G 442 (Pages : 4) Reg. No.....

Name.....

B.TECH. DEGREE EXAMINATION, MAY 2014

Sixth Semester

Branch : Electrical and Electronics Engineering

CONTROL SYSTEMS—I (E)

(Old Scheme—Prior to 2010 Admissions)

[Supplementary/Mercy Chance]

Time : Three Hours Maximum : 100 Marks

Graph sheets and semilog sheets to be supplied.

Part A

Answer **all** *questions briefly.*

Each question carries 4 *marks.*

1. Explain the merits and demerits of the block diagram reduction technique over signal flow graph method.
2. Obtain a mathematical model of sampler and zero order hold circuit.
3. Distinguish between type and order of a control system.
4. Discuss the importance of steady-state error constants K_p, K_v and K_a.
5. Check if the roots of the characteristic equation $z^3 - 1.3\,z^2 - 0.08\,z + 0.24 = 0$ lie within unit circle ?
6. What is direct root locus, inverse root locus and root contours ?
7. Explain how is the stability of a system is determined by the frequency domain specification ?
8. Define phase margin and gain margin ? Give practical values for good relative stability.
9. Define the working of an amplidyne ?
10. Discuss the advantages and disadvantages of the Bode plot compared to the Nyquist plot.

(10 × 4 = 40 marks)

Turn over

Part B

Answer **all** *questions.*
Each full question carries 12 *marks.*

11. Fig. 1 below shows the signal flow graph of a system with two input and two outputs. Find the expression for the outputs C_1 and C_2.

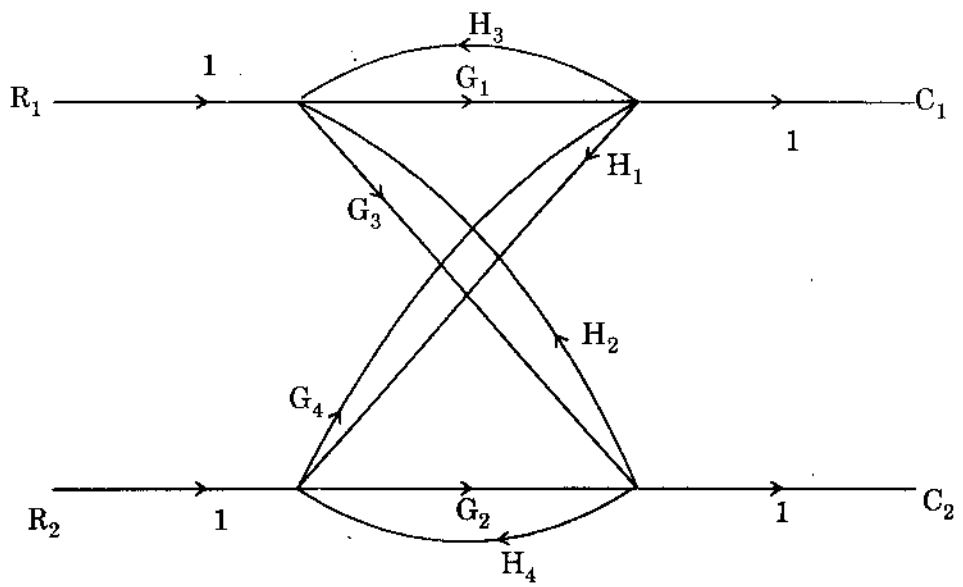

Fig. 1

(12 marks)

Or

12. Obtain the transfer function of the feedback control system shown in Fig. 2 by block diagram reduction technique.

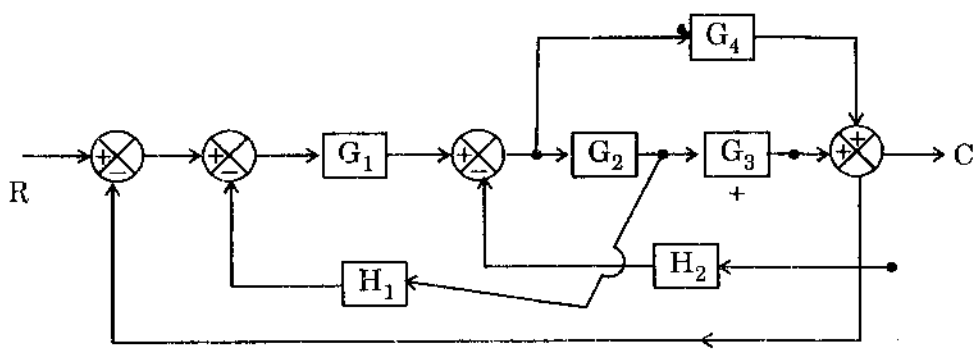

Fig. 2

(12 marks)

13. A unity negative feedback closed loop system with open loop transfer function $G(s) = \frac{3}{s(s+0.4)}$ is excited with unit step input.

Derive the response of the system. Plot the response of the system to step input and obtain the values of 2 % settling time, rise time, peak time and maximum percentage peak overshoot.

(12 marks)

Or

14. (a) A closed loop transfer functions of certain second order unity feedback control systems are given below. Determine the type of damping in the systems.

(i) $\frac{C(s)}{R(s)} = \frac{2}{s^2+4s+2}$.

(ii) $\frac{C(s)}{R(s)} = \frac{2}{s^2+4}$.

(iii) $\frac{C(s)}{R(s)} = \frac{2}{s^2+2s+1}$.

(3 × 2 = 6 marks)

(b) A unity feedback system has $G(s) = \frac{k}{s(s+1)(0.1s+1)}$ and $r(t) = 10t$. If $K = \frac{2}{s}$, determine $e_{ss}(t)$.

(6 marks)

15. (a) By means of Routh criterion, determine the stability of the system represented by $s^6 + 3s^5 + 5s^4 + 9s^3 + 8s^2 + 6s + 4 = 0$.

(6 marks)

(b) Using Jury's test examine the stability of the system whose characteristic equation is $F(z) = 2z^4 + 7z^3 + 10z^2 + 4z + 1$.

(6 marks)

Or

16. For a unity feedback system $G(s) = \frac{K}{s(s+2)(s+4)}$, sketch the nature of root locus showing all details on it. Comment on the stability of the system.

(12 marks)

17. Determine the phase margin, gain margin, percentage overshoot from the Bode plot for a step change for the system whose output response is given by $C(s) = \frac{22.5}{s(s+4)(s^2+0.9s+9)}$.

(12 marks)

Or

18. The open loop transfer function of a unity feedback system is $G(s) = \frac{1}{s(1+s)(1+2s)}$. Sketch the polar plot on a plain paper and determine the gain margin and phase margin.

(12 marks)

19. The open loop transfer function of a feedback system is $G(s)H(s) = \frac{k(1+s)}{(1-s)}$. Comment on stability using Nyquist plot.

(12 marks)

Or

20. The open loop transfer function of a unity feedback system is $G(s) = \frac{k}{s(s+2)(s+10)}$. By using Nyquist plot,

(a) find the range of k for stability.

(b) find the value of k for gain margin 10 dB.

(c) find the value of k for a phase margin 40°.

(12 marks)

[5 × 12 = 60 marks]