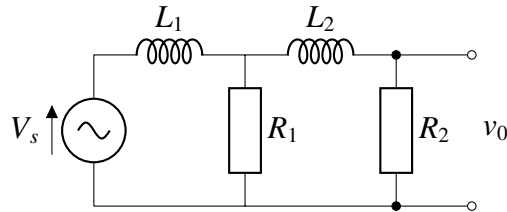


ME 36

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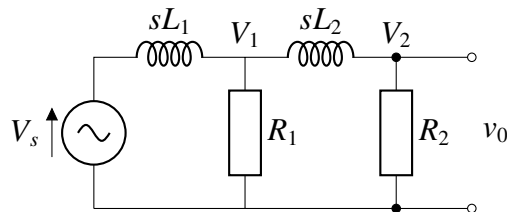
QUESTION: In the circuit shown below, $R_1 = 2\Omega$, $R_2 = 1\Omega$, $L_1 = 2$ h, and $L_2 = 0.5$ H. Which of the following describe(s) the correct characteristics of the circuit ?



- 1) Second order high pass filter
- 2) Second order low pass filter
- 3) Under damped system
- 4) Overdamped system

Solution:

Converting above circuit to frequency domain using laplace transform let V_1 and V_2 be voltages at shown positions



Variable	Value
R_1	2Ω
R_2	1Ω
L_1	2 H
L_2	0.5 H

TABLE 4

INPUT PARAMETERS

$$V_0 = V_1 \left(\frac{R_2}{R_2 + sL_2} \right) \quad (1)$$

$$V_1 = V_s \left(\frac{R_1 \left(\frac{sL_2 + R_2}{R_1 + R_2 + sL_2} \right)}{sL_1 + R_1 \left(\frac{sL_2 + R_2}{R_1 + R_2 + sL_2} \right)} \right) \quad (2)$$

$$V_1 = V_s \left(\frac{2 + s}{(2 + s) + s(6 + s)} \right) \quad (3)$$

$$V_0 = V_s \left(\frac{2}{s^2 + 7s + 2} \right) \quad (4)$$

$$\text{let } s = j\omega \quad (5)$$

$$V_0 = V_s \left(\frac{2}{-\omega^2 + 7j\omega + 2} \right) \quad (6)$$

$$= V_s \left(\frac{4 - 2\omega^2 - 7j\omega}{\omega^4 + 45\omega^2 + 4} \right) \quad (7)$$

For lower frequency V_0 is finite and for higher frequency V_0 is zero

\therefore Second order low pass filter

From 5

$$s^2 + 7s + 2 = 0 \quad (8)$$

$$\text{for } as^2 + bs + c = 0 \quad (9)$$

$$\zeta(\text{Damping Factor}) = \frac{b}{2\sqrt{ac}} \quad (10)$$

$$\text{By comparing } \zeta = \frac{7}{2\sqrt{2}} \quad (11)$$

$$\implies \zeta > 1 \quad (12)$$

\therefore Over-damped System

\therefore B,D are correct options