Code No. : 6397/N/A

FACULTY OF ENGINEERING

B.E. 4/4 (Prod.) I Semester (New) (Main) Examination, Nov./Dec. 2009

CONTROL SYSTEMS THEORY

Time: 3 Hours] [Max. Marks: 75

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

PART – A **(25 Marks)**

1. Identify the input, controller and output for each of the following control systems and also state which are open loop and which are closed loop ?
   a) A toaster
   b) A human being reaching to touch an object
   c) A hydroelectric generator. 3

2. What are the objectives of control system design ? 2

3. Compare ac and dc Servomotors. 3

4. $G(s) = \frac{(s+1)}{s^2(s^2+3s+9)}$; What is the type and order of the given system ? 2

5. The forward path transfer function of a unity feedback control system is $G(s) = \frac{k}{s(s+6.54)}$ find the values of M_r, W_r, and B and width (BW) of the closed loop system. 3

6. Linearise the non linear equation $z = xy$ in the region $5 \le x \le 7$, $10 \le y \le 12$ find the error if the linearised equation is used to calculate the value of 'z' when $x = 5$, $y = 10$. 3

7. State the properties of state transition Matrix. 3

8. What is the motivation behind the concept of abservability ? 2

9. What are minimum phase systems ? 2

10. What are the advantages of modern control systems over the classical control systems ? 2

PART – B (50 Marks)

11. Obtain the transfer function of the mechanical system given below in Fig. (1). 10

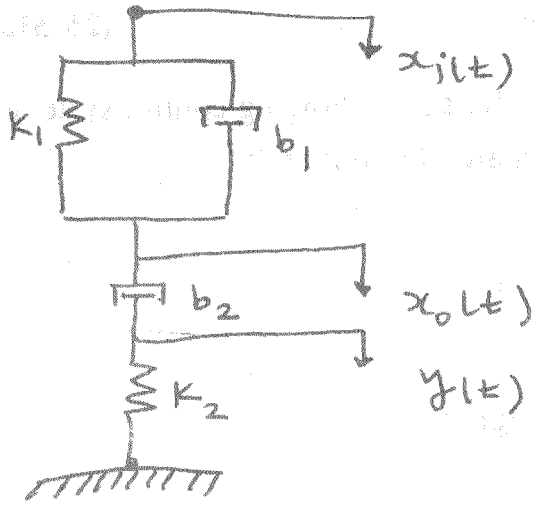

Fig. (1)

12. a) Using Mason's rule, find the transfer function

$T(s) = \frac{c(s)}{R(s)}$ for the system represented in Fig. (2) 5

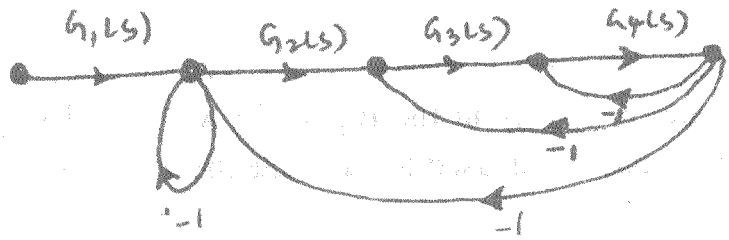

Fig. (2)

b)

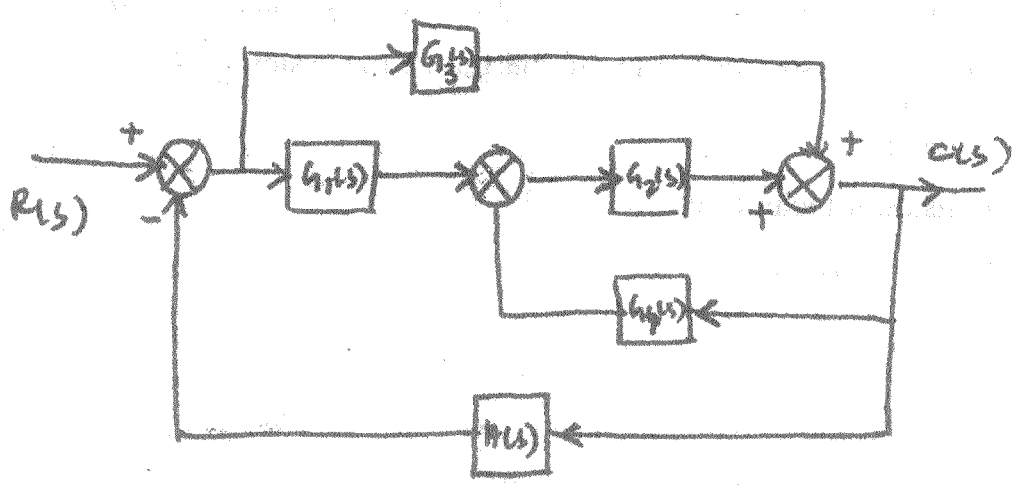

Fig. (3)

Reduce the system given in Fig. (3) to single transfer function $T(s) = \frac{c(s)}{R(s)}$. **5**

13. Sketch the root locus for the system with $G(s)\,H(s) = \frac{K}{s(s^2+6s+13)}$. **10**

14. Sketch the Nyquist plot and assess the stability of the closed loop system whose open loop transfer function is

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

15. $\frac{Y(s)}{V(s)} = \frac{2s^2+3s+1}{s^3+5s^2+6s+7}$

a) Obtain the state space model for the above transfer function.

b) Is the system state controllable ?

c) Is the system state observable ? **10**

16. Plot the bode diagram of $G(s) = \frac{K}{s(1+.1s)(1+.5s)}$ and

a) find the value of 'k' so that the gain margin of the systems in 20 dB.

b) find the value of 'k' so that the phase margin of the system is 45°. **10**

17. Write short notes on :

a) Lag compensation techniques

b) Sensitivity performance Indices. **10**
