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

Question Paper Code: 44603

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2018

Fourth Semester

Instrumentation and Control Engineering

14UIC403 - LINEAR CONTROL SYSTEMS

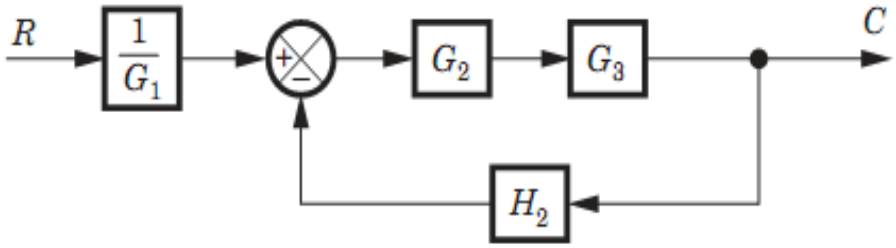
(Regulation 2014)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. The transfer function for the feedback control system shown in figure below is



(a) $G_1G_2/(1+H_1G_1G_2G_3)$ (b) $G_2G_3/G_1(1+H_1G_2G_3)$
(c) $G_2G_3/(1+H_1G_1G_2G_3)$ (d) $G_2G_3/(G_1(1+H_1G_2G_3)$

2. 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

3. The damping ratio of a system having the characteristic equation $S^2+2S+8=0$ is

(a) 0.353 (b) 0.330 (c) 0.300 (d) 0.250

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

66. 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. Calculate the acceleration error coefficient of a unity feedback system with $G(s) = \frac{10(S+2)}{S^2(S+5)}$.

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13. Define Gain Margin.

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

15. Develop the transfer function of a typical lag lead compensator

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)

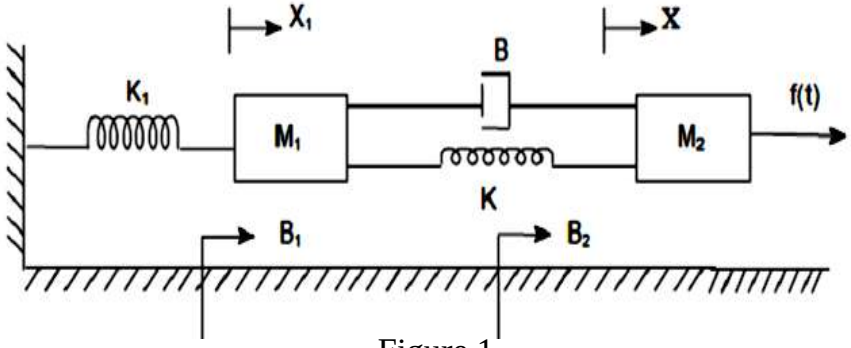
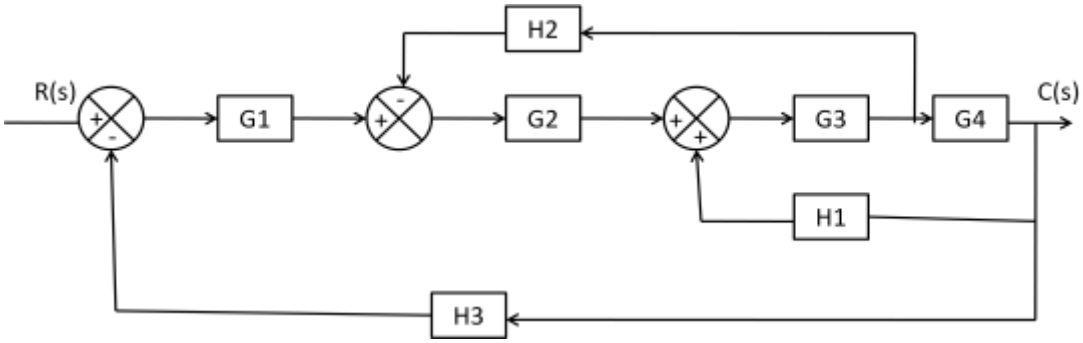


Figure 1

Or

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



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

Or

(b) Write any four advantages of frequency response analysis and name the different frequency response analysis plots commonly used. Describe in detail the correlation between time and frequency response for a second order system. (16)

1919. (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 lag compensator and draw its pole zero plot. (4)

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