Examination Feedback for EEE117 – Electrical Circuits and Networks
Spring Semester 2015-16

Feedback for EEE117 Session: 2015-2016

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. Another annoying practice that has come about in the last few years is the use of fractions rather than decimals – I suspect this is the default of certain models of calculator – express values as decimals please.
A few candidates failed to complete the front cover indicating which questions had been attempted (much improved on previous years so perhaps the message is getting through) – 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!
No requests for surgery sessions/problem classes were received by either lecturer leading up to the exam and it seems that students are preparing for exams in a first come, first serve order. In general extra surgery sessions that have been organised throughout the year were very poorly attended, and lecture attendance dropped off severely towards the end of each semester.

Question 1:

Attempted by approximately 72% of candidates. Despite variants of this circuit appearing in the Mid-term test, Tutorial sheet 2, the EEE117 Personal Tutorial, and having been worked through in a lecture with all three circuit analysis methods, students dealt with this question poorly. Part (a – i): Many students seemed to confuse 'loop analysis' with 'nodal analysis', and did not sum the voltages around each selected "loop". Directions of voltages were often not taken into account, and some students may have calculated the voltage across the current source but then used some arbitrary resistance to calculate power instead of multiplying V by I. Some students attempted this question by superposition, and yet still did not achieve the correct answer due to incorrect handling of current and voltage directions. Part (a-ii): Hardly any students actually calculated the current in the branch with Batt2 in, and seemed to decide a 50-50 choice with minimal justification would be satisfactory. In fact the battery provides zero current and is neither sinking or sourcing. Students who tackled this numerically and ended up with negligible current due to rounding errors would still obtain full marks if they justified the correct direction of current. Part (b – i): In many cases this part was attempted well, but in some cases the current source and resistance were transformed to a Thevenin equivalent circuit despite not being truly in parallel because of the voltage sources. Part (b – ii): Some students did not allow for the fact that voltage was dropped across the Thevenin resistance when calculating power. Part (c): A clear case of students not reading the question fully and following the instructions – a battery with internal impedance was to be placed in a given direction between points A and B (i.e. in PARALLEL with the existing 5ohm resistor), instead in the majority of cases the battery was placed in series with the resistor and the internal resistance often neglected. Students who correctly placed the battery and resistance achieved full marks for this part in general.

Question 2:

Attempted by approximately 29% of candidates. Part (a - i): Most students calculated the steady-state values correctly, but some did not seem to appreciate that the capacitor was discharged at switch over (as stated in the question). Part (a – ii): Despite the question being worth 4 marks and asking for 2 energies per switch position, some students did not record all 4 energies required. Part (a – iii): Very few students failed to appreciate that suddenly trying to switch the current in an inductor to zero would have voltage spike issues since V = L*di/dt, despite this being discussed in lectures. Part (a – iv): Mostly answered well, some issues with students redrawing the circuit incorrectly or writing down an incorrect resistance value. Part (a –v): Many students struggled to reduce the circuit down to an RC circuit – often using an incorrect Norton transformation. Many students seemed to forget that the 20V source is effectively a short-circuit and therefore the 10ohm resistor can be neglected. Many students appreciated that whilst the RC time product may have been less than the 2ms interval, the time taken to charge the capacitor to steady-state was not.

Question 3:

Attempted by approximately 83% of candidates. Part (a): Generally attempted well. Some students used the incorrect equation for capacitive reactance. Most used the conjugate correctly to achieve purely resistive denominator and stated that the imaginary values of the numerator must be forced to zero. In Part (a – iii) students seemed to analyse the circuit correctly, but then calculated the power with the incorrect voltage or current – something that seemed to be a problem in early homeworks and the Midterm test. Part (b – i): Often the complex voltage given in the question was assumed to be the impedance and the frequency was often stated as 50Hz despite being labelled as 1kHz in the figure. Students failed to list both the polar and cartesian forms of their answers thereby losing easy marks. Part (b – ii): Appreciation of a negative reactance being capacitive (-j = 1/j) was not taken into account and so many students did poorly.

Question 4:

Attempted by approximately 62% of candidates. Part (a) was reasonably well attempted, although only a very few candidates made any mention of assumptions, despite using the approximate equivalent circuit where the magnetizing branch has been moved to the terminals. A few candidates correctly referred R_2 and X_2, but forgot to refer the load.
In part (b) many candidates made the mistake of writing down the impedance as 43000 + j2800; this would be true if R_m and X_m were in series but they are in parallel. The easiest way is to calculate the current through R_m and X_m separately and then sum the currents remembering that they are 90º out of phase with each other. Some candidates even put a short circuit on the output – no-load means there is no load connected and hence no current through R_1, X_1 R_2'and X_2'. Part (c) also caused some problems; you cannot easily use I^2R_m as you do not immediately know the current through R_m – it is not the current from part (b) as only a proportion of this flows through R_m. In Parts (d) (i) and (iii) the many problem was students forgetting to refer the calculated value back to the secondary side to get the actual load current and actual load voltage. The remaining parts of section (d) were reasonably well attempted as was the descriptive question in part (e).

Question 5:

Attempted by approximately 62% of candidates. The main sources of error in this question were confusion between line and phase quantities and when to use total of phase values for real and reactive power. Parts (a) (i) and (ii) were reasonably well attempted but some candidates used the line voltage rather than the phase voltage. In part (b) (i) most candidates correctly realised that the capacitors need to supply the difference between to initial and corrected value of reactive power, but then forgot to divide this value by 3 to find the phase capacitance. In (b) (ii) again there was confusion between line and phase values. Very few candidates correctly answered part (b) (iii) – many calculated the VA rating and not the voltage rating – the question simply wanted the peak value of the sine wave. Part (c) cause the majority of problems in this question; the synchronous machine can do the job of power-factor correction as well as providing some useful mechanical output power. The question also clearly states that the power-factor of 0.95 is for the overall site and not just the motor. The only known parameter in the power triangle is the real power (factory + 1.2MW from the motor) and it is this value that must be used to find the overall reactive power and hence the amount of reactive power that the motor needs to supply (similar method to part (b) (i)). In part (c) (ii) the question clearly requests the VA rating of the motor, but many candidates incorrectly used the overall power (factory + motor) in this calculation. In part (c) (iii) again many candidates confused phase/line voltages and total/phase powers when finding the impedance. Quite a number of candidates did not show sufficient steps in their calculations making it almost impossible to award some marks for method if the final answer was wrong.

Question 6:

Attempted by approximately 88% of candidates. Part (a) was well attempted, although some candidates did not know how to calculate the circumference of a circle and others chose to ignore the iron core. Strictly the length of the core is the circumference reduced by the length of the airgap; in this example it has minimal effect, but it should have been noted if this approximation was assumed. A few candidates did not know how to convert from mm^2 to m^2; in part (i) the areas cancel out so the result is not affected, but will lead to an error in part (a) (ii). For part (b) candidates could have saved themselves some effort by noting that the flux density is the same as in part (a) and hence the required current would be the same. However it is important to note that in the AC case this will be the peak current and the rms value will be required when calculating the impedance which can then be used to find the reactance. Some candidates chose to use the equation $V_{rms} = 4.44\, f\, N\, \varphi_{max}$ which effectively ignores the resistance. In this example the resistance is actually small compared to the reactance so the approximation is valid, but candidates did not know this at the outset and a note of this approximation should have been made. Part (c) threw up many varied answers. A frequent problem was students using the 'j' notation and attempting to calculate the impedance; the current clearly is not a sine wave so this is totally incorrect. Many students chose only to calculate V_L or V_R in parts (i) and (iii), others decided to use pythagarus to sum the components – again this is only used when sinewave currents and voltages are 90º out of phase. In part (iv) again many candidates chose to only calculate the energy in the resistor or inductor (not both) and some tried to integrate $0.5\, L\, i^2$, which is already an energy.