(Pages : 4) **A – 2750**

Reg. No. : .....

Name : .....

Sixth Semester B.Tech. Degree Examination, May 2016
(2013 Scheme)
13.603 : CONTROL SYSTEMS (T)

Time : 3 Hours Max. Marks : 100

PART – A

Answer **all** questions. **Each** carries **2** marks.

1. Write any 2 advantages and any 2 disadvantages of closed loop control systems.
2. For the system shown, determine K_p and e_{ss} for unit step input.

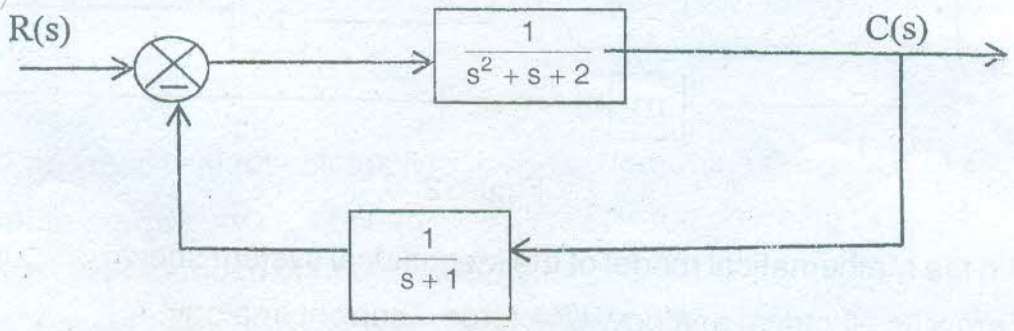

Figure 1

3. Write Masons rule and explain.
4. How can you predict the stability of a system using Routh Hurwitz criteria ?
5. Using Routh-Hurwitz criterion, check the stability of the system having following characteristics equation $s^5 + 6s^4 + 3s^3 + 2s^2 + s + 1 = 0$.
6. Define overshoot and settling time with reference to the 2nd order underdamped system.
7. Explain BIBO stability.
8. Define Gain Margin and Phase Margin.
9. Derive the equation for Transfer Matrix from the State model.
10. Write any 4 properties of the State Transition Matrix.

P.T.O.

PART – B

Answer **any one** question from **each** Module. **Each** carries **20** marks.

Module – I

11. Using block diagram reduction techniques obtain C/R by reducing the block diagram shown below.

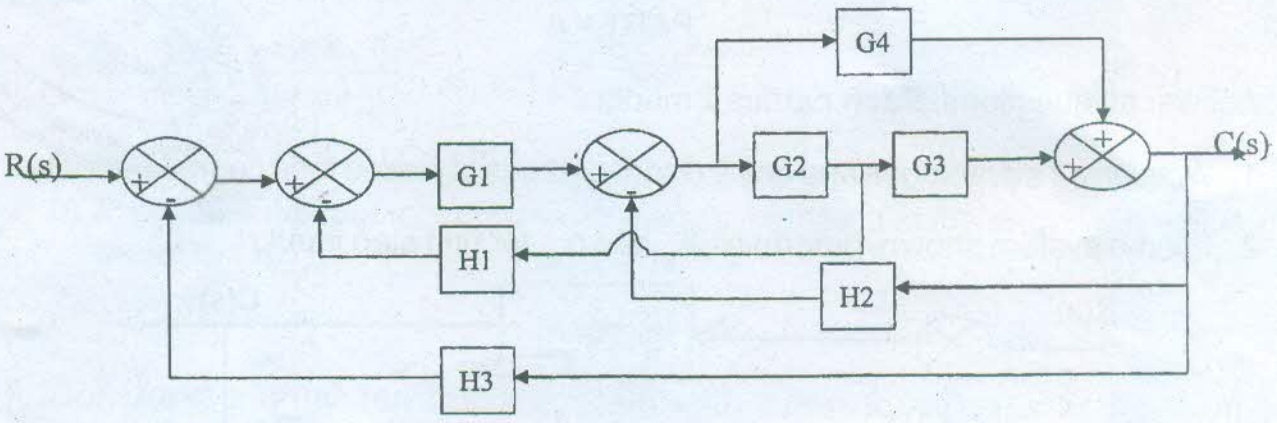

Figure 2

12. Obtain the Mathematical model of the Mechanical system shown in figure. 8
Also draw its electrical analogy. Use force – current analogy. 12

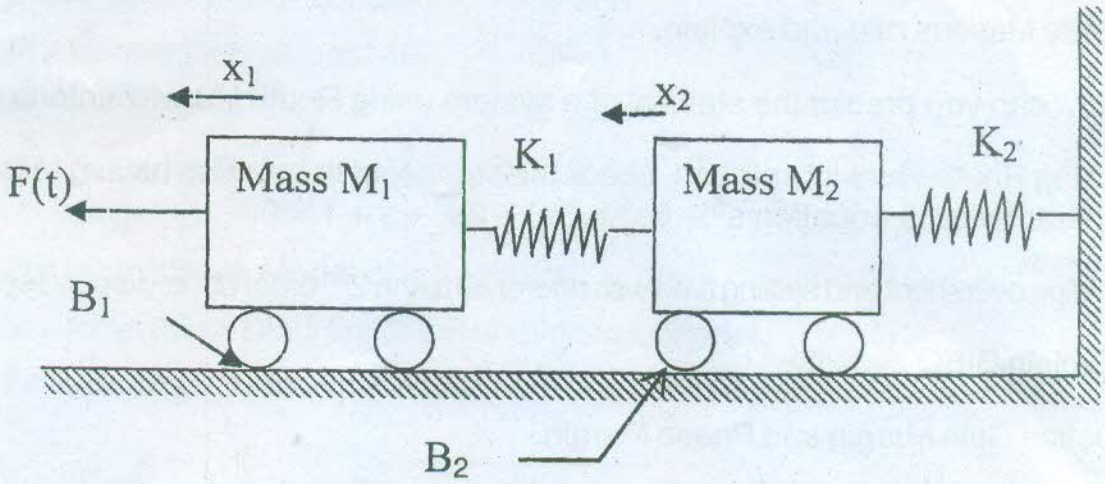

Figure 3

Module – II

13. a) Develop the closed loop transfer function of the position control system given in Figure below. 8

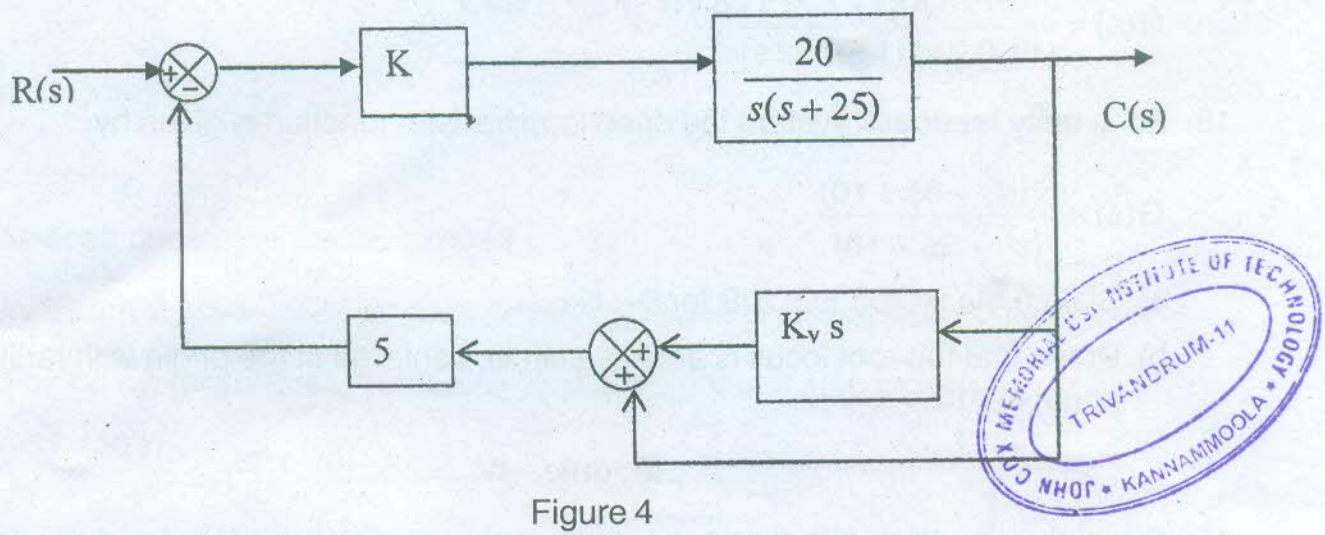

Figure 4

b) With no velocity feedback applied (Kv = 0), determine the gain K required for a natural frequency ω_n of 50 rad.sec. What is the damping ratio ξ ? Is the system over damped or under damped ? 6

c) What values of gain(K) and velocity feedback (Kv) are required for a natural frequency $\omega_n = 100$ rad/sec, while keeping the overshoot below 25% ? 6

14. The open loop transfer function of a servo system having unity feedback is given by $G(s) = \frac{8}{s^2 + 2s + 8}$.

Determine the following for a unit step input.

a) damped natural frequency

b) settling time

c) peak time

d) rise time

e) percentages overshoot.

Module – III

15. Sketch Bode Plot for the following transfer function and determine the system gain K for the gain cross over frequency to be 5 rad/sec.

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

16. For a unity feedback system the open loop transfer function is given by

$$G(s) = \frac{K(s^2+6s+10)}{(s^2+2s+10)}$$

a) Sketch the ROOT LOCUS for $0 \leq K \leq \infty$. 10

b) Prove that the root locus is arcs of a circle, centered at the origin with radius equal to $\sqrt{10}$. 10

Module – IV

17. Consider a unity feedback system with open loop transfer function

$$G(s) = \frac{1}{s(s+1)(0.5s+1)}.$$

Design a LAG compensator such that the closed loop system satisfies the following requirements.

i) Static velocity error constant = 5/sec and

ii) Phase margin is at least 40°.

18. For the Transfer Function given by $G(s) = \frac{s^2+3s+3}{s^3+2s^2+3s+1}$

a) Obtain the State Model of the system. 8

b) Draw the Block Diagram of the above State Model. 4

c) Find the State Transition Matrix. 8