

# National Institute of Technology, Delhi

Name of the Examination: B. Tech.

Mid-Semester Examination March, 2019

Branch : EEE

Semester : 4<sup>th</sup>

Title of the Course : Control Systems

Course Code : EEB 252

Time: 2 Hours

Maximum Marks: 25

Note : 1. All the 5 questions are compulsory. Make suitable assumptions wherever required.

2. All the symbols have their usual meaning.

- Q1. The open loop transfer function of a unity feedback system is given by  $G(s) = \frac{K}{s(\tau s + 1)}$  where  $K$  and  $\tau$  are positive constants. By what factor the gain  $K$  be reduced so that the peak overshoot of unit-step response of the closed-loop system is reduced to from 75 % to 25 %.

(4 M)

- Q2. Using Routh criterion, determine the stability of the system with the following characteristic equation. Also, determine the number of roots that are in the right-half  $s$ -plane and on the  $j\omega$  axis:

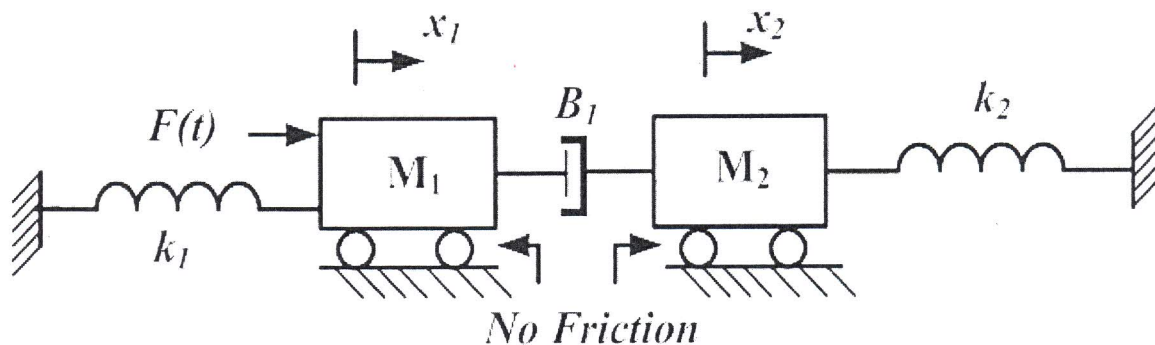
$$s^4 + 9s^3 + 4s^2 - 36s - 32 = 0$$

(5 M)

- Q3. Write the differential equation of the system shown below. Also, obtain the transfer function

$$\frac{X_2(s)}{F(s)}$$

(3+2 = 5 M)



Q4. Find the unit-step response of a system whose transfer function has a zero at -1, a pole at -2, and a gain factor of 2. (4 M)

Q5. Construct an equivalent signal flow graph of the system with the following block-diagram representation and find the overall transfer function by using Mason's gain formula. (3+4 = 7 M)

