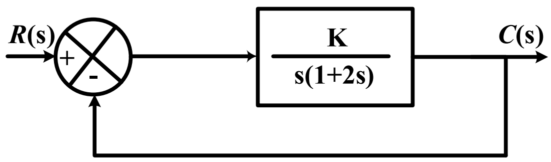

Fig. 2

10 Design a suitable compensator for the system with open-loop transfer function $G(s)H(s) = \dfrac{1}{s(s+1)(s+2)}$ so that the over shoot to a unit step input to be limited to 20% and the transient to be settled with in 3s. (10)

11 a) Briefly explain Ziegler – Nichol's PID tuning rules. (6)

b) Write the design steps of lead compensator based on frequency domain approach. (4)

PART C

Answer any two full questions, each carries 10 marks.

12 Find the complete response of the system (10)

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} x + \begin{bmatrix} 2 & 1 \\ 0 & 1 \end{bmatrix} U(t), x(0) = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

and $y(t) = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix} x$ to the following input, $U(t) = \begin{bmatrix} u(t) \\ e^{3t} u(t) \end{bmatrix}$ where *u(t)* is the unit step input.

13 a) Transform the system in to controllable canonical form (7)

$$\dot{x} = \begin{bmatrix} -1 & 1 \\ 0 & 2 \end{bmatrix} x + \begin{bmatrix} 2 \\ 1 \end{bmatrix} u \text{ and } y = \begin{bmatrix} 1 & 2 \end{bmatrix} x$$

b) State and explain sampling theorem (3)

14 a) Consider a system defined by (7)

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ -3 & 1 \end{bmatrix} x + \begin{bmatrix} 0 \\ 2 \end{bmatrix} u \text{ and } y = \begin{bmatrix} 1 & 0 \end{bmatrix} x$$

Using state feedback control $u = -Kx$, it is desired to have the closed loop poles at s = −3 and , s =−4, determine the state feedback gain matrix *K*.

b) What is pulse transfer function? (3)

PART D

Answer any two full questions, each carries 10 marks.

15 Obtain the describing function of saturation non-linearity (10)

16 A common form of an electronic oscillator is represented as shown in Fig. 3. For what value of *K,* the possibility of limit cycle predicted? If *K*=3, determine amplitude and frequency of limit cycle. Also find the maximum value of *K* for the (10)

system is stable.

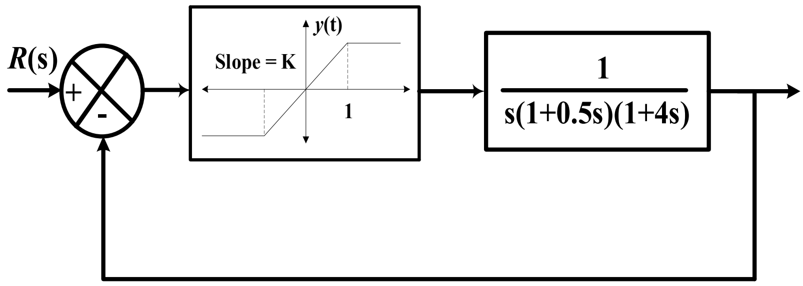

Fig. 3

17 A second order system is represented by $\dot{x} = Ax$ where (10)

$$A = \begin{bmatrix} 0 & 1 \\ -1 & -1 \end{bmatrix}$$

Assuming matrix Q to be identity matrix, solve for matrix P in the equation $A^T P + PA = -Q$. Use Lyapunov theorem and determine the stability of the system. Write the Lyapunov function $V(x)$

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