Exam Date & Time: 05-Dec-2023 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

VII SEMESTER B.TECH END SEMESTER EXAMINATIONS, NOV/DEC 2023

AUTOMATIC CONTROL ENGINEERING [MME 4062]

Marks: 50 **Duration: 180 mins.**

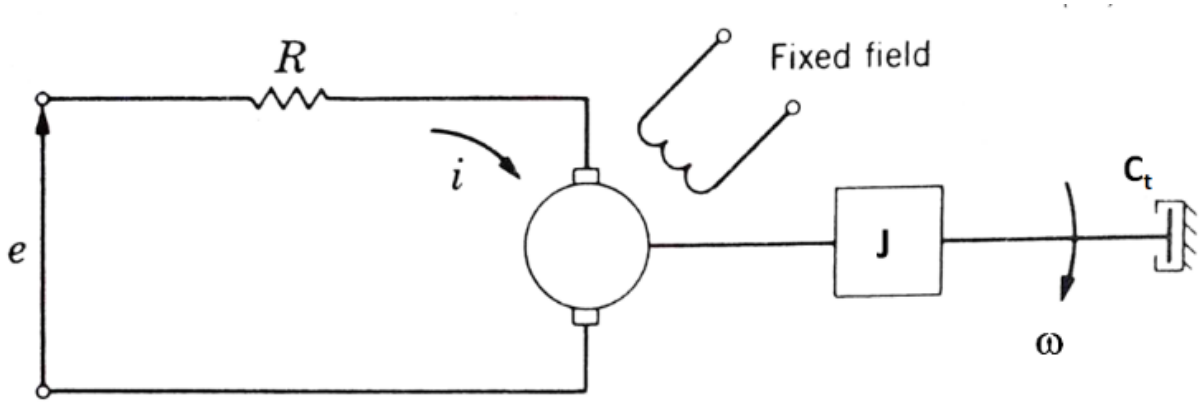
A

Answer all the questions.

Instructions to Candidates: Answer ALL questions Missing data may be suitably assumed

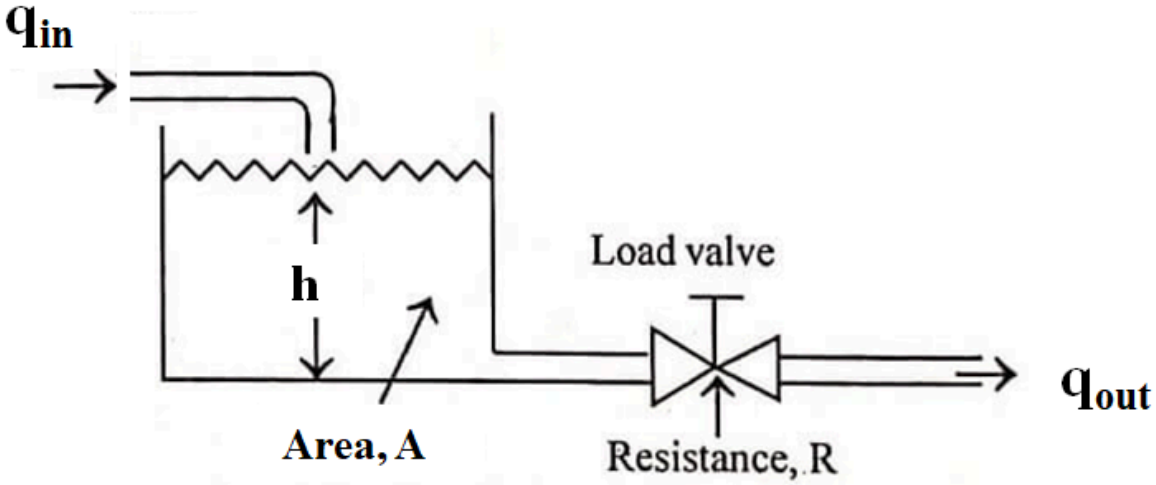
1) Obtain the transfer function for the DC motor as shown in figure below.

A)



(4)

B) Obtain the transfer function for the water level system shown in figure below.

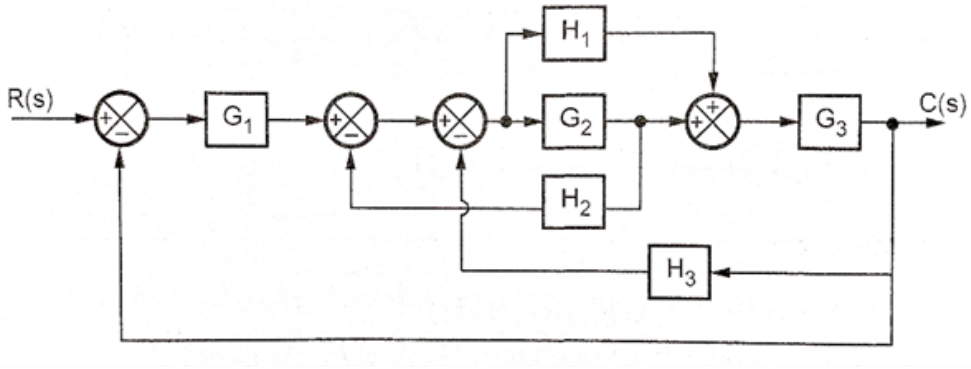


(3)

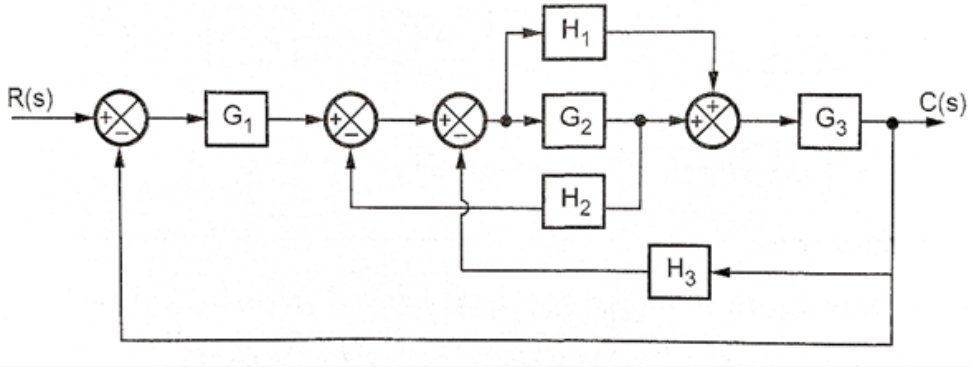
C) Explain follow up control system control system with an example. Also, draw function block diagram for the same. (3)

2) Determine the transfer function of the block diagram given using Block reduction method. (5)

A)

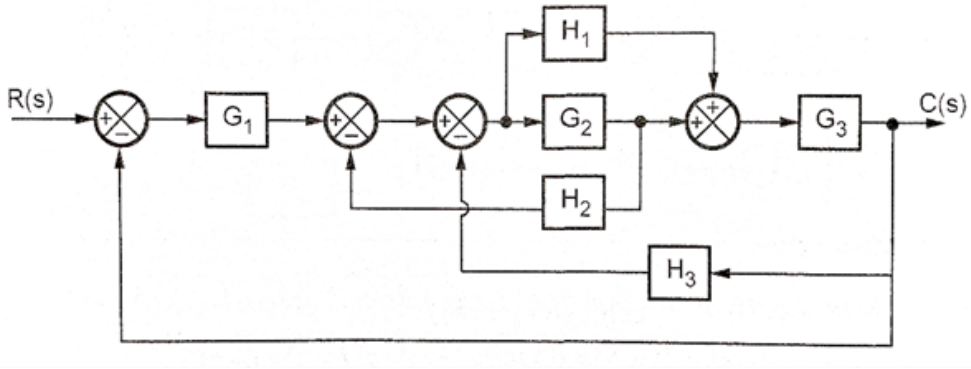


B) Draw the signal flow graph for the block diagram shown below.



(2)

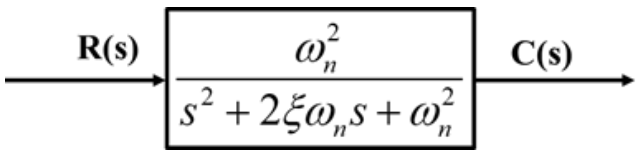
C) Determine the transfer function for the control system shown below using Mason's Gain method.



(3)

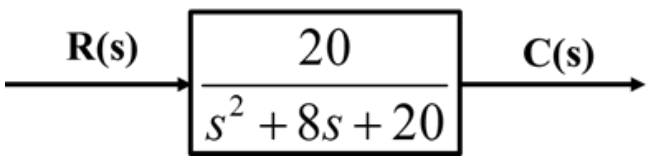
3) Perform the time response analysis of control system shown below for the unit impulse input signal. The value of damping ratio is (i) 0 (ii) 1 (iii) between 0 and 1.

A)



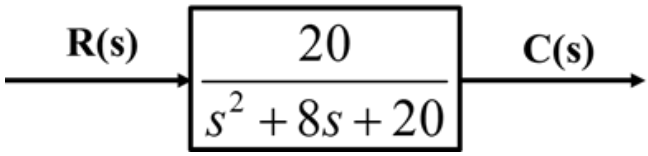
(5)

B) For the control system shown in figure below determine the natural frequency, damping ratio and damped natural frequency.



(2)

C) Find the time domain specifications of a control system shown in figure below when the unit step signal is applied as an input to the control system. (3)



4) Construct Routh array and determine the stability of the system whose characteristic equation is given by

A) $$s^6+3s^5+4s^4+6s^3+5s^2+3s+2=0$$ (5)

B) Find the transfer function for the state space model given as

$$\dot{X}=\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix}=\begin{bmatrix}-5 & -1\\ 3 & -1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}+\begin{bmatrix}2\\ 5\end{bmatrix}[u]$$

$$Y=\begin{bmatrix}1 & 2\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$$ (3)

C) Determine steady state error constants for type-zero system for step and ramp input. (2)

5) For the unity feedback system with transfer function given as

A) $$G(s)=\frac{K}{s(s+5)(s+10)}$$

Determine the following: (3)

i) Angle of asymptotes

ii) Centroid of asymptotes

iii) Break points with real axis

B) For the unity feedback system with transfer function given as

$$G(s)=\frac{K}{s(s+5)(s+10)}$$ (4)

i) Determine the value of K for stability.

ii) Obtain root locus plot.

C) Verify the controllability and observability of a linear time-invariant system is described by the state space model as, (3)

$$\dot{X} = \begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -1 & 0 \\ 0 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} \begin{bmatrix} u \end{bmatrix}$$

$$Y = \begin{bmatrix} 0 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

-----End-----