BM 43

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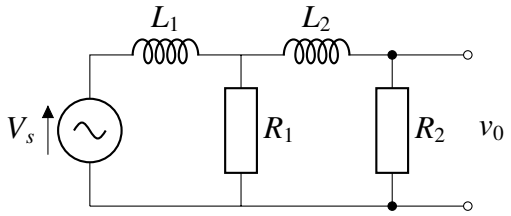
QUESTION: In the circuit shown below, $R_1 = 2\Omega$,$R_2 = 1\Omega$,$L_1 = 2$ h,and $L_2 = 0.5$ H. Which of the following describe(s) the correct characteristics of the circuit ?



1) Second order high pass filter

2) Second order low pass filter

3) Under damped system

4) Overdamped system

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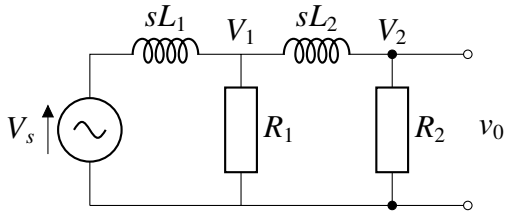
Solution:
Converting above circuit to frequency domain using laplace transform
let V_1 and V_2 be voltages at shown positions



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

TABLE 4
INPUT PARAMETERS

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

$$V_1 = V_s\left(\frac{R_1\left(\frac{sL_2+R_2}{R_1+R_2+SL_2}\right)}{sL_1 + R_1\left(\frac{sL_2+R_2}{R_1+R_2+SL_2}\right)}\right) \tag{2}$$

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

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

$$\text{let } s = j\omega \tag{5}$$

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

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

For lower frequency V_0 is finite and for higher frequency V_0 is zero
$\therefore$ Second order low pass filter
From 5

$$s^2 + 7s + 2 = 0 \tag{8}$$

$$\text{for } as^2 + bs + c = 0 \tag{9}$$

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

$$\text{By comparing } \zeta = \frac{7}{2\sqrt{2}} \tag{11}$$

$$\implies \zeta > 1 \tag{12}$$

$\therefore$ Over-damped System
$\therefore$ B,D are correct options