b) Consider a linear system described by the following transfer function, $\frac{Y(s)}{U(s)} = \frac{10}{s(s+1)(s+2)}$. Design a feedback controller with a state feedback so that the closed loop poles are placed at $-2, -1 \pm j1$. **(13)**

PART – C **(1×15=15 Marks)**

16. a) A unity feedback control system has an open loop transfer function,

$G(s) = \frac{k}{s(s^2+4s+13)}$. Sketch the Root Locus. **(15)**

(OR)

b) Construct the Nyquist plot for a system whose open loop transfer function is given by $G(s)H(s) = \frac{K(1+s)^2}{s^3}$, Find the range of K for stability. **(15)**

Reg. No. :

Question Paper Code : 41245

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2018

Fifth Semester

Instrumentation and Control Engineering

IC 6501 – CONTROL SYSTEMS

(Common to Electrical and Electronics Engineering/Electronics and Instrumentation Engineering)

(Regulations 2013)

Time : Three Hours

Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. List the characteristics of negative feedback in control system.
2. Write the expression for mason's gain formula.
3. How is a system classified depending on the value of damping ?
4. What is steady state error ?
5. Give the advantages of frequency response analysis.
6. Define corner frequency.
7. Differentiate between gain margin and phase margin.
8. What is dominant pole ?
9. Write the advantages of state space analysis.
10. State the concept of observability.

PART – B (5×13=65 Marks)

11. a) Write the differential equations governing the mechanical system shown in Fig 11.a. Also draw the force voltage and force current analogous circuit and verify by writing mesh and node equations. (13)

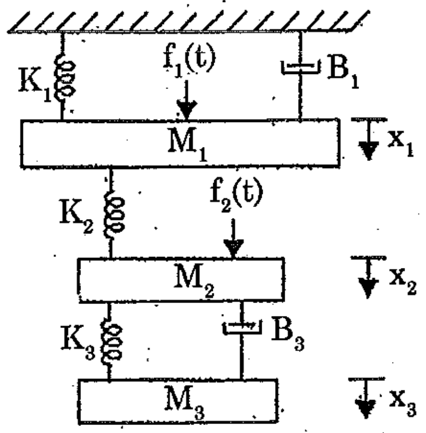

Fig 11. a)

(OR)

b) The block diagram of a closed loop system is shown in Fig 11. b). Using block diagram reduction technique, determine the closed loop transfer function. (13)

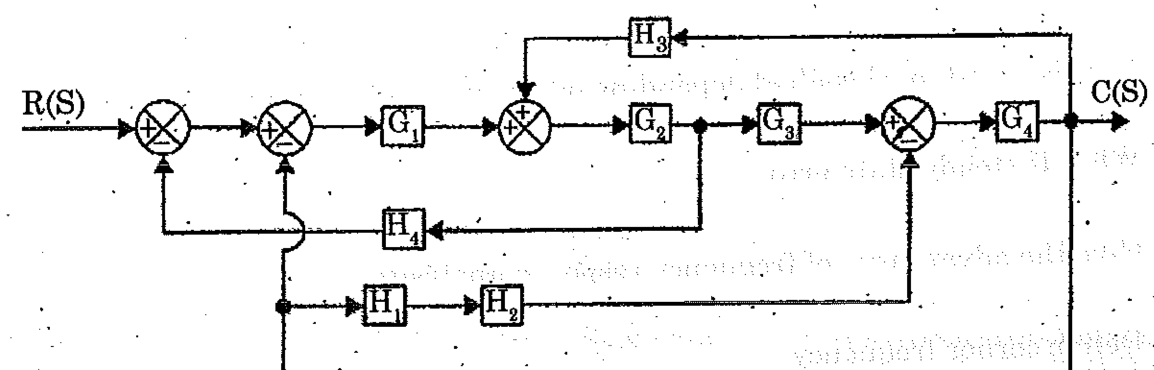

Fig. 11. (b)

12. a) i) Outline the time response of first order system when it is subjected to a unit step input. (8)

ii) Determine the response of the unity feedback system whose open loop transfer function is $G(s)=\dfrac{4}{s(s+5)}$ and when the input is unit step. (5)

(OR)

b) i) A unity feedback system has the forward transfer , function $G(s)=\dfrac{K_1(2s+1)}{s(5s+1)(1+s)^2}$ when the input r(t) = 1 + 6t, determine the minimum value of K_1 so that the steady error is less than 0.1. (8)

ii) Derive the transfer function of PID controller. (5)

13. a) Construct the polar plot and determine the gain margin and phase margin of a unity feedback control system whose open loop transfer function is,

$$G(s)=\frac{(1+0.2s)(1+0.025s)}{s^3(1+0.005s)(1+0.001s)}.$$ (13)

(OR)

b) Draw the bode diagram for the following transfer function,

$$G(s)=\frac{75(1+0.2s)}{s(s^2+16+100)}$$ (13)

14. a) i) Use the routh stability criterion, determine the range of K for stability of unity feedback system whose open loop transfer function is

$$G(s)=\frac{K}{s(s+1)(s+2)}.$$ (10)

ii) State Routh stability criterion. (3)

(OR)

b) Design a lead compensator for a unity feedback system with open loop transfer function, $G(s)=\dfrac{K}{s(s+1)(s+5)}$ to satisfy the following specifications

i) Velocity error constant, $K_v \geq 50$

ii) Phase margin ≥ 20 degrees. (13)

15. a) Determine the canonical state model of the system whose transfer function is

$$T(s)=\frac{2(s+5)}{(s+2)(s+3)(s+4)}.$$ (13)

(OR)