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

Question Paper Code: 44603

B.E. / B.Tech. DEGREE EXAMINATION, MAY 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. 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. A lag compensation network

(a) Increases the gain of the original network without affecting stability

(b) Reduces the steady state error

(c) Reduces the speed of response

(d) Permits the increase of gain of phase margin is acceptable

In the above statements, which are correct?

(a) Both (a) and (b) (b) Both (b) and (c)
(c) All (b), (c) and (d) (d) All the above

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.

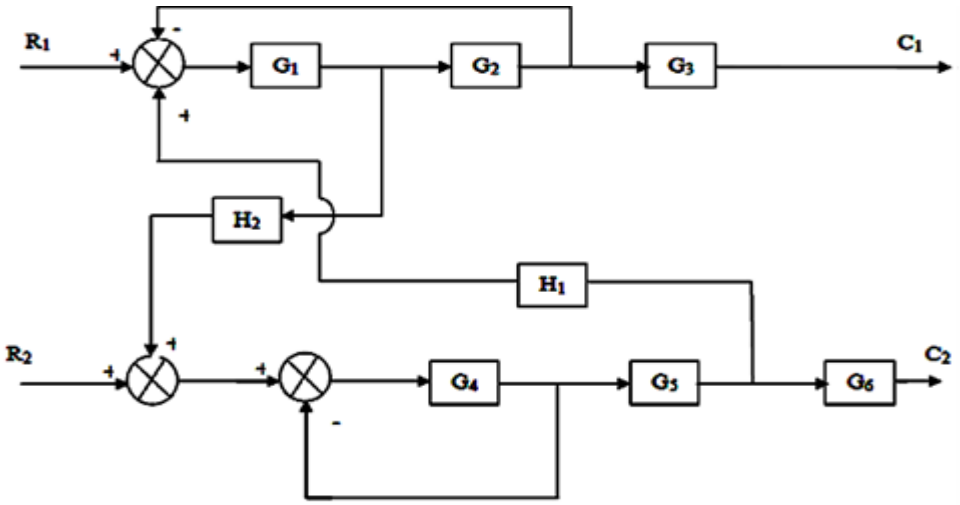
13. Define Gain Margin.

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.

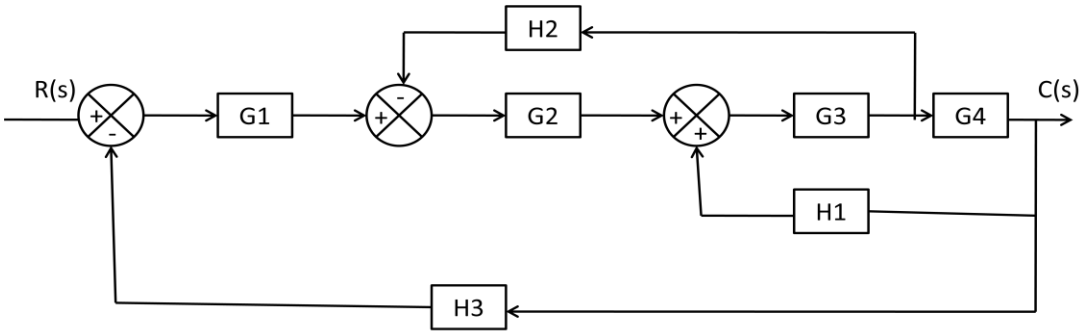
PART - C (5 x 16 = 80 Marks)

16. (a) 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) 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) 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) The forward path transfer function of a certain unity feedback control system is given by $G(s) = \frac{k}{s(s+2)(s+8)}$. Design a suitable lag compensator so that the system meets the following specifications.

(i) Percentage overshoot less than or equal to 16% for unit step input.

(ii) Steady state error less than or equal to 0.125 for unit ramp input. (16)