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

Question Paper Code: 41643

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

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. 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)

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 of these

PART - B (5 x 2 = 10 Marks)

11. What is the mathematical model of a system?

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

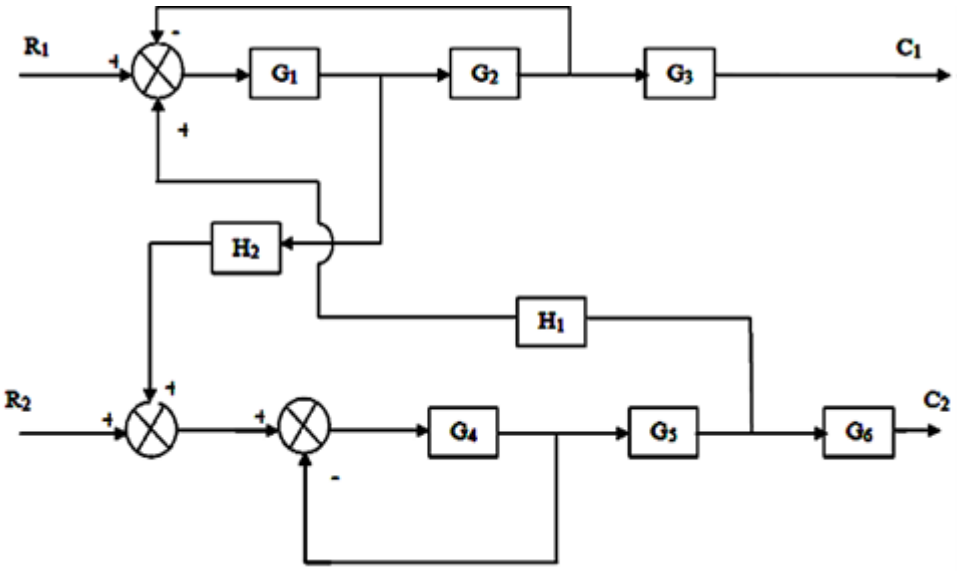
13. Define Gain Margin.

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.

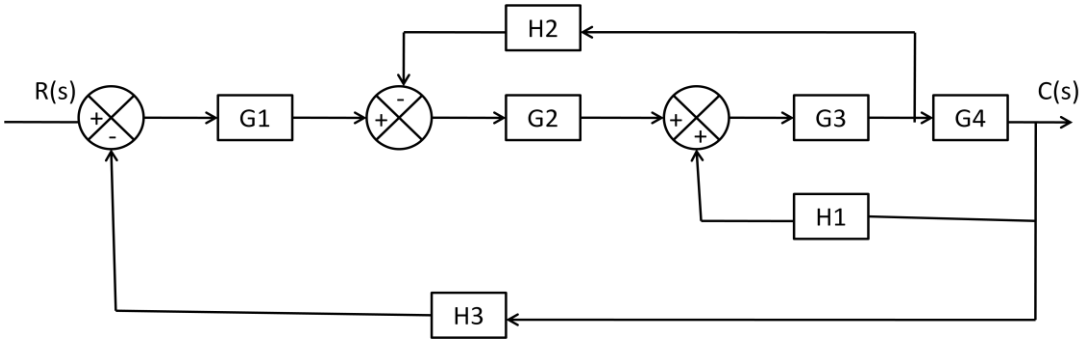
PART - C (5 x 16 = 80 Marks)

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



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) The open loop transfer function of a servo system with unity feedback is $G(s) = \frac{10}{s(0.1s + 1)}$. Evaluate the static error constants of the system. Obtain the steady state error of the system, when subjected to an input given by the

polynomial $r(t) = a_0 + a_1 t + \frac{a_2}{2} t^2$. Also find the generalized error constants and hence $e_{ss.}$ (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) 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) Construct the Routh array and determine the stability of the system represented by the characteristic equation

$$s^5 + s^4 + 4s^3 + 24s^2 + 3s + 63 = 0$$

Comment on the location of the roots of the characteristic equation. (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) Explain in detail the design procedure of lag lead compensator using Bode plot. (16)

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