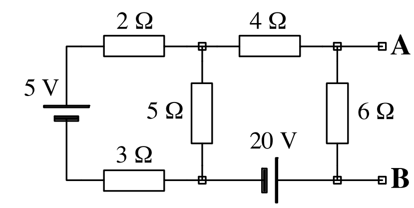
Question 5:

Attempted by approximately 45% of candidates. Most candidates made a reasonable attempt at this question with several gaining full marks. Unfortunately once again most candidates did not show sufficient intermediate steps or the method they had used. In part (a) the main sources of error were: confusing line and phase quantities, forgetting the √3 in the total power formula when using line quantities or the 3 when using phase quantities, attempting to use V^2/R (which is not possible here as you do not know the voltage across the resistive part). Parts (b)(i) and (ii) did not cause too many problems but some candidates attempted to use cos(0.6) rather than realizing that 0.6 was the cosine already! The main problem was in part (b)(iii) and also part (c) – you cannot simply add the individual KVAs together as they have associated phase angles. You need to find the total real and reactive powers first and then use $S = \sqrt{P^2 + Q^2}$ For part (d) you need to use P (not S) to find the new value of reactive power since adding the capacitors will change S.

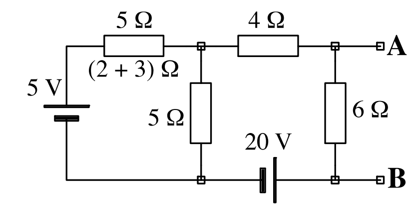
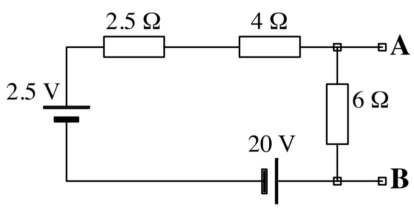
Question 6:

Attempted by approximately 86% of candidates. Most candidates correctly answered parts (a)(i) and (ii) although a few only accounted for one side of the iron core, or omitted to deduct the airgap length from the core length (this latter was acceptable provided an explanation was given). Part (b) provided the greatest source of error as candidates needed to be aware of when to use peak and rms values. Part (b)(i) was very poorly answered – some candidates simply used the equation $V_{rms} = 4.44\, fN\phi_{\max}$ but this expression effectively ignores the resistance; other candidates simply multiplied the resistance by the current – you first need to calculate the impedance then multiply this by the current taking care that the question asks for rms voltage (The current calculated in part (a) gives rise to the maximum flux permitted so this the peak value of current when supplied from a sinusoidal supply). Most candidates answered part (b)(ii) incorrectly by using $P = V^2 / R$; this cannot be used directly as you do not know the voltage across the resistive part of the coil – use $P = I^2 R$ but again I needs to be an rms value. Part (b)(iii) caused few problems. Part (c)(i) was very well answered although some candidates forgot that when the airgap increases the length of the iron core will decrease. Parts(b)(ii) and (iii) caused little problem.

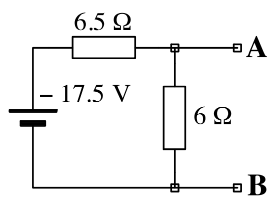
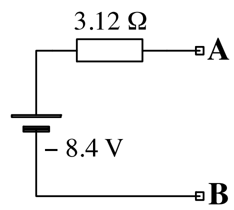
Appendix 1:

<table>
<tr><td colspan="2">A Thevenin transformation approach to Q1 part (c)</td></tr>
<tr><td>1 This is the original circuit. Notice that the 2 Ω and 3 Ω resistors are in series with the 5 V source. This part of the circuit has been simplified in circuit 2.</td><td>
</td></tr>
<tr><td>2 This is the simplified version of circuit 1. The 5 V source, the (2 + 3) Ω and the 5 Ω resistors can be formed into a Thevenin equivalent as shown in circuit 3.

$R_{Th} = 5\ \Omega \ // \ 5\ \Omega = 2.5\ \Omega$

$V_{Th} = 5 \times [\ 5\ \Omega \ / \ (5\ \Omega + 5\ \Omega\ )\ ] = 2.5$ V</td><td>
</td></tr>
<tr><td>3 This is the circuit with the Thevenin equivalent of the 5 V source and resistors 5 Ω and (2 + 3) Ω. The circuit to the left of the 6 Ω resistor can be simplified easily by adding the sources and adding the resistors. Note that the 20 V source is in the opposite direction to the 2.5 V source. The result is circuit 4.</td><td>
</td></tr>
<tr><td>4 This is the simplified version of circuit 3. With the source as drawn its value must be negative. 6.5 Ω is simply the sum of 2.5 Ω and 4 Ω. The final step is to represent circuit 4 as the Thevenin equivalent shown in circuit 5

$R_{Th} = 6.5\ \Omega \ // \ 6\ \Omega = 3.12\ \Omega$

$V_{Th} = -\ 17.5\ \text{V} \times [6\ \Omega \ / \ (6.5 + 6)\ \Omega] = -\ 8.4$ V</td><td>
</td></tr>
<tr><td>5 The Thevenin equivalent circuit looking into terminal AB as required by the question. Armed with this equivalent circuit it is easy to calculate the current through a 10 Ω external load and hence the load power dissipation.</td><td>
</td></tr>
<tr><td colspan="2">Notice how at each stage of the process the terminals A and B have been explicitly available. Many of you made the mistake of absorbing A or B into some combined component. For example, many people at the circuit 2 and 3 stage tried to combine the 20 V source with (4 + 6) Ω to make a Norton equivalent of those components. In doing that, V_A was lost and you ended up producing a Thevenin equivalent circuit representing a viewpoint other than the AB viewpoint required.

To use a method like this successfully you must be confident in your application of Thevenin and Norton circuits and you must be reasonably good at interpreting circuit diagrams. It is an elegant solution method riddled with traps and pitfalls to catch the unwary.</td></tr>
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