Examination Feedback for EEE409/6120– Modelling of Electrical Machines
Spring Semester 2006-07

Feedback for EEE409/6120 Session:2006-2007

General Comments:

This paper was sat by a relatively small group of 8 students and the attempts were on the whole, very good. Somewhat surprisingly, the calculation elements of the paper seemed to pose less difficulties than those concerned with standard theory and the discussion of results.

Question 1:

This question was entirely based on theory and standard derivations rather than calculations. Most candidates attempted this question, in most cases achieving good marks. There were several instances of incorrect labelling of current directions in the Kron primitive model of part (a). This was simply carelessness, since the conventions are well known and have been covered many times in lectures (arguably laboured to death!). There were also missing subscripts in the matrix – again carelessness. These were marked harshly, essentially at a rate of a loss of ½ mark per minor error. There were a few minor errors (often repeated by several candidates) in the derivation of the induction machine equivalent circuit (a few rogue $\sqrt{2}$ etc). However, on the whole, this section was answered well. The responses to the section on the starting of single-phase induction motors was very variable. The best response, which unsurprisingly got the full 5 marks, included an introduction which stated the basic problem, i.e. the need to provide some net rotating field at standstill, and then proceeded to describe 3 approaches in great detail, consisting of schematic circuit diagrams, a list of advantages and disadvantages and well drawn torque-speed curve in which the curves for a machine without starting capability were clearly shown.

Question 2:

All candidates attempted this question, all to good effect. The question consists of a series of derivations and calculations, which to some degree build on each other. Part (a) was universally well answered, although as was the case for Q1, attention to detail in terms of labelling current directions etc went astray in a couple of cases. Part (b) which is again standard theory was well done. It is preferable in answering this type of question to write the matrix in terms of the operator 'p' and then explicitly show what form p takes for the various excitation conditions considered, rather than diving straight in with the DC and steady-state AC matrices – although the latter approach is not wrong. The calculation sections of (c) and (d) were generally well done, but a few candidates come unstuck in terms of calculating the effective resistance R (which should have done via the calculation of M). A few candidates went straight to R=V/I, with a result of ensuing chaos as this propagated through the remainder of the calculations. Part (e), again standard theory, was variable. Some candidates took the time to read the question properly in terms of 'Describe the basic principle…with the ***aid*** of ..' and included a few sentences about the basic ideas behind compensation. Others, who naturally lost a significant proportion of the available marks simply drew the Kron primitive and sketched two phasor diagrams, without a word of explanation. This kind of thing puts one in mind of the oldest (and still the best) advice on exam questions – read the question at least twice!

Question 3:

Another popular question with all candidates having made an attempt. Most candidates made a good attempt at part (a), although it would have been helpful to state that the rate of change of flux linkage with rotor angular displacement was estimated from Figure3 and not just presented as a number with no recognition of its source. One error noted was a failure to convert the speed to rad/s from rpm. Part (b), which involved plotting a Ψ/I diagram, posed very few problems, and almost all candidates derived a good estimate of the static torque. Since the question did not state that graph paper should be used, it was quite correct for some candidates to plot the characteristics in their answer books (as it was to request graph paper). If however future questions of this type specifically request graph paper, then please use this. The dynamic trajectories in part (c) were done reasonably by most candidates. In assessing these, I was looking for an understanding of key points, not just something that looked roughly correct. Hence, even though they are only sketches, attention to detail on matters such as shading the correct areas, ensuring that lines that should join up do in fact join up etc are important. Several candidates misunderstood part (d) and went off into unrelated descriptions of the effect of airgap length etc. All that was required was a discussion of factors such an moment of inertia, speed etc and their broad effects on trajectory form.

Question 4:

Very few students made an attempt at this question, but made a reasonable job of answering it. It may have been the fact that the machine was linear rather than rotating which put candidates off. However, the differences are only small, e.g. linear velocity instead of angular velocity, and so the methods developed for rotating machines can be readily applied with little in the way of modifications. The candidates that did attempt this question, did a good job on the calculations themselves, but were weaker on the sections requiring explanation of the behaviour observed, e.g. effects of saturation etc. Although it is tempting to concentrate on the calculations, equal care and time should be given to answering the trailing edge discussion question as this often carries as much importance as the more obvious calculation stage.