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Question Paper Code: 41045

B.E. / B.Tech. DEGREE EXAMINATION, APRIL 2015.

Fourth Semester

Electronics and Communication Engineering

01UEI422 – LINEAR CONTROL ENGINEERING

(Regulation 2013)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions.

PART A - (10 x 2 = 20 Marks)

1. What is feedback? What are the components of feedback control system?
2. Write Masons Gain formula.
3. Why derivative controller is not used in control systems?
4. List the time domain specifications.
5. The damping ratio and natural frequency of oscillation of a second order system is 0.5 and 8 *rad/sec*. calculate the resonant peak and resonant frequency.
6. Define Phase cross over and Gain cross over frequency.
7. State Nyquist stability criterion.
8. Define Relative stability. What is the necessary condition for stability?
9. What are the advantages of State Space analysis?
10. A discrete time system is described by the difference equation, $y(k+2)+3y(k+1)+5y(k)=u(k)$. Determine the transfer function of the system.

PART - B (5 x 16 = 80 Marks)

11. (a) (i) Obtain the closed loop transfer function *C(S)/R(S)* of the system whose block diagram is shown in Fig. 1. (8)

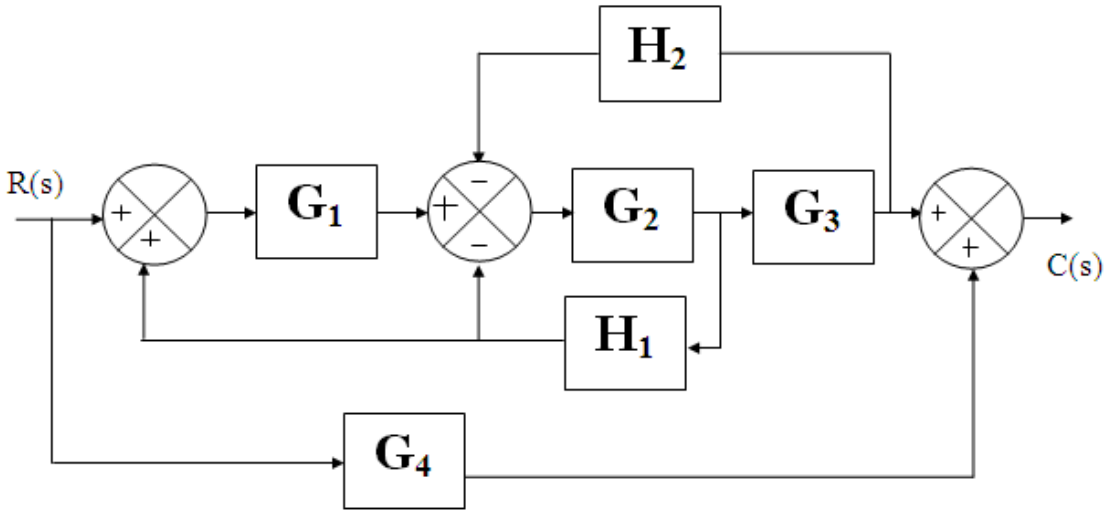

Fig.1

(ii) Find the overall gain *C(s)/R(s)* for the signal flow graph shown in Fig. 2. (8)

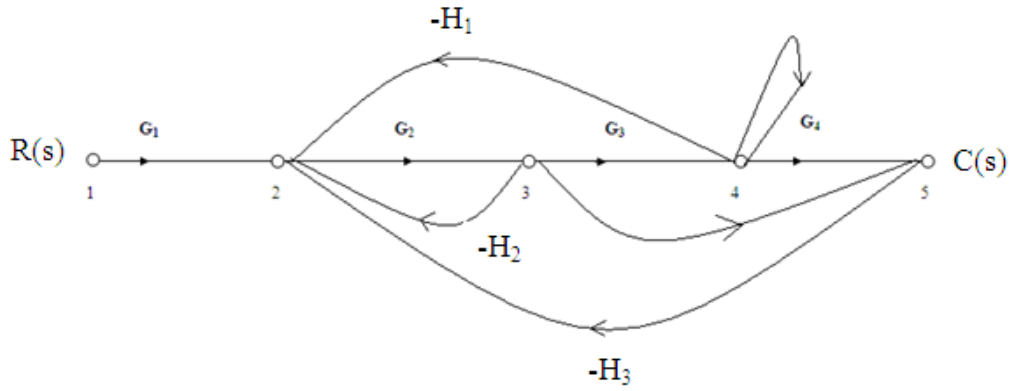

Fig.2

Or

(b) Write the differential equations governing the mechanical system shown in Fig. 3. Draw the force-voltage and force-current electrical analogous circuits and verify by writing mesh and node equations. (16)

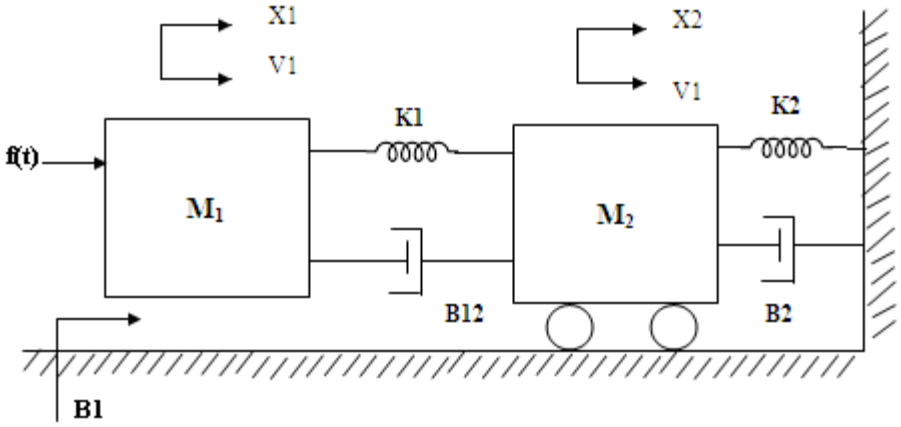

Fig.3

12. (a) (i) Derive the expression for the response of first order system for unit step input. (8)

(ii) The unity feedback system is characterized by an open loop transfer function $G(s) = \frac{K}{s(s+10)}$. Determine the gain *K*, so that the system will have a damping ratio of 0.5 for this value of *K*. Determine settling time, peak overshoot and time to peak overshoot for a unit step input. (8)

Or

(b) (i) For servomechanism with open loop transfer function given below explain what type of input signal give rise to a constant steady error and calculate their value. Given $G(s) = \frac{10}{(s+2)(s+3)}$. (6)

(ii) Consider a unity feedback system with a closed loop transfer function $\frac{C(s)}{R(s)} = \frac{Ks+b}{s^2+as+b}$. Determine the open loop transfer function *G(s)*. Show that the steady state error with unit ramp input is given by $\frac{(a-K)}{b}$. (10)

13. (a) (i) A unity feedback control system has $G(s) = \frac{K}{s(s+4)(s+10)}$. Draw the Bode plot. Find *K* when phase margin 30^o. (12)

(ii) Write short notes on correlation between time domain and frequency domain specifications. (4)

Or

(b) (i) Sketch the polar plot of the given transfer function and find phase margin and gain margin $G(s) = \frac{1}{s(s+4)(s+8)}$. (12)

(ii) What is compensator. Write the procedure to design lead compensator using Bode plot. (4)

14. (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. (16)

Or

(b) The open loop transfer function of a system is $G(s) = \frac{K}{s(1+0.1s)(1+s)}$ (16)

(i) Determine the value of *K* so that gain margin is 6 *db*.

(ii) Determine the value of *K* so that phase margin is 40^o.

15. (a) Obtain the state model of the mechanical system shown in Fig. 4 by choosing a minimum of three state variables. (16)

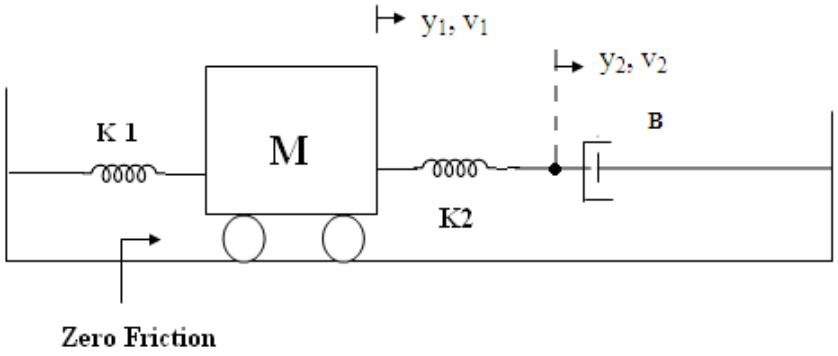

Fig.4

Or

(b) A discrete time system is described by the difference equation *y(k+2)+5y(k+1)+6y(k)=u(k); y(0)=y(1)=0; T=1Sec*. (16)

(i) Determine a state model in canonical form.

(ii) Find the state transition matrix.

(iii) For input $u(k)=1; k \geq 1$, find the output *y(k)*.