

tr5frbj 12/08/24

Circuit Theory and Devices

Lab: LT Spice (2nd week onwards)

book: Engineering Circuit Analysis (9th edition)

Relative grading

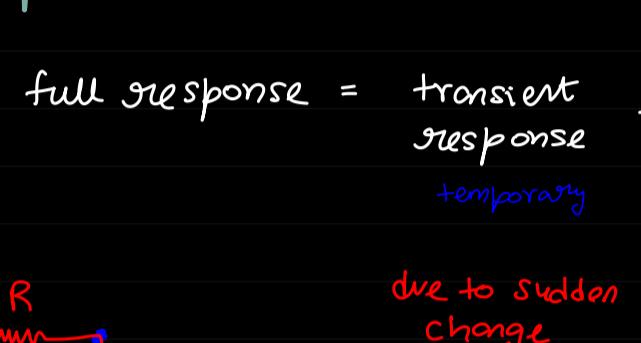
Labs	20%
Quiz	20%
Midsem	30%

Scientific calc

Course: 9 modules chapter 10 onwards
{continuation of BE3}

Lecture 1

⇒ Linear Circuits



System is linear if

$$Kx \rightarrow [\text{sys}] \rightarrow Ky$$

where K is constant

"R" Resistor: linear element ✓
 $V = iR$

"L" Inductor: linear element ✓

$$V = L \frac{di}{dt}$$

"C" Capacitor: linear element ✓

$$i = C \frac{dv}{dt}$$

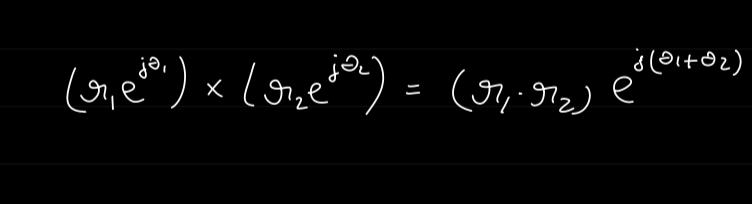
* Linear Electric Circuits:

consists of ⇒

① $R, L, C \rightarrow$ linear elements

② Independent voltage & current sources

③ Linear dependent sources



example would not have been

linear if $V_s = kV_x^2$

Note: diode and transistors are non-linear elements

Non-linear elements

Non-linear response

depends on current/voltage source

* Response of a linear circuit

① full response = transient response + steady state

transient temporary persists

steady state $t \rightarrow \infty$

Nodes

due to sudden change

also called natural response

depends on R, L, C

due to source

also called forced response

depends on current/voltage source

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* Section 10.1

(a) $Q_1 y \quad 5\sin(5t - 9^\circ)$

$$t=0 \Rightarrow 5\sin(-9^\circ) = -5\sin(9^\circ) = -0.782$$

$$t=0.01 \Rightarrow 5\sin(0.05 - 9^\circ) = -5\sin(8.95^\circ) \quad X$$

\Downarrow
radians

$$5\sin\left(\frac{0.05 \times 80}{\pi} - 9^\circ\right) = 5\sin(2.86^\circ - 9^\circ)$$

$$\Rightarrow -5\sin(6.14^\circ) = -0.534$$

$$t=0.1 \Rightarrow 5\sin(0.5 - 9^\circ) = 5\sin(28.64^\circ - 9^\circ) = 5\sin(19.64^\circ)$$

$$\Rightarrow 1.6805$$

(b) $4\cos 2t$

$$t=0 \Rightarrow 4\cos(0) = 4$$

$$t=1 \Rightarrow 4\cos(2) = 3.997$$

$$t=1.5 \Rightarrow 4\cos(3) = 3.994$$

(c) $3.2 \cos(6t + 15^\circ)$

$$t=0 \Rightarrow 3.2 \cos(15^\circ) = 3.09$$

$$t=0.01 \Rightarrow 3.2 \cos(0.06 + 15^\circ) = 3.2 \cos(3.43^\circ + 15^\circ)$$

$$\Rightarrow 3.2 \cos(18.43^\circ)$$

$$\Rightarrow 3.035$$

$$t=0.1 \Rightarrow 3.2 \cos(0.6 + 15^\circ) = 3.2 \cos(34.3^\circ + 15^\circ)$$

$$= 3.2 \cos(49.3^\circ)$$

$$= 2.086$$

Q2) (a) $300\sin(628t) \rightarrow 300 \cdot \cos(628t - 90^\circ)$

$$4\sin(3\pi t + 30^\circ) \rightarrow 4\cos(3\pi t - 60^\circ)$$

$$14\sin(50t - 8^\circ) - 10\cos 50t \rightarrow$$

Q3) $V_L = 10\cos(10t - 45^\circ)$

(a) $i_L = 5\cos 10t$

$$-45^\circ$$

