

COLLEGE OF ENGINEERING & TECHNOLOGY



Department : Electrical & Control Engineering

Lecturer : Staff

Course : Automatic Control

Course Code : EE 418

Marks : 40

Date : 24/5/2015

Time : 2 hours

Answer the following three questions and either question 4 or 5:

Question 1:

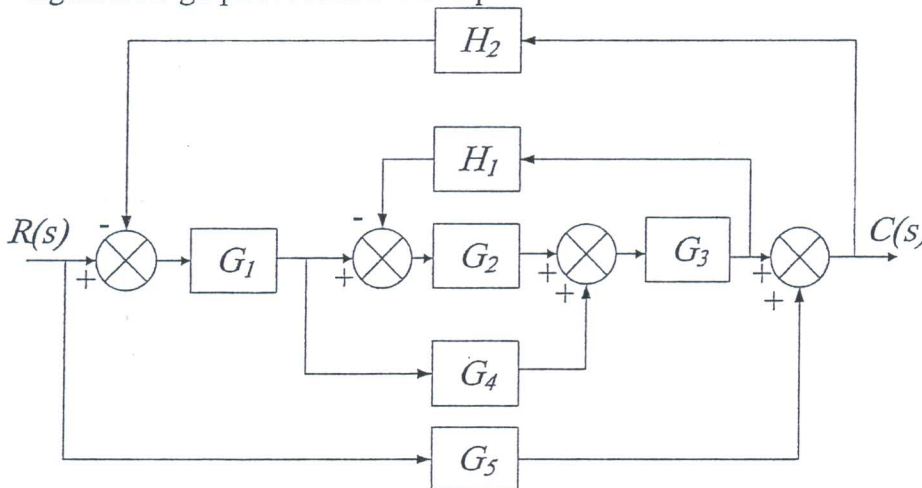
Reduce the following block diagram to get the overall transfer function $\frac{C(S)}{R(S)}$ using:

- a. Block diagram reduction Technique

OR

- b. Signal flow graph reduction technique

(10 marks)



Question 2:

A unity gain second order system is subjected to a unit step input, its transient response contains an overshoot of 77%, occurring after 32.5 ms. Find:

- The damped natural frequency (ω_d) rad/sec, and the un-damped natural frequency (ω_n) rad/sec. (3 marks)
- The system poles. (4 marks)
- The setting time within $\pm 2\%$ of the final value (3 marks)

Members of course Examination Committee:	Signature:	Date:
Lecturer: Staff		13/5/2015
Course Coordinator : Dr. Ahmed El-shenawy		13/5/2015
Head of Department: Prof. Hamdy Ashour		13/5/2015

Question 3:

A unity feedback control system has an open loop transfer function as

$$\frac{K(S - 2)}{(S^2 + 4)}$$

Sketch the root locus plot, determine the following:

- a. Centroid (Point of intersection of asymptotes with the real axis), number and angles of asymptotes. (2 marks)
- b. The range of gain (K) for stable operation. (2 marks)
- c. Angles of arrival/departure (if any). (2 marks)
- d. Break away/in (if any) and the corresponding gain. (2 marks)
- e. Calculate the steady state error when $K = 1$. (2 marks)

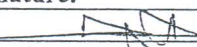

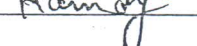
Question 4:

A control system with a unity feedback has the forward transfer function as

$$G(s) = \frac{200}{s(s + 2)(s + 10)}$$

- a. Sketch the bode plot showing the phase margin in decibels and phase angles as a function of log frequency. (4 marks)
- b. Determine the gain crossover frequency and phase crossover frequency. (3 marks)
- c. Determine the gain margin in db and phase margin, comment about the system stability. (3 marks)

GOOD LUCK

Members of course Examination Committee:	Signature:	Date:
Lecturer: Staff		13/5/2015
Course Coordinator : Dr. Ahmed El-shenawy		13/5/2015
Head of Department: Prof. Hamdy Ashour		13/5/2015