**Exam. Code: 0930**
**Sub. Code: 33678**

**2055**

**B.E. (Electronics and Communication Engineering)-Sixth Semester**

**EC-624: Control System**

**Time allowed: 3 Hours** **Max. Marks: 50**

*NOTE:* ***Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Part. Missing data (If any) can be appropriately assumed.***

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**Q1** **Explain briefly**

A) Find the value of position error constant for second order system using ramp input. (2)

B) What is Polar plot? (2)

C) Which characteristic feature of the lag network is utilized for compensation? (2)

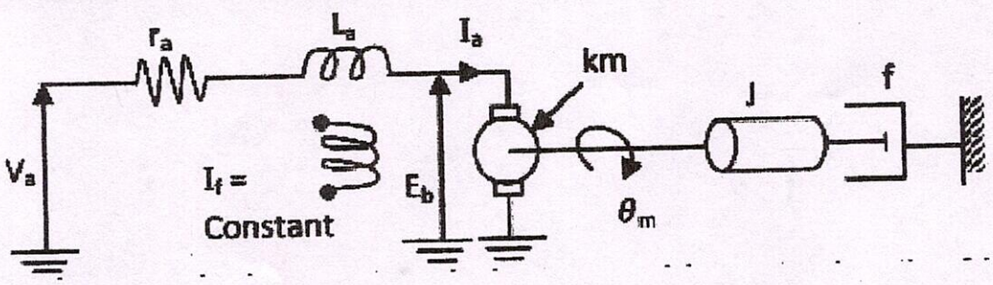
D) What is the need for a controller? (2)

E) Is the state-model of a system unique? (2)

## Part A

**Q2 A)** What is meant by open loop and closed loop control systems? Differentiate both. (5)

**B)** Develop a signal flow graph for the motor shown in figure below with the given constants. Find the transfer function using Mason's formula. (5)




**Q3 A)** Derive the expression for peak time and rise time in terms of $\xi$ and $\omega_n$ for a second order system. (5)

**B)** Measurements conducted on a servomechanism show the system response to be $c(t) = 1 + 0.2e^{-60t} - 1.2e^{-10t}$ when subject to a unit step input. Obtain an expression for the closed loop transfer function. Determine the undamped natural frequency and dampling ratio. (5)

**Q4 A)** With the help of Routh's stability criterion find the stability of the following systems represented by the characteristic equations: (5)

(i) $s^5 + s^4 + 2s^3 + 2s^2 + 3s + 5 = 0$

(ii) $9s^5 - 20s^4 + 10s^3 - s^2 - 9s - 10 = 0$

**B)** Sketch the root locus of the system whose open loop transfer function is $G(s) = \frac{K}{s\,(s+2)(s+4)}$. Find the value of K so that the damping ratio of the closed loop system is 0.5. (5)

## Part B

**Q5 A)** The open loop transfer function of a system is given by: $G(s) = \frac{40}{(s+4)(s^2+2s+1)}$. Sketch the Nyquist plot and comment on the stability of the system. (7)

**B)** Discuss the merits and demerits of representing a state model into: (i) Phase variable form. (ii) Canonical form. (3)

**Q6 A)** Obtain the transfer function of Lead Compensator, draw pole-zero plot and write the procedure for design of Lead Compensator using Bode plot. (7)

**B)** Why compensations are required in the control systems? (3)

**Q7 A)** Determine the state vector x(t) for the state model: (7)

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -12 & 2/3 \\ -36 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1/3 \\ 1 \end{bmatrix} u;$$

and the initial conditions are $x_1(0) = 2$, $x_2(0) = 1$.

**B)** Discuss about the properties of state transition matrix. (3)

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