Exam Date & Time: 10-Jan-2024 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

VII SEMESTER B.TECH END SEMESTER MAKE-UP EXAMINATIONS, JAN 2024

AUTOMATIC CONTROL ENGINEERING [MME 4062]

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

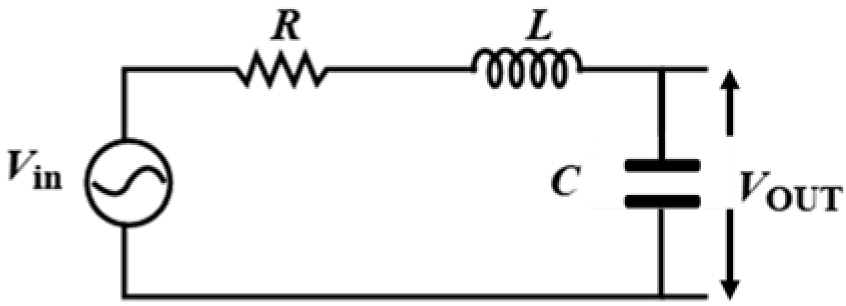
A

Answer all the questions.

Instructions to Candidates: Answer ALL questions

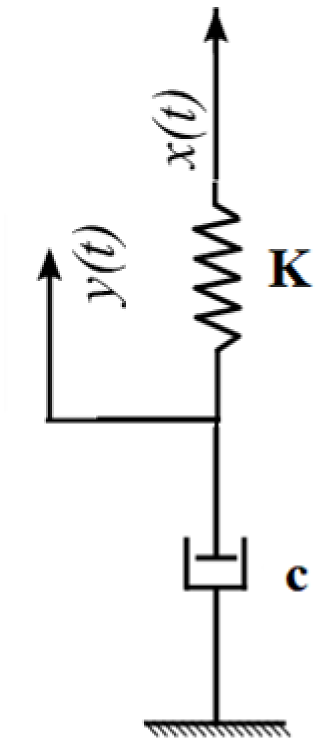
1) Obtain the transfer function for the R-L-C circuit as shown in figure.

A)



(4)

B) Obtain the transfer function for the spring damper as shown in figure.



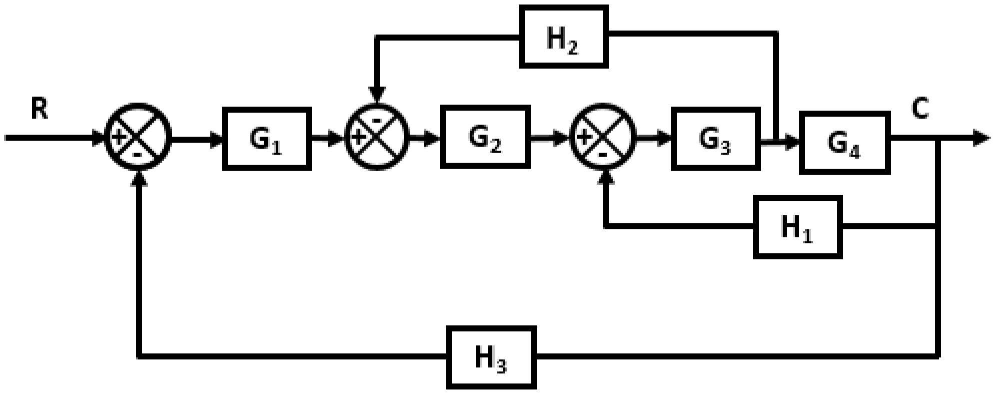
(3)

C) (3)

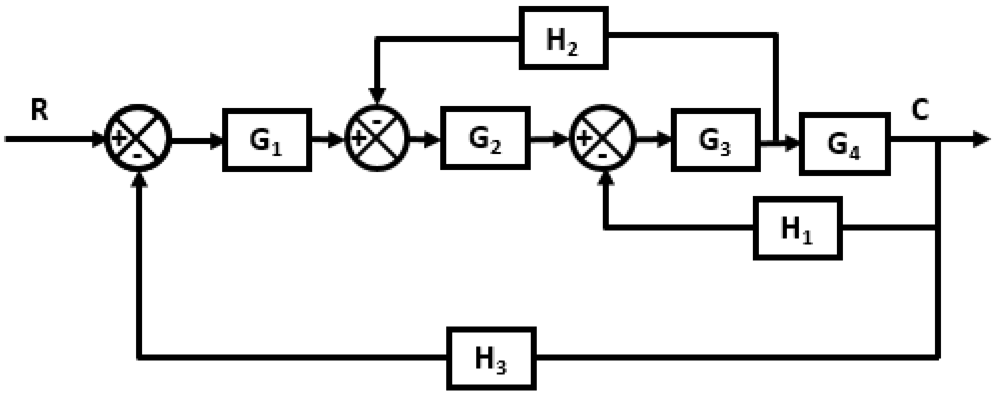
Explain follow up control system with an example. Also draw function block diagram for the same.

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

A) (5)

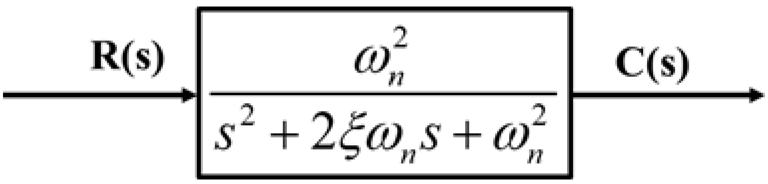


B) Draw the signal flow graph for the block diagram shown below and determine the transfer function using Mason's Gain method. (5)

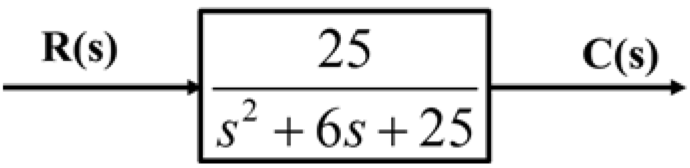


3) Perform the time response analysis of control system shown below for the unit impulse input signal. The value of damping ratio is i) in between 0 to 1 and ii) greater than 1. Also plot the nature of output signal.

A) (5)

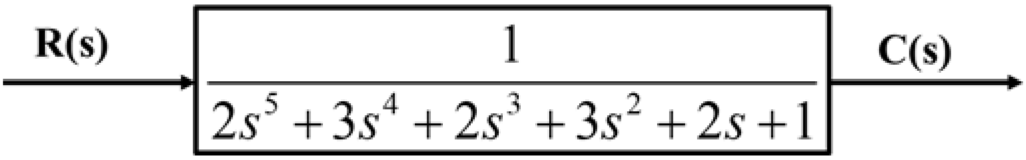


B) Find the time domain specifications of a control system shown in figure below when the unit step signal is applied as an input to the control system. (5)



4) Construct Routh array and determine the number of poles in the left half-plane, right-half plane, and on imaginary axis for the control system given below. (5)

A)



B) Find the state space model for the system having transfer function

$$\frac{Y(s)}{U(s)} = \frac{5}{s^3+4s^2+7s+2}$$ (3)

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

5) Obtain root locus plot for the unity feedback system with transfer function given as

A) $$G(s) = \frac{K}{s(s+1)(s+2)(s+3)}$$ (7)

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

$$\dot{X} = \begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -1 & 0 \\ 0 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} [u]$$ (3)

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

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