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

Question Paper Code: 31463

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

Fourth Semester

Instrumentation and Control Engineering

01UIC403 – LINEAR CONTROL SYSTEMS

(Regulation 2013)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

(Use of polar chart is permitted)

PART A - (10 x 2 = 20 Marks)

1. Differentiate an open loop control system from a closed loop control system.
2. Convert the block diagram in Figure 1 to signal flow graph.

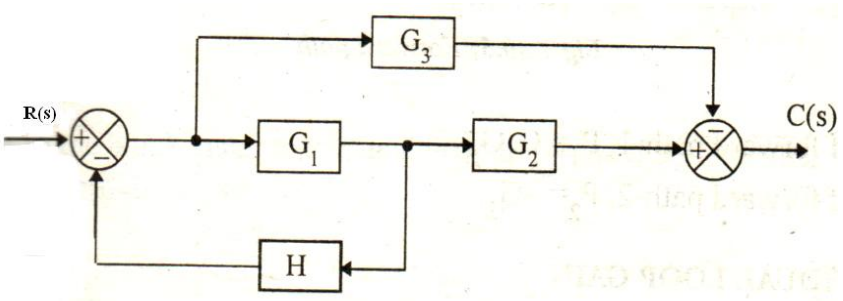

Figure 1

3. Draw and write the mathematical expressions for step and ramp signals.
4. List any four generic features of a PI controller.
5. For a second order system the damping ratio is 0.75 and natural frequency of oscillation 12 *rad/sec* respectively. Calculate peak overshoot and peak time.

6. How the closed loop frequency response is determined from the open loop frequency response using M and N circles?

7. Assess the stability of the system represented by the characteristic equation $s^4+8s^3+18s^2+16s+5=0$ using Routh criteria.

8. Deduce the angle criterion of root locus from the open loop transfer function.

9. Give two significances of compensators in feedback control systems.

10. When is a lead compensator employed? Sketch its pole-zero plot.

PART - B (5 x 16 = 80 Marks)

11. (a) Obtain the closed loop transfer function *C(s)/R(s)* of the system whose block diagram is shown in Figure 2. (16)

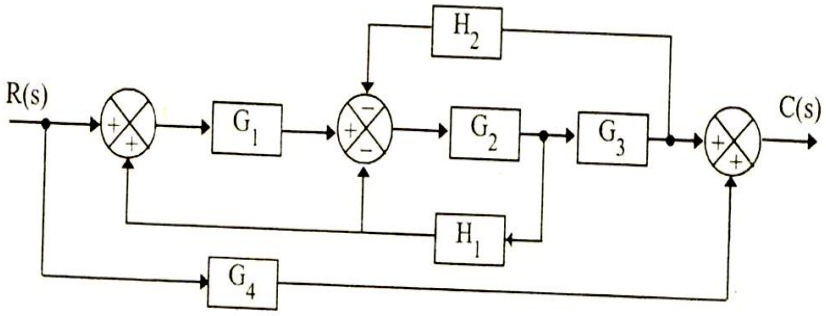

Figure-1

Or

(b) Derive the transfer function of armature controlled DC motor and field controlled DC motor. (16)

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

Or

(b) Illustrate the use of generalized error coefficients and formulate an expression for error function. (16)

13. (a) Develop a Bode diagram and obtain gain and phase crossover frequencies for the transfer function given by $G(s) = \frac{10}{s(1+0.4s)(1+0.1s)}$. (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)

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

Or

(b) Explain Nyquist stability criterion and the procedure for investigating stability using Nyquist criterion with an example. (16)

15. (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)

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