Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 77119

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2015.

Fourth Semester

Electronics and Communication Engineering

EC 6405 — CONTROL SYSTEM ENGINEERING

(Common to Mechatronics Engineering and Medical Electronics Engineering)

(Regulation 2013)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Find the transfer function of the network given in Fig. 1

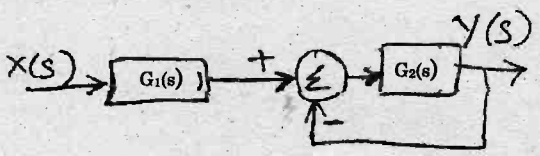

Fig. 1

2. State Mason's gain formula.

3. How do you find the type of a system?

4. Find the unit impulse response of system $H(s) = 5s/(s+2)$ with zero initial conditions.

5. What is the use of Nichol's chart?

6. What are the characteristics of phase lead network?

7. Find the range of K for closed loop stable behavior of system with characteristic equation $2s^4 + 12s^3 + 22s^2 + 12s + K$ using Routh Hurwitz stability criterion.

8. What is the value of gain K at any given point on root locus?

9. Define observability of a system.

10. State Sampling theorem.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Explain the features of closed loop feedback control system. (4)

(ii) Derive the transfer function of system shown in fig. 2. (12)

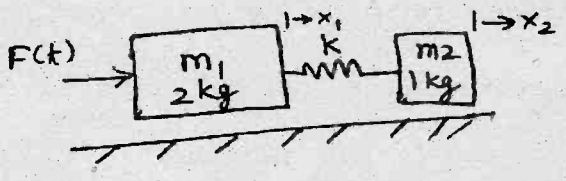

Fig. 2

Or

(b) Find the transfer function of the system shown in fig. 3 using block diagram reduction technique and signal flow graph technique.

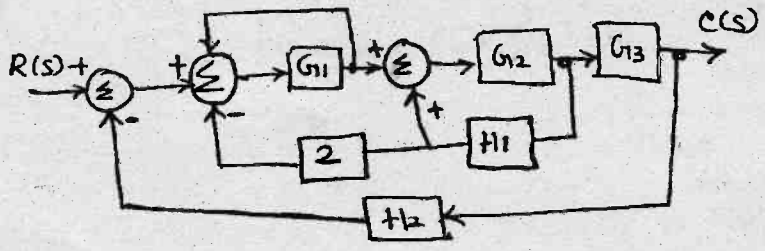

Fig. 3

12. (a) (i) A unity feedback system has the forward transfer function $G(S) = \frac{KS}{(1+S)^2}$. For the input $r(t) = 1 + 5t$, find the minimum value of K so that the steady state error is less than 0.1 (Use final value theorem).

(ii) Briefly discuss about step response analysis of second order system.

Or

(b) (i) For the system shown in Fig. 5 find the effect of PD controller with $T_d = 1/10$ on peak overshoot and setting time when it is excited by unit step input.

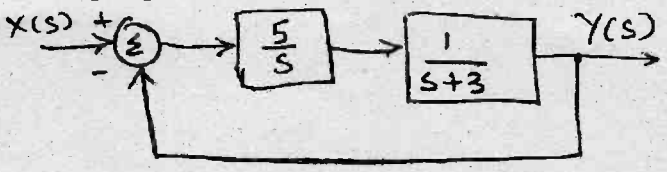

Fig. 5

(ii) Discuss- the effect of PID controller in the forward path of a system.

13. (a) For the following transfer function draw the Bode plot, find the gain and phase margin :

$$G(S)\,H(S) = \frac{5}{S(10+S)(20+S)}.$$

Or

(b) Design a lead compensator for the system $G(s) = 1/s(s+2)$ with damping coefficient equal to 0.45, velocity error constant > 20 and small setting time.

14. (a) A single loop negative feedback system has a loop transfer function $G_c(s)G(s) = \frac{K(s+6)^2}{s(s^2+1)(s+4)}$. Sketch the root locus as a function of K. Find the range of K for which the system is stable, K for which purely imaginary roots exist and find the roots.

Or

(b) Draw the Nyquist plot and find the stability of the following open loop transfer function of unity feedback control system $G(s)H(s) = K(s+1)/s^2(s+10)$. If the system is conditionally stable, find the range of K for which the system is stable.

15. (a) Consider a system with state-space model given below.

$$x = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -5 & -1 \end{bmatrix} X + \begin{bmatrix} 0 \\ 5 \\ -24 \end{bmatrix} u;\ y = [1\ 0\ 0]x + [0]u;$$

Verify that the system is observable and controllable.

Or

(b) Explain the functional modules of closed loop sampled data system and compare its performance with open loop sampled data system.
