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Question Paper Code: 31457

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

Fourth Semester

Electronics and Communication Engineering

01UEI422 – LINEAR CONTROL ENGINEERING

(Regulation 2013)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

(Use of polar chart and bode chart may be permitted)

PART A - (10 x 2 = 20 Marks)

1. What do you mean by an open loop control system?
2. Write Mason's gain formula and its purpose.
3. Why are test signals needed?
4. What is steady state error?
5. List the advantages of frequency response analysis.
6. Define phase crossover frequency.
7. Write the necessary and sufficient condition for stability using the Routh method?
8. What is the effect of adding zeros to G(s) H(s) on the root locus?
9. List the advantages of state space analysis over transfer function approach.
10. Write the state model.

PART - B (5 x 16 = 80 Marks)

11.(a) Write the differential equations governing the behavior of the mechanical system shown in Figure-1. Also obtain the analogous electrical circuits based on (a) Force-Current analogy (b) Force-Voltage analogy. Also obtain the transfer function $X_1(s)/F(s)$. (16)

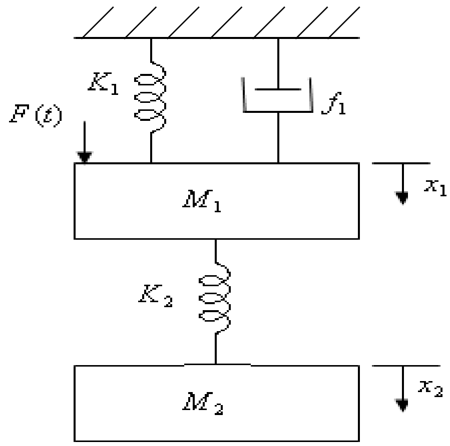

Figure-1

Or

(b) (i) Draw the block diagram of an armature controlled dc motor and derive its transfer function. (8)

(ii) Obtain the transfer function of the control system whose block diagram is shown in Figure-2 by block diagram reduction technique. (8)

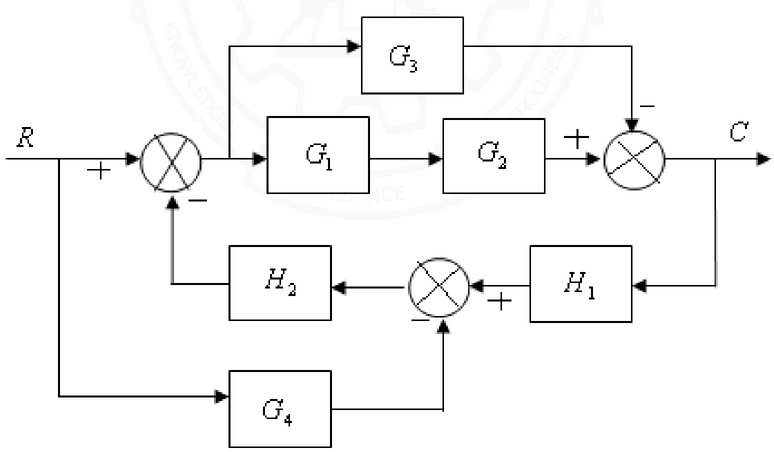

Figure-2

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12. (a) (i) Derive and draw the unit ramp response of a first order system. (8)

(ii) Derive and draw the unit step response of a second order system for under damped condition. (8)

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 coefficients (K_p, K_v,K_a) for 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 evaluate the dynamic error using dynamic error coefficients. (16)

13. (a) Sketch the Bode plot for the following transfer function and determine the system gain K for the gain cross over frequency to be 10 *rad/s*.

$$G(s)H(s) = \frac{Ks^2}{(1+0.25s)(1+0.025s)} \quad (16)$$

Or

(b) Sketch the Polar plot for the following transfer function. Determine whether the plot cross the real axis. If so, determine the frequency at which the plot cross the real axis and the corresponding magnitude $|G(j\omega)|$.

$$G(s) = \frac{1}{(1+s)(1+2s)}. \quad (16)$$

14. (a) A unity feedback control system has an open loop transfer function has an open loop transfer function $G(s) = \frac{K\left(s+\frac{4}{3}\right)}{s^2(s+12)}$· Sketch the complex root locus. Find the value of K for which all the roots are qual. What is the value of these roots? (16)

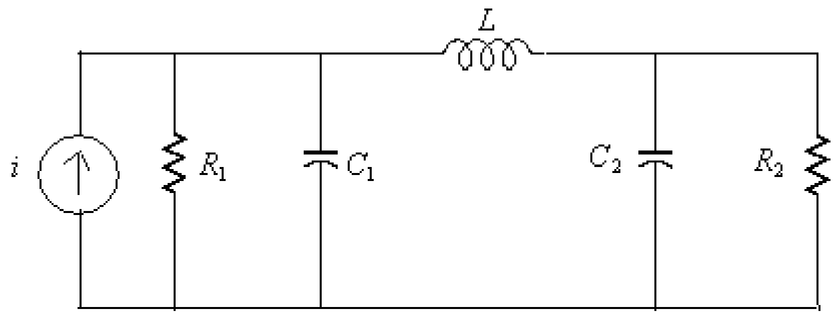
Or

(b) (i) Determine the range of values of K for the system to be stable.

$$s^3 + 3Ks^2 + (K+2)s + 4 = 0 \quad (6)$$

(ii) Check the stability of the following system using Nyquist stability criterion $\frac{10}{(s+1)^3}$ (10)

15. (a) Obtain the state model of the network shown in Figure-3. Assume $R_1=R_2=1\Omega$, $C_1=C_2=1F$ and $L=1H$. (16)



Or

(b) Obtain the time response of the following system

$$\begin{bmatrix}\dot{x_1}\\ \dot{x_2}\end{bmatrix} = \begin{bmatrix}0 & 1\\ -2 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}0\\ 1\end{bmatrix}u$$ where $u(t)$ is the unit-step function occurring at $t=0$.

(16)

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