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

Question Paper Code: 44063

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2017

Fourth Semester

Instrumentation and Control Engineering

14UIC403 - LINEAR CONTROL SYSTEMS

(Regulation 2014)

Duration: Three hours | Maximum: 100 Marks

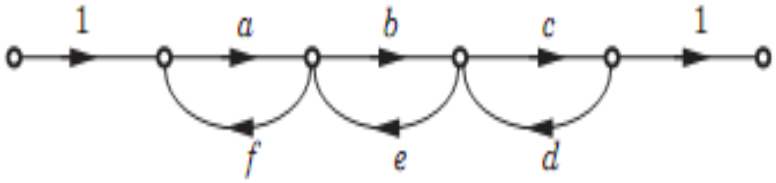
Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. A car is running at a constant speed of 50 *km/h*, which of the following is the feedback element for the driver?

   (a) Clutch
   (b) Eyes
   (c) Needle of the speedometer
   (d) Steering wheel

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. Steady-state error of a feedback control system with an acceleration input becomes finite in a

   (a) type 0 system
   (b) type 1 system
   (c) type 2 system
   (d) type 3 system

4. 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

5. The frequency and time domain are related through which of the following?

(a) Laplace Transform and Fourier Integral (b) Laplace Transform
(c) Fourier Integral (d) Either (b) or (c)

6. 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

7. 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

8. 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

9. 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 of these

10. 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

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 mechanical system shown in figure 1 below and develop the transfer function. (16)

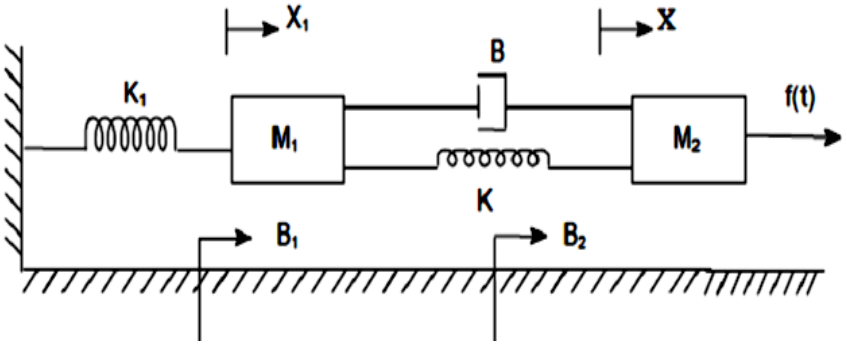
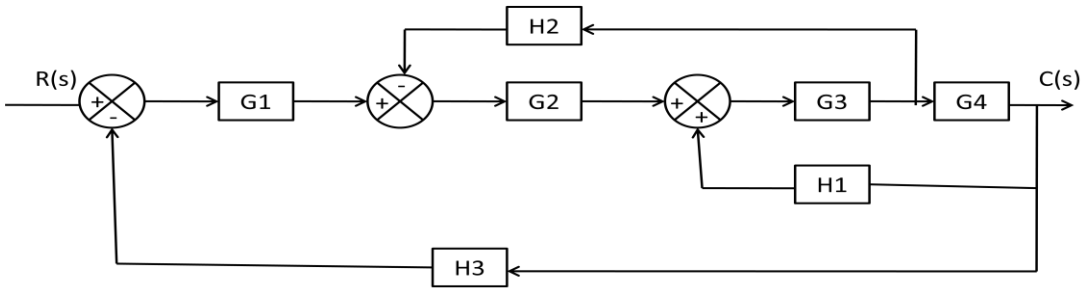


Figure 1

Or

(b) Using block diagram reduction rules, convert the block diagram to a simple loop. (16)



17. (a) 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)

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) Given $G(s) = \frac{Ke^{-0.2s}}{s(s+2)(s+8)}$ Calculate 'K' so that the system is stable with gain margin equal to 6 db and phase margin equal to 45^o (16)

Or

(b) Sketch the polar plot of $G(s) = \frac{1}{[s(1+0.5s)(1+0.02s)]}$ and determine the phase cross over frequency. (16)

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

Or

(b) 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)

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) Explain in detail the design procedure of lag lead compensator using Bode plot. (16)