

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)  
ORGANISATION OF ISLAMIC COOPERATION (OIC)  
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination

Summer Semester, A. Y. 2022-2023

Course No.: EEE 4605 / EEE 4691

Time: 3 Hours

Course Title: Control System Engineering I

Full Marks: 150

The symbols have their usual meanings. Programmable calculators are not allowed. Marks of each question and corresponding COs and POs are written in the brackets.

1. Consider the dynamic system shown in the following diagram.

150  
(CO2,  
PO2,  
PO3)



$$G(s) = \frac{K(s + 5)}{s(s^2 + 4s + 25)}$$

- i) Design a cascade compensator to maintain overshoot of 15% by reducing the settling time by three times. In addition, reduce the steady-state error by 10 times. Generate a table to compare the results of uncompensated and compensated systems. (40)
- ii) Sketch the physical realization of the designed compensator using active networks. (10)
- iii) Design a feedback compensator using 2<sup>nd</sup> approach of the feedback compensation. Use overshoot of 10% in the minor loop, and overshoot of 15% in the major loop. Generate a table to compare the results of uncompensated and compensated systems. (30)
- iv) Sketch the Bode plot and the Nyquist diagram of the system. (40)
- v) Find the gain margin, phase margin, zero dB frequency, 1800 frequency, and the closed-loop bandwidth. Hence estimate the damping ratio, percent overshoot, settling time, and peak time. And find the steady-state error from the bode plot. (30)