

Reg. No. :

J 3218

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2009.

Fourth Semester

Mechatronics Engineering

EE 1264 – CONTROL SYSTEMS

(Regulation 2004)

Time : Three hours

Maximum : 100 marks

(Polar, Semilog graph sheets are to be provided)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define Mason's gain formula.
2. Give any two examples for closed loop control system.
3. Why steady state error is zero in integral controllers?
4. Mention any two standard test inputs.
5. Define stability of system in terms of gain margin and phase margin.
6. What is meant by non-minimum phase system?
7. What are the desired pole locations for system stability?
8. State Nyquist stability criterion.
9. What is the need for compensation?
10. How is time-domain specifications converted to desired root locations?

PART B — (5 × 16 = 80 marks)

11. (a) Obtain the overall transfer function C/R from the signal flow graph shown in figure-1

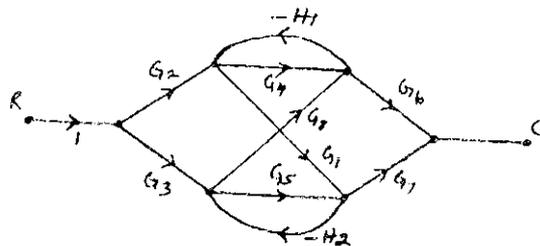


Fig 1

Or

- (b) Obtain the transfer function of the mechanical system shown in figure-2

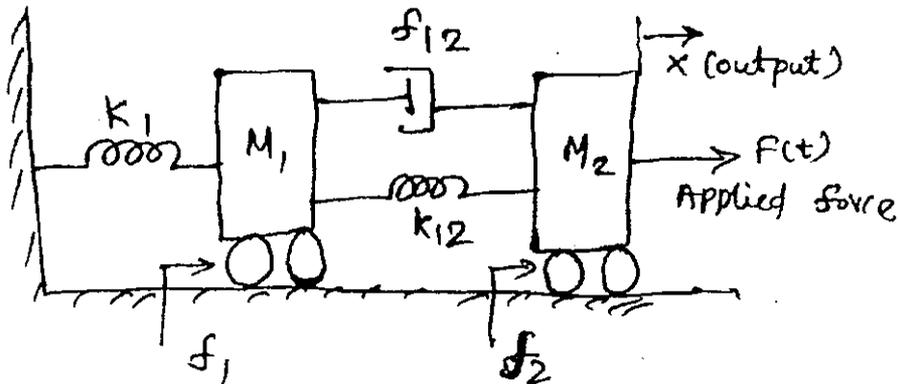


Figure - 2

12. (a) Explain the characteristics of P, PI and PID controllers.

Or

- (b) The open-loop transfer function of a servo system with unity feedback is $G(s) = \frac{10}{s(0.1s+1)}$. Evaluate the static error constants (K_p, K_v and K_a) for the system. Obtain the steady-state error of the system when subjected to an input given by the polynomial $r(t) = a_0 + a_1t + a_2t^2$.

13. (a) Draw the Bode plot of the following open-loop transfer function and comment on the stability.

$$G(s) = \frac{75(1+0.2s)}{s(s^2+16s+100)}$$

Or

- (b) Draw a polar plot for the given transfer function and comment on the stability.

$$G(s) = \frac{s(1+0.2s)}{s^2(s+3)(s+4)}$$

14. (a) By use of Nyquist stability criterion, determine whether the closed-loop systems having the following open-loop transfer function is stable or not. If not, how many closed-loop poles lie in the right-half of the s-plane?

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

Or

- re-2
- (b) The characteristic equation for certain feedback control system is given below. Determine the range of values K for the system stability.

$$s^4 + 20Ks^3 + 5s^2 + 10s + 15 = 0.$$

15. (a) A unity feedback system has an open-loop transfer function of

$$G(s) = \frac{4}{s(2s+1)}.$$

It is desired to obtain a phase margin of 40° without sacrificing the K_v of the system. Design a suitable lag-network and compute the value of network components assuming any suitable impedance level.

Or

- (b) A unity feedback system has an open loop transfer function

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

Design a suitable lead compensator for this system to meet the following specifications :

Damping ratio $\zeta = 0.7$

Settling time $t_s = 1.4$ sec

Velocity error constant $K_v = 2 \text{ sec}^{-1}$.
