Examination Feedback for ACS342 – Feedback Systems Design
Autumn Semester 2015-16

Feedback for ACS342 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:

As usual, performance was quite variable, but this year the average level of attainment was encouraging. Candidates performed well on those questions that required calculations or the application of a procedure. On the other hand, questions which probed understanding and required explanatory answers were very poorly attempted.

The quality of sketches in the questions on Bode diagrams and root locus was markedly improved with respect to previous years.

Question 1:

Attempted by less than 10% of candidates. Students were asked to select the gains of a PI controller via curve fitting on a provided step response, and then later to discretize the PI controller (i.e. into digital form). Therefore, the question combined two topics that appear late on in the semester (week 10 onwards). Moreover, the final part of the question required some understanding of sampling in control systems.

Most were able to complete part (a) adequately and go on to show that the PI controller is merely a phase-lag compensator in part (b). Of those who attempted part (c), all tried to digitize the controller via zero-order hold and z-transforms, ignoring the far simpler numerical integration technique that was provided in the lecture notes, and all failed to arrive at the correct answer. Answers to part (d), regarding the choice of sampling rate, seemed to be pure guesswork.

Question 2:

Attempted by 93% of candidates. Part (a), which asked candidates to sketch a Bode diagram for a given system, was generally done well; sketches were (mostly) legible, and only a tiny minority this year resorted to calculating data points rather than using the far quicker construction rules. Part (b) asked candidates to explain why the convention is to plot the open-loop, rather than closed-loop, diagram. The most popular explanation offered was “because it’s easier”, without saying why that might be the case. The gain margin calculating or estimation was done well in part (c); most seemed to understand how to obtain GM from a Bode diagram. Part (d) asked candidates to complete the design of a compensator; this split the candidates into those who correctly interpreted the question and tailored the normal design procedure to provide what was being asked for, and those who just followed the design procedure by rote.

Question 3:

Question 3 was answered by 95% of candidates and was the highest scoring question on the paper. A large majority could correctly calculate the parameters and metrics being asked for in part (a); a few forgot to divide through by mass and obtained the wrong numerical answers, but their workings were otherwise sound. Part (b) caused more of a problem, yet most managed to derive something close to the closed-loop transfer function and have a reasonable attempt at the numerical calculations in the final part. (The question was setup so that those who blindly applied the negative feedback manipulation rule to the system obtained a transfer function close to the correct one, which required a more subtle and thoughtful analysis.) The vast majority had no idea why a reference input was unnecessary.

Question 4:

Question 4, attempted by all but one candidate, combined some routine and popular topics: Routh array, steady-state error constants and root locus. The Routh array analysis was done very well indeed, with only a few (arithmetical) errors. The position error constant calculation in part (b) caused more of a problem; some tried to apply the final value theorem to the closed-loop transfer function, which misses the point of the error constant approach. Another issue was that the position error constant ended up negative; many seemed unsure about how this affected the tracking error. The root locus sketches were, in general, done well in part (d); however, quite a few candidates re-derived the breakpoint that was provided in the question. The final part, which asked why phase-lag compensation would be problematic in for this system, elicited no correct reasons or explanations; in fact, the popular but incorrect answer was that a PI or PID controller could be used here to improve steady-state performance. This indicates a gap in the ability of students to relate the PI/PID controller to what they have learnt earlier in the course about root locus and pole locations.