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

**Question Paper Code: 31463**

B.E. / B.Tech. DEGREE EXAMINATION, NOVEMBER 2015

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. Express the rule for eliminating positive feedback loop.
2. List the two assumptions to be made while driving transfer function of electrical systems?
3. The open loop transfer function of a unity feedback system is $G(s) = 20/s(s+10)$. Examine the nature of response of closed loop system for unit step input?
4. Write the transfer function of PID controller.
5. A unity feedback system has the transfer function $G(s) = 10/s(s+6)$. Estimate resonant peak.
6. Define $M$ and $N$ circles.
7. Examine the stability of the following system (i) $G(s)H(s) = 1/(s+2)(s+4)$ and (ii) $G(s)H(s) = 9/s^2(s+2)$.
8. Give Nyquist stability criterion.
9. When lag compensation is employed?
10. Give the electrical network of lag-lead compensator.

PART - B (5 x 16 = 80 Marks)

11. (a) Express the transfer function $\frac{X(s)}{F(s)}$ for the system shown in figure-1. (16)

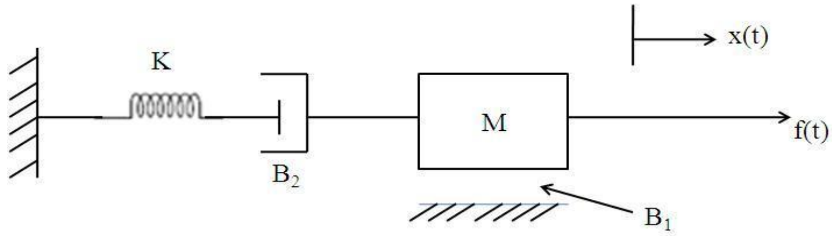


Figure-1

Or

(b) Express the transfer function $\frac{C(s)}{R(s)}$ for the system shown in figure-2 using the Mason's gain formula. (16)

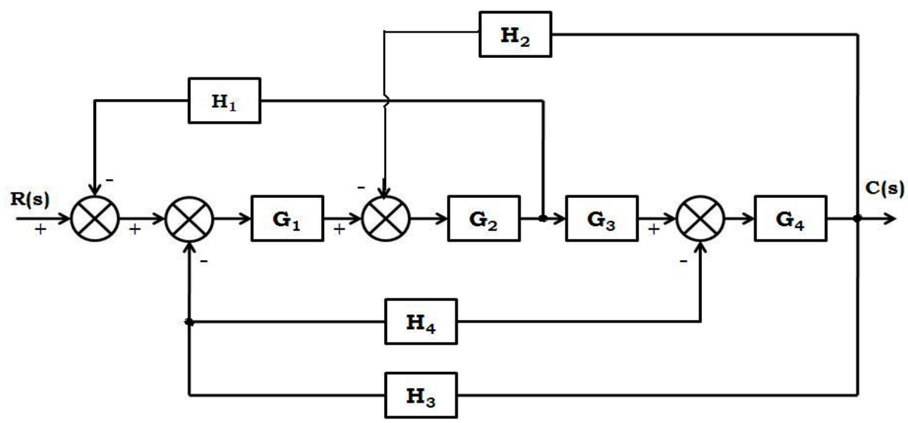


Figure-2

12. (a) (i) The closed loop transfer function of the system is $\frac{25K}{s^2 + (5 + 500K_t)s + 25K}$

Calculate the value of $K$ and $K_t$ so that the maximum over shoot of the output is approximately 20 percent and the rise time is 0.05*sec*. (8)

(ii) Discover the output response of the first order system for step input. (8)

Or



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(b) (i) A unity feedback system with the closed loop transfer function $\frac{C(s)}{R(s)} = \frac{Ks+b}{s^2+as+b}$. Discover *G(s)* and show that steady state error with unit ramp input is given by $\frac{(a-K)}{b}$. (8)

(ii) The open loop transfer function of a system with unity feedback system is given as $G(s) = \frac{10(s+2)}{s^2(s+1)}$. Calculate the first three co-efficient of the error series and hence determine the steady state error for the input $R(s) = \frac{3}{s} - \frac{2}{s^2} + \frac{1}{3s^2}$. (8)

13. (a) (i) A unit step response test conducted on a second order system yielded peak overshoot $M_p$=0.12, and peak time $t_p$=0.2*s*. Determine the corresponding response indices resonant peak, resonant frequency, bandwidth for the system. (8)

(ii) Analyze the correlation between time and frequency response of a second order system. (8)

Or

(b) The open loop transfer function of a system with unity feedback system is given by, $G(s) = \frac{(1+0.2s)(1+0.025s)}{s^3(1+0.005s)(1+0.001s)}$ Sketch the polar plot and evaluate phase margin. (8)

14. (a) (i) The open loop transfer function of a unity feedback system is given by $G(s) = \frac{K(s+1)}{s^3+as^2+2s+1}$. Determine the value of $K$ and $a$ so that the system oscillates at a frequency of 2 *rad/sec*. (8)

(ii) Using Routh criterion, examine the stability of the system represented by the characteristic equation, $S^6+2S^5+8S^4+12S^3+20S^2+16S+16=0$. Comment on the location of the roots of characteristic equation. (8)

Or

(b) Construct the root locus of the system whose open loop transfer function $G(s)=\frac{K}{s(s+2)(s+4)}$. Determine the value of $K$ so that the damping ratio of the closed loop system is *0.5*. (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 steady state error for ramp input is less than or equal to *0.2*. (16)

Or

(b) Design a phase lead compensator for the given system $G(s)=\frac{K}{s(1+s)}$ to satisfy the following specifications. (i) The phase margin of the system $\geq 45^o$ (ii) Steady state error for a unit ramp input $\leq 1/15$ (iii) The gain cross over frequency of the system must be less than 7.5 *rad/sec*. (16)