BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: M. Tech — **SEMESTER : II**
BRANCH: Mechanical — **SESSION : SP/22**

SUBJECT: ME533 – Automatic Control

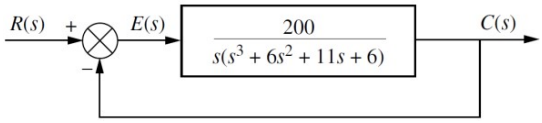
TIME: 2 Hours — **FULL MARKS: 50**

INSTRUCTIONS:
1. Attempt all questions.
2. The missing data, if any, may be assumed suitably.
3. Before attempting the question paper, be sure that you have got the correct question paper.

Q.1a Linearize the nonlinear equation $z = x^2 + 4xy + 6y^2$ in the region defined by 8 ≤ x ≤ 10, 2 ≤ y ≤ 4. Also find the error in percentage. [5]

Q.1b Consider a closed-loop system and define '***Open-loop transfer function***', '***feed-forward transfer function***' and '***closed-loop transfer function***'. [5]

Q.2a Find the number of poles in the left half-plane, the right half-plane, and on the *jω*-axis for the system of the given figure using Routh's stability criterion. [5]



Q.2b Consider the following characteristic equation: $s^4 + Ks^3 + s^2 + s + 1 = 0$. Determine the range of K for stability. [5]

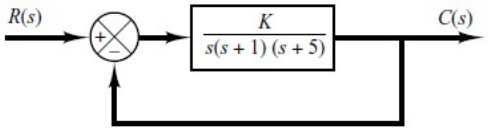
Q.3a Given the unity feedback system, where [5]

$$G(s) = \frac{K(s+1)}{s(s+2)(s+3)(s+4)}$$

i. Sketch the root locus.
ii. Find the asymptotes.
iii. Find breakaway and breakeven points

Q.3b Write short notes: (any one) [5]
i. Compensator
ii. Lead compensation

Q.4a Draw a Bode plot diagrams for the closed-loop system as shown in Figure. Consider, K=10. [5]



Q.4b Draw polar plot for first order system $(1+j\omega T)^{\pm 1}$. [5]

Q.5a Consider the system defined by [5]

$$\dot{\mathbf{x}} = \mathbf{A}\mathbf{x} + \mathbf{B}u \qquad y = \mathbf{C}\mathbf{x}$$

where,

$$\mathbf{A} = \begin{bmatrix} 1 & 2 \\ -4 & -3 \end{bmatrix}, \quad \mathbf{B} = \begin{bmatrix} 1 \\ 2 \end{bmatrix}, \quad \mathbf{C} = \begin{bmatrix} 1 & 1 \end{bmatrix}$$

Transform the system equations into the controllable canonical form.

Q.5b Describe the difference between root locus method and frequency response method. What are different frequency response methods? What is corner frequency? [5]

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