Reg. No. : | | | | | | | | | | |

Question Paper Code: 41643

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2016

Fourth Semester

Instrumentation and Control Engineering

14UIC403 - LINEAR CONTROL SYSTEMS

(Regulation 2014)

Duration: Three hours | Maximum: 100 Marks

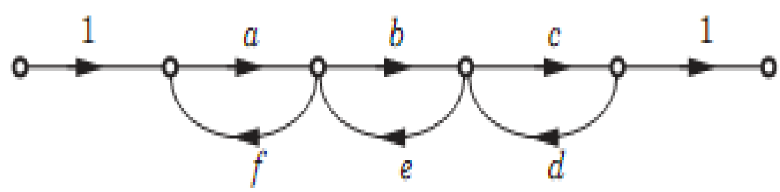
Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. In an open loop control system

   (a) Output is independent of control input
   (b) Output is dependent on control input
   (c) Only system parameters have effect on the control output
   (d) None of the above

2. The sum of the gains of the feedback paths in the signal flow graph shown in figure below is



   (a) af + be + cd + abef + bcde   (b)af + be + cd
   (c)af + be + cd + abef + abcdef   (d) af + be + cd + cbef + bcde + abcdef

3. The impulse response of a LTI system is a unit step function, then the corresponding transfer function is

   (a) $1/s$ (b) $1/s^2$ (c) 1   (d) s

4. For a second order system settling time is Ts = 7 s and peak time is Tp = 3 s. The locations of poles are

(a)-0.97 ± j0.69 (b)-0.69 ± j0.97
(c)-1.047 ± j0.571 (d) -0.571 ± j1.047

5. A system with gain margin close to unity or a phase margin close to zero is

(a) Highly stable (b) Oscillatory
(c) Relatively stable (d) Unstable

6. For the transfer function, the phase cross-over frequency is

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

(a)0.5 rad/sec (b)0.707 rad/sec
(c)1.732 rad/sec (d)2 rad/sec

7. The equation $2s^4 + s^3 + 3s^2 + 5s + 10 = 0$ has __________roots in the left half of s-plane.

(a) one (b) two (c) three (d) four

8. If the Nyquist plot of the loop transfer function *G(s) H(s)* of a closed-loop system encloses the *(-1 + j0)* point in the *G(s) H(s)* plane, the gain margin of the system is

(a) zero (b) greater than zero
(c) less than zero (d) infinity

9. The transfer function of $\frac{1+0.5S}{1+S}$ represents a

(a)Lag network (b)Lead network
(c)lag Lag–lead network (d) Proportional controller

10. Introduction of the lag compensator shifts the gain cross over frequency to the __________ frequency region of Bode plot

(a) Low (b) Medium (c) High (d) None

PART - B (5 x 2 = 10 Marks)

11. Identify why negative feedback is preferred in control application?

12. Distinguish between generalized error constants over static error constant.

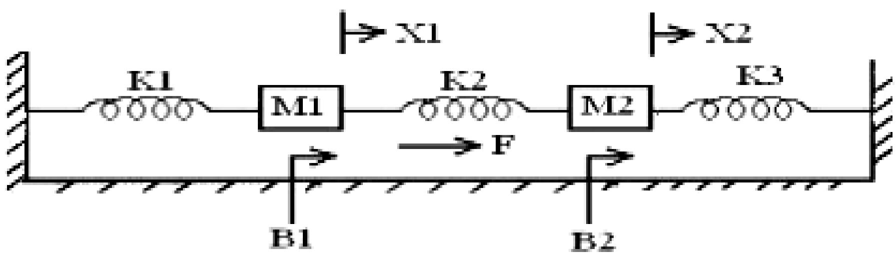
13. Define Gain Margin.

14. Analyze the effect of adding a pole to the open loop transfer function of the system?

15. When the lag, lead and lag-lead compensation is employed?

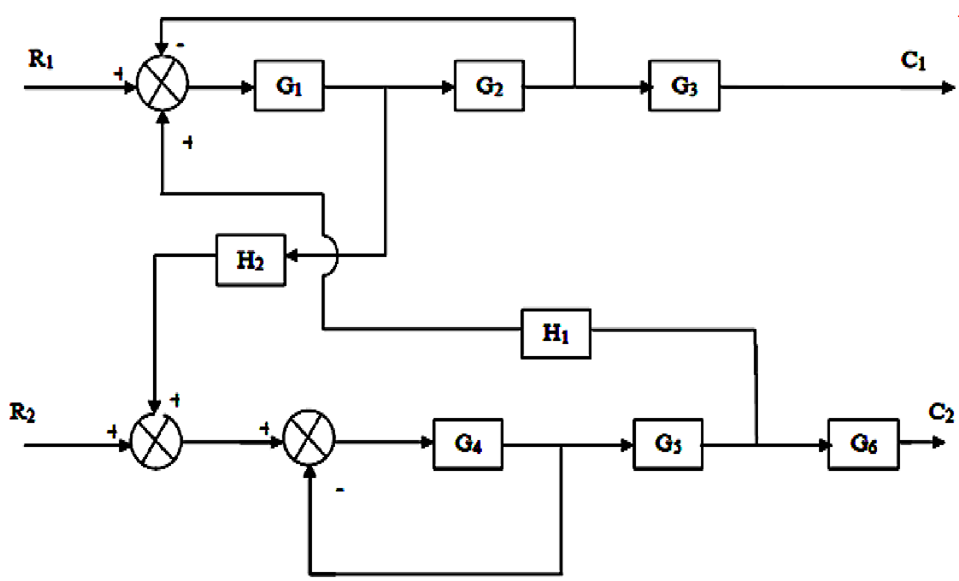
PART - C (5 x 16 = 80 Marks)

16. (a) Write the differential equations governing the behaviour of the mechanical system shown in figure below. Obtain an analogous electric circuit based on force current analogy. (16)



Or

(b) Determine C1/R1 and C2/R1 for the system represented by the block diagram shown in below figure. (16)



17. (a) A unity feedback control system is characterized by the following open loop transfer function G(s) = (0.4S+1) / S(S+0.6). Determine its transient response for unit step input and sketch the response. Infer the maximum overshoot and the corresponding peak time. (16)

Or

(b) For a unity feedback control system the open loop transfer function $G(s) = 10(S+2) / S^2 (S+1)$. Calculate (i) Position, velocity and acceleration error constants (ii) Steady state error when the input is $R(s) = (3/S)-(2/S^2)+(1/3S^3)$. (16)

18. (a) (i) Sketch the polar plot of $G(s) = \frac{1}{[s(1+0.5s)(1+0.02s)]}$ and determine the phase cross over frequency. (12)

(ii) What are the advantages of frequency domain approach? (4)

Or

(b) Sketch the Bode plot for the following transfer function and obtain gain and phase cross over frequencies. $G(s) = \frac{20}{[s(1+0.4s)(0.1s+1)]}$. (16)

19. (a) Sketch the root locus of the system whose open loop transfer function is $G(s) = \frac{K}{s(s+2)(s+4)}$ .Interpret the value of K so that the damping ratio of the closed loop system is 0.5. (16)

Or

(b) Describe Nyquist stability criterion and the procedure for investigating stability using Nyquist criterion. (16)

20. (a) A unity feedback system has an open loop transfer function $G(s) = \frac{K}{s(1+2s)}$. Design a suitable lag compensator so that phase margin is 40^o and the steady state error for ramp input is less than or equal to 0.2. (16)

Or

(b) (i) Explain in detail the design procedure of lag lead compensator using Bode plot. (12)

(ii) Write the transfer function of a typical lead compensator and draw its pole zero plot. (4)

———————