Examination Feedback for EEE6202 – Energy Storage Management
Spring Semester 2015-16

Feedback for EEE6202 Session: 2015-2016

Feedback: Please write simple statements about how well students addressed the exam paper in general and each individual question in particular including common problems/mistakes and areas of concern in the boxes provided below. Increase row height if necessary.

General Comments:

100% exam module. Overall the exam was well attempted, but yielded a slightly lower than expected average. This seemed to be a result of the new questions which students had not seen recorded in an exam before. This trend of students learning the previous exams verbatim is concerning, even more so that students complain that there should be more exam questions available, even if answers are not provided so that variance in questions can be minimized. A mock exam (hour long half-questions) was provided in semester 1 as an unmarked homework, but only a few students had bothered to attempt it before it was run through in a subsequent lecture – this in spite of MSc students asking for more coursework elements/worked examples in modules at staff-student committees.

Question 1:

Attempted by approximately 74% of candidates. Generally well attempted, with very good recall of battery chemical equations. Some poor figures of both battery structure and operational waveforms. Some poor notation of the graphs where information was given in the question to be used. A few students seemed to confuse the question with NiCd or Fuel-cell chemistry and gave charging graphs and equations for a Fuel-cell which is impossible.

Part (b ii), seemed to cause the most problems as some students did not assess how many cells were in the battery and therefore could not space out the balancing resistors correctly. Many students did not account for the current branching off to the balance resistors when calculating current charging the actual cells.

Question 2:

Attempted by approximately 52% of candidates. Part (a) was attempted well, but students should attempt to make their diagrams as neat as possible – some were illegible. Part (b i) was well attempted across the board; however in Part (b ii) most students derived a V_o/I_{in} Transfer Function and not the State Variable equations. I suspect that this is because a mock exam question had the transfer function for a first-order circuit and students are repeating previous exams verbatim. Part (c) was a mixed result – some students new exactly how to extract the resistance values from the graphs, whilst others tried to form a complex impedance and take the complex conjugate for some reason. I will allow that the graph tick-marks on the real axis are not very clear on reproduction, and so allowed a margin of error on the answers. However, many students did not identify which resistance was which considering the question asked students to identify and estimate the values.

Question 3:

Attempted by approximately 98% of candidates. This exam question is similar to worked examples and previous exams and generally students achieved high averages, especially for Parts (a) and (b). For this reason Part (c) was strictly marked and half points were lost if diagrams were not of a suitable quality or important operating voltages were omitted. The key error here was that graphs were plotted of terminal voltage against SoC and not against current density.

Question 4:

Attempted by approximately 87% of candidates. Similarly to Q3, examples of Parts (a), (b), (c) and (d) can be found in the notes and previous exams, and so the average was quite high. However, some diagrams of pumped hydro-electric systems were wildly inaccurate (one pump tunnel in parallel with a generator tunnel) or mildly inaccurate (lower reservoir is so far below the motor/generator that water could not be pumped. Marks were graduated accordingly. There were many instances of not converting volume of water to mass. Part (d) was generally well answered; however students would calculate a negative volume using the correct ratio of *ln*(atmospheric pressure/pumped pressure) because the work is being done on the system and energy is therefore negative. Many students would then go back and invert the *ln* ratio to get a positive volume, or just ignored the negative. Marks could be lost accordingly. Part (e) was designed to evaluate the students' understanding of the difference of the two systems and make an engineer's judgement of which system to choose in a very cold climate where thermal storage (lossy at best) would be even more difficult for an adiabatic CAES. More importantly a fully functioning industrial CAES has yet to be commissioned. Conversely a diabatic CAES which loses its thermal energy on compression could be harnessed to a district heating system, and the energy recovered on depressurisation using combustors – albeit 50% efficient, but currently achievable. Only a handful of students could fully justify their reasoning, since this was not implicitly stated in the notes and required appreciation of the information given.

Question 5:

Attempted by approximately 5% of candidates (4 students). A new question introduced this year and evidence that students are learning previous exam questions. Part (a) was for the most part reproduced from the notes clearly, whilst Part (b) had instances of a fuel-cell parallel hybrid drive train and not supercapacitors linked to the traction battery via a DC-DC converter. Part (c) was attempted very well (some method marks were awarded if numerical values were not correct).

Question 6:

Attempted by approximately 81% of candidates. Similarly to Qs 2&3, examples of Parts (a) and (b) can be found in the notes and previous exams, and so the average was quite high for these parts. Many students in Part (a) described a Grid-connected ESS instead of the actual flywheel as an electromechanical system. In Part (b) some students used the flywheel inertia equation for a solid cylinder, and some for a thin-rimmed cylinder. Whilst the flywheel was specified as a disc (solid cylinder) both equations were allowed and yield the same ratio of speeds. I will update the notes to clarify this section. Some students did not take into account that the specific strength was given in kJ/kg and not J/kg.

However, in Part (c) (again a new question) based on some of the last lecture notes, only a handful of students recognized the three key services that can be offered to the Grid by Energy Storage Systems – Peak power buffering/time-shifting of energy demand, Fast Reserve and Fast Frequency Response. Other students pretty much waffled and tried to include as much material as possible that was not pertinent. This section was marked strictly and required the above three services to be stated or at least described accurately.