Examination Feedback for EEE123 – Introduction to Electric and Electronic Circuits
Spring Semester 2015-16

# Feedback for EEE123 Session: 2015-2016

## General Comments:

The exam counts for 80% of the overall module marks, with 4 lab classes making up the remaining 20%.

A significant number of candidates only answered 3 questions and a handful answered more than the required 4 (additional questions were not marked) – ***you should always read the rubric on the front cover of the exam to find out the number of questions that you need to answer.*** This year only about 20% of candidates failed to fill in the numbers of the questions answered on the front cover of the answerbook (which is a vast improvement on previous years. Some scripts were extremely untidy and difficult to read; many candidates could have gained more marks if they had shown equations used and intermediate steps – simply quoting an answer which is incorrect cannot be awarded any marks. Another annoying practice is to quote answers as fractions rather than decimals – please always use the latter.

The following particularly relates to questions 4 – 6 (semester 2 material):

Throughout the paper marks were lost by the following bad habits: **(i)** In questions involving a bit of circuit analysis (hard to avoid in electronics!) failing to draw a circuit diagram with clearly labelled currents and voltage differences. This means that the reader/marker has no idea what the equations you write are about because they don't know how you have labelled your diagram. A properly drawn and clearly labelled diagram is also likely to help you avoid errors. **(ii)** In questions involving resistors, some people miss off the unit multipliers in their equations – eg they might write 80 instead of 80 kΩ – but then forget to put them back before calculating. Some of you lost marks as a result of calculating currents 1000 times too big. Be suspicious if you calculate a current of a few amps in a circuit driven by a few volts and containing resistors in the kΩ region. **(iii)** Read the questions carefully – several people lost marks because they answered a question that wasn't asked instead of the one that was.

## Question 1:

Attempted by about 91% of candidates. Part (a) was very similar to an example in the lecture notes but many candidates made a very poor job of answering it. In part (i) many candidates did not recognize that the voltage across the bulbs was in phase with the current and that the voltage across the inductor leads these by 90º. Most candidates correctly calculated the current (which is for 3 bulbs in parallel) in part (ii), but in part (iii) the vast majority of candidates quoted the inductor voltage as 100V which is incorrect as this voltage is not in phase with the supply voltage of the bulb voltage (a little thought about the phasor diagram should have indicated this) which meant an incorrect value for the inductor in part (iv). For part (v) most candidates connected the capacitor in series with the inductor; whilst this would create a series resonant circuit in which the supply voltage and current would be in phase (hence unity power-factor) this would result in 300V appearing across the bulbs, negating the very reason for using the inductor in the first place. The only place to connect the capacitor is directly across the supply. Because the majority of candidates incorrectly sited the capacitor they calculated the incorrect peak voltage for part (vi); if they had quoted the relationship between rms and peak voltage rather than simply quoting an incorrect answer, they would have gained half a mark.
For part (b) there was some ambiguity as the rms subscript was omitted from the 4kV; some candidates took the voltage as rms, others as peak; both sets of answers were acceptable. Most candidates correctly calculated the current in part (i), but some mistook the impedance for current whilst others failed to calculate the power-factor. In parts (ii) and (iii) and also part (c) there was a lot of confusion between VA and power. (Remember VA is volts x amps, i.e. voltage x current and no cos(Ø) term. It is the power in Watts that has this term P = v x i x cos(Ø); the problem stems from the fact that students remember
P = V x I from a DC circuit).

**Question 2**:

Attempted by about 90% of candidates. Apart from a handful of candidates who clearly had made little attempt to study for this module, part (a) generally presented very few problems, however some students did not know the circumference of a circle or how to convert $cm^2$ to $m^2$. A few students even mistook the length, *l*, if the numerator of the reluctance formula as a '1', despite *l* being defined on the formula sheet! In part (b) a common problem was to simply shorten the length of the core and recalculate the reluctance and totally ignore the reluctance of the airgap which will dominate the new magnetic circuit. Only about 30% of students correctly answered part (c); several assumed the current of flux density from a previous part of the question, others simply skipped this part. Almost all students correctly answered part (d)(i) and the majority correctly calculated the current in part (ii), however many students forgot about the power-factor when calculating the power – remember P = V x I ONLY for DC or unity power-factor ac circuits. Most students correctly answered parts (iv) and (v) although a handful forgot that the number of turns must be an integer number.

**Question 3**:

Attempted by about 90% of candidates. This question was very similar to one on the tutorial sheets and also on past exam papers. Many students gave near perfect answers whilst others clearly had little idea about solving circuits. A common problem was lack of diagrams – there is little point writing down equations containing various currents if there is no way of identifying to which branch they refer, Many candidates lost potential marks because of this.

Part (a) was reasonably well attempted, although some students used the wrong resistor when proportioning currents into different branches. Part (b) caused many more problems; students should realize that it is just an extension of part (a) so it is only necessary to consider the 6A current source and then add this result to that from part (a). A common fault was to try and proportion the currents, which does not work; the best way is to find the equivalent resistance of the network (actually required for part (c)), calculate the voltage across the equivalent resistor, and hence the current through the 4 Ohm resistor. In part (c) many students missed marks because they did not draw the equivalent circuit. Another common problem was to draw the voltage source pointing downwards (probably because a of a previous year's exam question); work out the current in the 8 Ohm resistor and then the voltage can be found and the direction of increasing potential is in the opposite direction to the current. Many students were completely confused with part (d); simply add the 18V battery to the terminals of the Thevenin circuit and apply Kirchoff's voltage law around the loop. The Norton circuit in part (e) follows directly from the Thevenin circuit of part (c), but remember to indicate the direction of the current source.

**Question 4**:

The response to this question was disappointing. Parts (a) and (b) should have been easy marks but caused many of you some problems. The arrowhead in the diode symbol indicates the direction of conventional forward current flow through the diode. The bar at the sharp end of the symbol represents the cathode so the other end must be the anode. To make the forward current flow there must be a driving potential difference across the diode so the anode must be positive with respect to the cathode. Part (c) asked about diode conduction state. Some just wrote a statement with no justification, others justified their statement with brief argument, something you should always try to do. In part (d) the biggest problem people faced was dealing with the sign conventions in the analysis to find the $V_1$ needed for the diode to be on the point of conduction. In the Zener diode design of part (f) people had difficulty deciding whether to use $I_{LMAX}$ or $I_{LMIN}$ and $V_{IMAX}$ or $V_{IMIN}$. The thing to remember here is that the resistor chosen must allow the circuit to work under the worst operating conditions in the specification. The worst case for $I_L$ and $V_I$ are the values that give the smallest $I_Z$ – these are $V_{IMIN}$ (because this will reduce the voltage across $R$ and hence reduce the current $I_R$) and $I_{LMAX}$ (because this takes the biggest fraction of $I_R$ and hence leaves the smallest value of $I_Z$).

**Question 5**:

The first part was attempted well by most. In section (b), some people were not quite sure what to do with the quantities $V_i$, $V_{BEON}$ and $V_{CESAT}$. The best cure for this is to revise the appropriate bit of the notes and then practice switching problems. In part (b) (ii), finding the maximum value of $R_2$ that could be used, many people decided to work out $I_B$ using $h_{FEMAX}$ because that gave the smallest $I_B$. The circuit must also work with a transistor that has a gain of $h_{FEMIN}$ and this will require a somewhat lower $R_2$ than one calculated by using $I_{BMAX}$. So you should have chosen to use $h_{FEMIN}$ to find $I_B$.

**Question 6**:

This was answered well by most. Some people thought the amplifier of part (a) was inverting and in the analysis of part (b) wrote statements like since $v^+ = 0$, $v^-$ is a virtual earth. A moment's glance at the circuit diagram shows that $v^+$ is actually connected to $v_i$. People had few problems with the rest of the question except for one or two who didn't realize that when it came to identifying $R_1$ and $R_f$ in the last part, the ac and dc conditions can be treated separately.