General comments on EE2-21 Feedback Systems paper 2017

Overall, the students have done fairly well on the exam paper, scoring an exam average of 59%.

1. The students have done relatively well on this question, scoring approximately 63%. This is an op–amp modeling, proportional controller design and Nyquist stability analysis question and is a variation on a past exam question and typical study group questions.
   (a) Tests understanding of transfer functions for simple circuits.
   (b) Tests obtaining differential equations from transfer functions.
   (c) Tests obtaining state–space realizations from transfer functions. A bit tricky since inputs and their derivatives are involved.
   (d) Tests understanding of the use of the final value theorem in simple analysis.
   (e) Tests understanding of the use of the final value theorem in simple design.
   (f) Tests understanding of the use of the final value theorem in more complex design.
   (g) Tests sketching Nyquist diagrams for simple systems.
   (h) Tests the use of the Nyquist theorem in simple proportional stability design.

2. This is a Nyquist diagram analysis and design question that involves a a third order stable system. It also introduces the small gain theorem. The students did less well on this question scoring approximately 50%.
   (a) Requires the students to demonstrate an understanding of the Routh–Hurwitz stability criterion and its use in sketching Nyquist diagrams.
   (b) Requires an understanding of the use of the Routh–Hurwitz stability criterion to determine the stability margins and the cross–over frequency.
   (c) Qualitative analysis of the effects of phase–lead compensation on the stability margins.
   (d) Explores the relation between Nyquist analysis and the small gain theorem. Also, introduces, step–by–step, the use of the small gain theorem in robust stability analysis.

3. This is a question about rate feedback control system design using pole placement and the characteristic equation. The students did relatively well on this question, scoring approximately 64%.
   (a) Tests the students' understanding of the relation between design specifications and pole location.
   (b) Tests the students' understanding of simple block diagram manipulations.
   (c) Tests the students' understanding of the characteristic equation for nonstandard feedback loops.
   (d) Tests the students' understanding of the limits of proportional compensator design.
   (e) Tests the students' understanding of the use of the characteristic equation in pole placement compensator design.