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

Question Paper Code: 31643

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

Fourth Semester

Instrumentation and Control Engineering

01UIC403 – LINEAR CONTROL SYSTEMS

(Regulation 2013)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

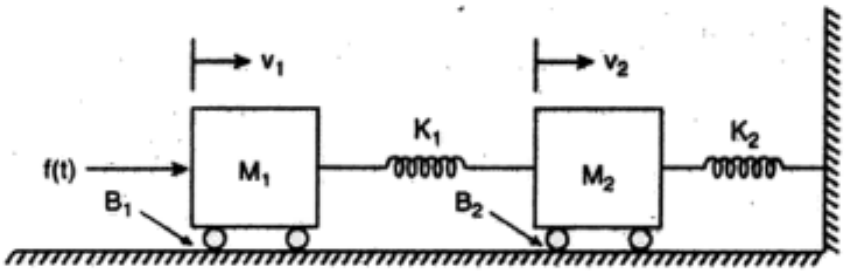
(Use of polar chart is permitted)

PART A - (10 x 2 = 20 Marks)

1. Distinguish open loop and closed loop control systems.
2. Define Transfer function. Mention the need of modeling.
3. Define percentage peak overshoot.
4. Compare P, I and D control modes.
5. List the frequency domain specifications.
6. Give the correlation between time domain and frequency domain specifications.
7. Comment on location of roots in S-plane for stability.
8. State Nyquist stability criterion.
9. Mention the need of compensators.
10. Draw the lag electric network.

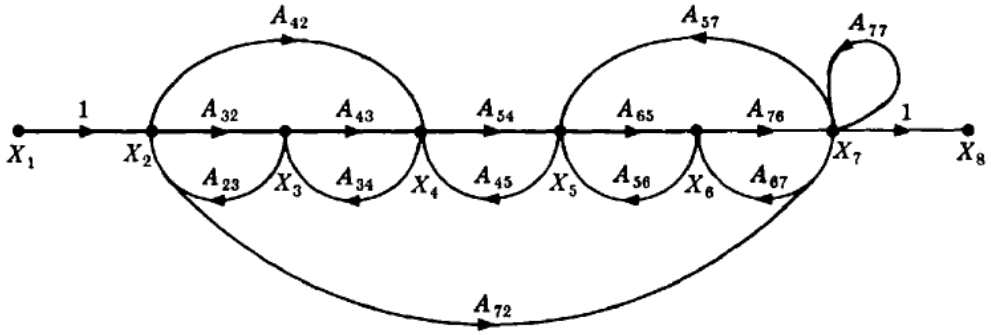
PART - B (5 x 16 = 80 Marks)

11. (a) Find the transfer function of the following system. Also draw the force-voltage and force-current electrical analogous circuits. (16)



Or

(b) Apply Mason's Rule to calculate the transfer function of the system represented by following Signal Flow Graph. (16)



12. (a) (i) The forward path transfer function of an unity feedback control system is given by $G(s) = \frac{2}{s(s+3)}$. Obtain an expression for unit step response of the system.

(8)

(ii) A unity feedback system is characterized by an open loop transfer function $G(s) = \frac{k}{s(s+10)}$. Determine the gain 'k' so that the system will have a damping ratio of 0.5. For this value of 'k', find peak overshoot and peak time for a unit step input. (8)

Or

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

13. (a) The open loop transfer function of a system is given by

$$G(s)H(s) = \frac{30}{s(1 + 0.5s)(1 + 0.08\,s)}$$

Draw the bode plot and determine Gain margin and phase margin. (16)

Or

(b) The open loop transfer function of a system is given by

$$G(s) = \frac{10\,(s + 2)}{s(s + 1)(s + 3)}$$

Draw the polar and determine gain margin and phase margin. (16)

14. (a) Draw the root locus plot for the system whose open loop transfer function is given by

$$G(s)H(s) = \frac{k}{s(s + 4)(s^2 + 4s + 13)}$$

Find the marginal value of 'k' which causes sustained oscillations and the frequency of these oscillations. (16)

Or

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

15. (a) What is a lag compensator? Obtain the transfer function of lag compensator. Also explain the different steps to be followed for the design of lag compensator using Bode plot. (16)

Or

(b) A unity feedback system has, $G(s) = \frac{10}{s(s + 1)}$. Design a lead compensator such that the closed loop system will satisfy the following specifications.

Static velocity error constant = 20 sec

Phase margin = 50^o

Gain margin $\geq$ 10dB

Draw the Bode plot and explain. (16)

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