Code No. : 3085

FACULTY OF ENGINEERING

B.E. 3/4 (Mech.) II Semester (Main) Examination, May/June 2011

CONTROL SYSTEM THEORY

Time : 3 Hours] **[Max. Marks : 75**

Note : Answer **all** questions from Part – A. Answer any **five** questions from Part – B.

PART – A (Marks : 25)

1. An automatic iron box set at 'silk' will get heated upto a particular value, and if it is set at 'wool' iron box will get heated upto a higher value. Draw a block diagram representing the control system and identify the location of following components : 4
   (a) Process output signal
   (b) Measuring device
   (c) Actuator
   (d) Sensor
   (e) Controller
   (f) Reference signal

2. What are the dynamic characteristics of a PD controller ? 3

3. What factors influence the choice of state variables in any system ? 2

4. State Mason's Rule. 3

5. If a Routh table has two sign changes above the even polynomial and five sign changes below the even polynomial, how many right half-plane poles does the system have ? 2

6. A position control system tracking with a constant difference in velocity, would yield how much position error in the steady state ? 2

7. Sketch the polar plot for a unity feedback system with open loop transfer function. 4

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

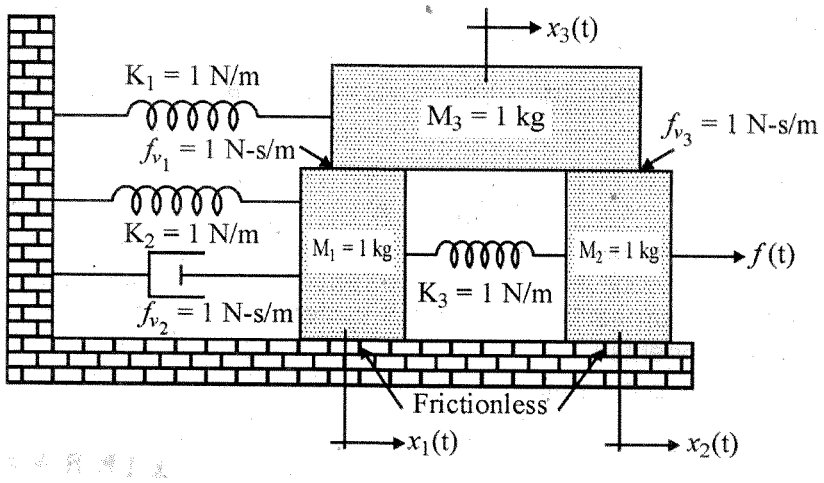
8. What are the properties of state transition matrix ? 2

9. Diagonalise the given state matrix : 3

$$A = \begin{bmatrix} 4 & 1 & -2 \\ 1 & 0 & 2 \\ 1 & -1 & 3 \end{bmatrix}$$

PART – B **(Marks : 50)**

10. Find the transfer function $G(s) = \frac{X_3(s)}{F(s)}$ for the translational mechanical system given in Fig. (1). **10**

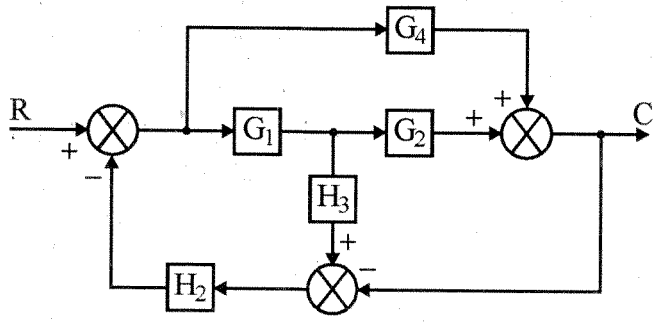


11. Plot the root Loci for a closed loop control system represented by open loop transfer functions as **10**

$$G(s) = \frac{K(s + 0.2)}{s^2(s + 3.6)}$$

Comment on the stability of the system.

12. For the system represented by the block diagram in Fig. (2), obtain the transfer function of the system using block reduction technique. **10**



13. Draw the Bode plot of a system with transfer function **10**

$$G(s) = \frac{z_0}{s\,(s + 2)\,(s + 5)}$$

(a) find the frequency corresponding to G(jw) H(jw) = 180° from the phase plot.

(b) find the gain in v_b corresponding to the frequency obtained in (a).

14. Consider a unity feedback system with open-loop transfer function : **10**

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

(a) Draw the Nyquist plot and check whether the system is stable if k = 1.

(b) From Nyquist plot, find the range of values of 'k' for which the system is stable.

15. Consider a system with state space model as **10**

$$\dot{x} = \begin{bmatrix} -3 & 1 & 0 \\ 0 & -3 & 1 \\ 0 & 0 & -3 \end{bmatrix} x + \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix} u$$

$$y = \begin{bmatrix} a_1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix}$$

(a) Is the system observable ? Does it depend on 'a' ?

(b) Find the range of values of a_1 for which the system is observable ?

(c) Is the system controllable ? Does it depend on a_1 ?

16. Write short notes on : **10**

(a) Performance Indices

(b) Specifications of a 2nd order system in frequency domain analysis.

(c) PID controller
