

BITS, PILANI – DUBAI CAMPUS
SECOND SEMESTER 2013 – 2014
EEE/INSTR/ ECE F242, AAOC C321 CONTROL SYSTEMS
COMPREHENSIVE EXAMINATION (CLOSED BOOK)

MAXIMUM MARKS: 80
DATE: 27.05.14

WEIGHTAGE: 40%
DURATION: 3 HOURS

NOTE: Answer Part A and Part B in separate answer sheets.

- If a question is answered twice and not cancelled, only the first attempt will be evaluated.
- Show calculations stepwise.
- Sketches/ diagrams are to be complete in all respects.

PART A

1. Using the Block diagram reduction technique, find the closed loop transfer function $\frac{C(s)}{R(s)}$ for the block diagram shown in Figure 1. [10 M]

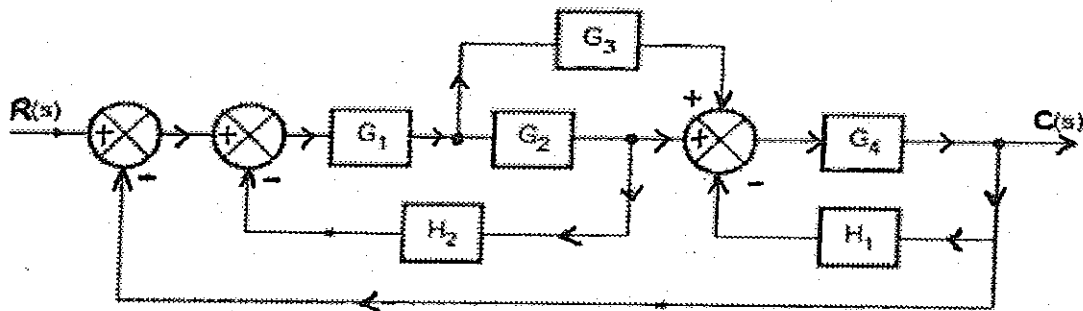


Figure. 1

2. Obtain the closed loop transfer function of the given signal flow graph in Figure 2, using the Mason's gain Formula. [10 M]

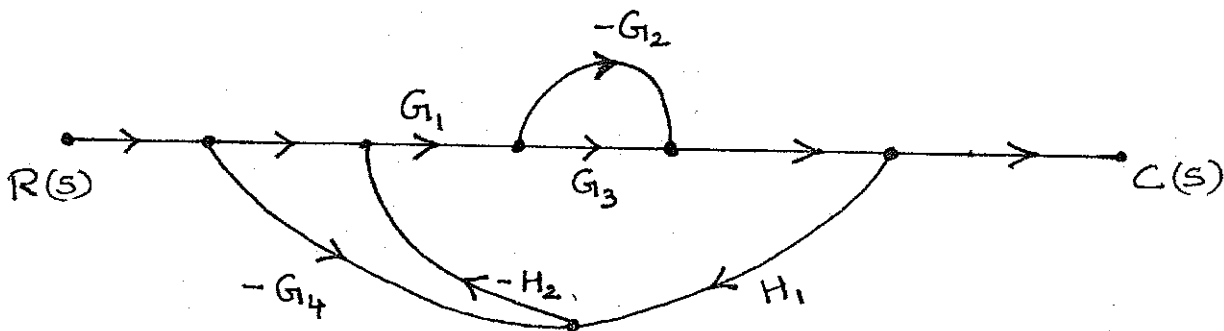


Figure. 2

PART B

5. A unity feedback control system has an open loop transfer function

$$G(s)H(s) = \frac{K(s+1)}{(s+2)(s^2+2s+2)}$$

Draw the root locus in the graph sheet provided. Draw it to scale, clearly demonstrating all the necessary steps. Indicate the different values of K at appropriate locations. [10M]

6. The closed loop transfer function of a control system is given by

$$\frac{C(s)}{R(s)} = \frac{K}{s^4 + 6s^3 + 30s^2 + 60s + K}$$

Determine the range in which K must lie for the system to be stable. [5M]

7. The open loop transfer function of a unity feedback system is given by

$$G(s) = \frac{K}{s(1+0.2s)(1+0.05s)}$$

Draw the polar plot (in the graph sheet) and determine the value of K so that

(7A) Gain margin is 18 db

(7B) Phase margin is 60°

Assume the frequencies to be 0.6, 0.8, 1, 2, 3, 4, 5, 10 rad/sec and a scale of 1 circle = 0.05 magnitude as specified in the graph sheet provided. [15M]

8. Draw the Bode plot (in the semilog sheet) for the open loop transfer function

$$G(s)H(s) = \frac{20s^2}{(1+0.2s)(1+0.02s)}$$

and determine

(8A) Gain cross over frequency

(8B) Phase cross over frequency

Assume Lower frequency $\omega_L = 0.1$ rad/sec; Higher frequency $\omega_H = 100$ rad/sec [10M]
