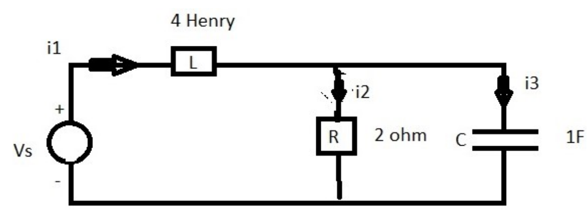
Unit 4 Assignment (Control System)

1. Define: (a) state (b) state variable (c) state-space. Mention the advantages of state-space approach.
2. How do we represent state-equation and output-equation?
3. What is the state equation and output equation of the differential given below

   $\frac{d^3}{dt^3}y + 6\frac{d^2}{dt^2}y + 3\frac{d}{dt}y + 4y = 7u$
4. A system is represented by $3\frac{d}{dt}y + 2y = u$. what is transfer function to the system $\frac{Y(s)}{U(s)}$.
5. The dynamic model of a pendulum is given by

   $\frac{d^2}{dt^2}Q + 400Q = 100T$. where Q= displacement , T= torque. It representation in time scale-state variable from $\dot{x}=\alpha x + \beta u$ can have constant.
6. Consider the network shown below:



   Find the state space representation for the above figure.
7. For a transfer function given below

   $G(s) = \frac{Y(s)}{U(s)} = \frac{20(10s+1)}{(s^3 + 3s^2 + 2s + 1)}$

   Find the state equation and output equation.
8. Explain Kalaman's test for: (a) Controllability (b) Observability
9. Verify the controllability of a control system which is represented by state equation:

   $\dot{x} = \begin{bmatrix} \dot{x}1 \\ \dot{x}2 \end{bmatrix} = \begin{bmatrix} -1 & -1 \\ 1 & 0 \end{bmatrix}\begin{bmatrix} x1 \\ x2 \end{bmatrix} + \begin{bmatrix} 1 \\ 0 \end{bmatrix}[u]$
10. The state equation of a system is given as-

    $\dot{x}1 = 2x1 + x2 + 4$

    $\dot{x}2 = -2x2$

    Check for controllability.
11. Verify the observability of a control system which is represented by state equation:

    $\dot{x} = \begin{bmatrix} \dot{x}1 \\ \dot{x}2 \end{bmatrix} = \begin{bmatrix} -2 & -2 \\ 1 & 0 \end{bmatrix}\begin{bmatrix} x1 \\ x2 \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \end{bmatrix}[u]$
12. Explain transfer function decomposition of :

    (i) $G(s) = \frac{Y(s)}{U(s)} = \frac{10}{(s^2+5s+6)}$ (using direct decomposition)

    (ii) $G(s) = \frac{Y(s)}{U(s)} = \frac{1}{(s+2)(s+3)(s+4)}$ (using cascade decomposition)

    (iii) $G(s) = \frac{Y(s)}{U(s)} = \frac{1}{(s+2)(s+3)(s+4)}$ (using parallel decomposition)