Examination Feedback for
EEE338 – Power Engineering – see questions A1–A4 and B1–B4
EEE341 – Electrical Power Systems – see questions A1–A4
EEE301 – Power Systems Engineering – see questions B1–B4
Spring Semester 2015-16

Feedback for EEE338 / EEE341 / EEE301 Session: 2015-2016

General Comments:

The main problem in this exam was students failing to show sufficient working and intermediate steps meaning it was difficult to award part marks if the final answer was incorrect. This is particularly important with diagrams. There were also a number of problems associated with conversion from complex to polar form and vice-versa (repeatedly in lectures I mentioned it is worth spending a few pounds and getting a calculator that can handle this correctly and also save you time in performing the calculations.
Several candidates achieved very high marks, but there were a similar number who failed to make the pass mark and it is quite clear that the latter did not spend anywhere near enough time on independent study and practice. You should be spending about 5 hours per module per week outside lectures and then seeking help with any problems that you encounter. The attendance at lectures, particularly towards the end of semesters, was poor. There are several aspects of this module that you will not understand simply by reading through the lecture notes – you need to come to lectures to have it explained.
Some candidates only answered 4 rather than 5 questions (EEE338) – it is not clear whether they ran out of time or failed to read the instructions on the front page. This year most candidates completed the front cover to indicate which questions had been attempted – an improvement on previous years.

Question A1:

Attempted by approximately 75% of candidates. For part (a) diagrams were very untidy and in many case very difficult to read the text; many candidates omitted to show the parameters requested in the question on their diagram. In part (b) (i) a number of candidates incorrectly calculated the slip and hence the load resistance – they failed to realize that the slip must be negative as the generator runs above synchronous speed. A negative value of slip will result in a negative resistance which gives a negative value of power indicating power is being transferred into the electrical system from the mechanical power source. Many candidates also forgot to take the complex conjugate of the current in the apparent power calculations which meant the reactive power was of the incorrect sign which affected later parts of the question. In part (ii) a large number of candidates forgot to account for 3-phases when calculating the mechanical power. A common problem was to omit performing the energy audit that was requested – read the question! In part (iii) most candidates correctly calculated the real and reactive power of the factory, but then messed up with the sign of the real and reactive power from the generator – the whole point of installing an induction generator is to reduce real power demand (real power of the generator is negative), but the drawback is that it adds to the reactive VARs, hence the need for the capacitor bank. This kind of mistake is typical of those who simply plug numbers into formulas without any logical thinking about what is actually going on. The main problem in part (c) is that many candidates considered the capacitor bank as star connected, whereas the question clearly states it is delta connected; others again forgot to multiply by 3 for the 3-phases. Many candidates skipped part (d).

Question A2:

Attempted by approximately 85% of candidates. Parts (a) and (b) were pure bookwork but were completely ignored by many candidates. Of those that did attempt it diagrams were very poor and description was often nonexistent – a diagram without explanation is virtually worthless. Most candidates successfully managed part (b)(i) without too much difficulty, however a small minority drew completely the wrong reactance diagram. Part (b)(ii) caused far more problems. It is always best to find the p.u. current through the required component (*G1* here) and then multiply by the base current. Many students forgot the √3 in the formula for base current and all but 2 candidates forgot the generator was delta connected. In part (b) (iii) most candidates correctly identified that the fault needed to be on either busbar 1 or 2 and calculated the total fault current at these locations (which was what was asked on a previous year's exam! However here the question asks for the maximum current through the reactor so it is necessary to proportion the current.

Question A3:

Attempted by approximately 73% of candidates. This question was a classical example of students failing to fully read and think about the question – a large proportion just dived straight in with Millman's theorem for part (a) which is inappropriate for a system with a neutral wire and zero impedance. The fact that this part of the question was only worth 2 marks should have given a hint. In part (b) (i) phasor diagrams were generally of very poor quality and many candidates did not show the wattmeter voltages as requested. In part (b) (ii) there were a multitude of very basic errors – some candidates using phase not line voltages, some using the incorrect angles between current and voltage phasors, and others missing the cosine term all together. In part (b) (iv) many candidates stated that the current wattmeter connection was wrong and suggested alternative ways of connecting the two wattmeters. The connection shown in the question is actually correct for the two wattmeter method, however this method is not valid when there is a neutral current flowing and it is necessary to use three wattmeters to measure the power in each phase. Part (c) is now where Millman's theorem could be used, but the question did request using the star-delta transformation. Candidates who used Millman correctly gained the majority of the marks. Many candidates lost marks simply because they only calculated the currents and not the voltages – again an example of not reading the question. Similar problems existed in parts (c) (ii) and (iii) as occurred in parts (b) (ii) and (iii). Several students tried to claim agreement between the wattmeter result and the I^2R result (simply writing down the same number having made no attempt to perform the calculation. The examiners do check values and no marks were awarded in such cases.

Question A4:

Attempted by approximately 35% of candidates. For part (a) most candidates correctly wrote down the equations for the synchronous machine, but the phasor diagrams presented far more of a problem. It was obvious most students were attempting these from memory rather than looking at the equations and using a little thought. All but two candidates skipped part (b) and hence missed out on 25% of the marks for this question. This is bookwork, but the ‘V’ curves could be derived with a little thought about the phasor diagram – another instance of students simply trying to memorise similar past exam questions rather than putting the additional effort throughout the year to fully understand the subject. The common mistakes in part (c) (i) and (ii) were confusion between the total MVA and the MVA of the synchronous machine (the question requests the latter), using line instead of phase voltages and using total power/VA rather than phase quantities. A few students stated that the machine operates at a lagging power-factor – if so how will it improve the p.f. of a lagging p.f. load? In part (c) (iii) a common error was to assume the same value of load angle as in the previous part, but this will change. A few students even tried to calculate current from $I = \sqrt{(E^2 - V^2)} / X$; this was on a previous exam but is only valid if the p.f. is unity. Part (d) was skipped by the majority of candidates.

Question B1:

Attempted by approximately 31% of candidates. Parts (a) to (c) were bookwork and highly descriptive. The main problem here was insufficient details and poor, unlabeled diagrams. There were a few cases where candidates had given a good answer, but to a totally different question! Again I suspect it was a case of learning past exam solutions and not reading the question properly. In part (d) most candidates simply quoted equations for k and Z in terms of A, B and C with no explanation where these came from. In some cases these were memorized incorrectly and then ‘adjusted’ to fit the desired result – again this is an example of if you understand the principles you can work out the (correct) equations without having to memorize them. The full derivation was not given in the course notes but was thoroughly worked through in the lecture. Two reoccurring problems appeared in part (e) – (i) incorrectly writing k = 1.2 rather than 1.12 (20% tap rather than 12% tap) and (ii) forgetting to scale Z_{nom} for the selected tap. Many students omitted part (f) but the main problem here was working out the current base; the fault is on the low voltage side, but the question asks fpr the current on the high voltage side.

Question B2:

Attempted by approximately 48% of candidates. Parts (a) (i) to (iii) were straight from the lecture notes and were either skipped completely or reasonably well answered. In part (ii) a small diagram would have been useful. In part (b) (i) many candidates achieved full marks, but some, although they had clearly made mistakes in the earlier stages amazingly appeared to get the correct answer! You are likely to gain more marks for showing your method and intermediate steps, even if you end up with the incorrect answer, rather than simply pretending you gained the value in the question. Part (b) (ii) was reasonably well attempted but some candidates omitted to change the GMR into metres and others only calculated the inductance, not reactance. The main source of error in part (b) (iii) was forgetting to account for the current and impedance angles when accounting for the voltage drop across the line impedance. You can use the same equation as for a synchronous generator, or even draw a phasor diagram which would help with understanding part (iv).

Question B3:

Attempted by approximately 43% of candidates. Most candidates made a reasonable attempt at part (a) but often there was insufficient explanation and/or lack of diagrams. Only two candidates attempted part (b) and only one of these completed it successfully. It is identical to one of the questions on tutorial sheet 3 so if students had completed the tutorial sheets this should have been an easy 4 marks. Most students made a good attempt at all of part (c). A handful of candidates omitted the $j0.1$ p.u. reactance of the generator and a couple took the p.u. voltage of the generator as 1.1 (this is what happens when you simply memorize past exam questions without understanding the principles). In part (iv) sketches were particularly untidy; in some cases this may have been deliberate to disguise the boundaries between accelerating and decelerating areas! A common problem was simply to put δ_s and δ_c on the diagram with no explanation of what they were. In part (v) a few candidates did not do sufficient steps to show the load angle starting to decrease.

Question B4:

Attempted by approximately 89% of candidates. Part (a) was well attempted by most candidates although some did not notice the voltage mismatch between *G2* and *T2* or scaled to 22kV for some reason (*G2* is rated at 12kV, *T2* at 13kV) There were also quite a few cases of candidates misreading or mixing up values from the table – take care and double check values. Again in part (b) most candidates correctly drew the positive and negative sequence diagrams but a few struggled with the zero sequence diagram (which does not contain either *G1* or *G2*). The main error in part (c) was omitting the factor of 3 when calculating the total fault current ($I_A = 3I_+$). Not a single candidate successfully answered part (d) with the majority missing it. It is first necessary to proportion each of the sequence currents tofind the current flowing through the line; some students calculated the current at the point of fault which was what was asked on a previous exam question. Part (e) was reasonably well answered but a lot of candidates only mentioned the earthing reactor and not G2 – neither will actually have an effect as G1 and G2 do not appear in the zero sequence diagram.