EE-101-2020
Week- 1 Assignment

Question

1. (a) Identify the first five harmonics of the square wave $v(t)$ expressed in the Fig 1. Consider V = +2 Volt, T = 628 msec

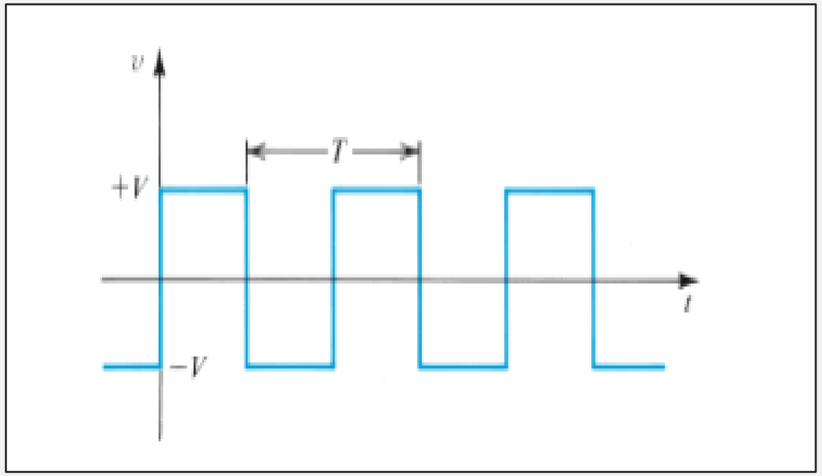


Fig. 1

(b) What fraction of energy of $v(t)$ in its fundamental?

(c) What fraction of energy of $v(t)$ in its first five harmonics?

(d) Till what number of harmonics is 90% of the energy?

Question

2. (a) Find the time period. and the cyclic and radian frequencies for each of the following sinusoids

$$v_1(t) = 17\cos(2000t - 30\,°)$$
$$v_2(t) = 12\cos(2000t + 30\,°)$$

(b) Derive the expression and sketch the graph of $v_3(t) = v_1(t) + v_2(t)$ [Graph Paper Preferred]

Question

3. Graphically sketch the waveform described by

$$v(t) = \frac{r(t)}{T_c}\left[V_A e^{-\frac{t}{T_c}}\right] u(t)\, Volt$$

[Graph Paper Preferred]

$$V_A = 1\, Volt, \;\; T_c = 1\, sec$$

Question

4. (a) Express the Gated Pulse Waveform of Fig.2 in terms of Step functions u(t).

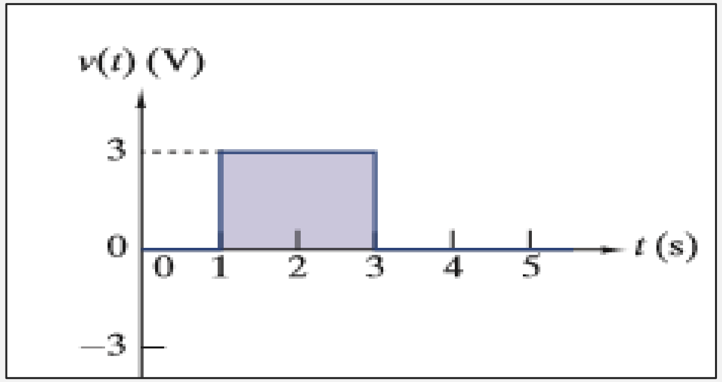


Fig. 2

(b) Determine the expression and graphically sketch the derivative of the gated pulse waveform shown in Fig.2 [Graph Paper Preferred]

(c) Determine the expression and graphically sketch the integral of the gated pulse waveform shown in Fig.2 [Graph Paper Preferred]

Question

5. (a) Plot $v(t)$ expressed by

$$v(t) = 10[e^{-1000t} - e^{-2500t}]u(t)$$

[Graph Paper Preferred]

(b) What is the value of $v(t)$ at the extremum and the time when it occurs?

Question

6. Find the equivalent resistance seen from terminal A-B using Y - Δ transformation in Fig. 3 $R_L = 10\ \Omega$

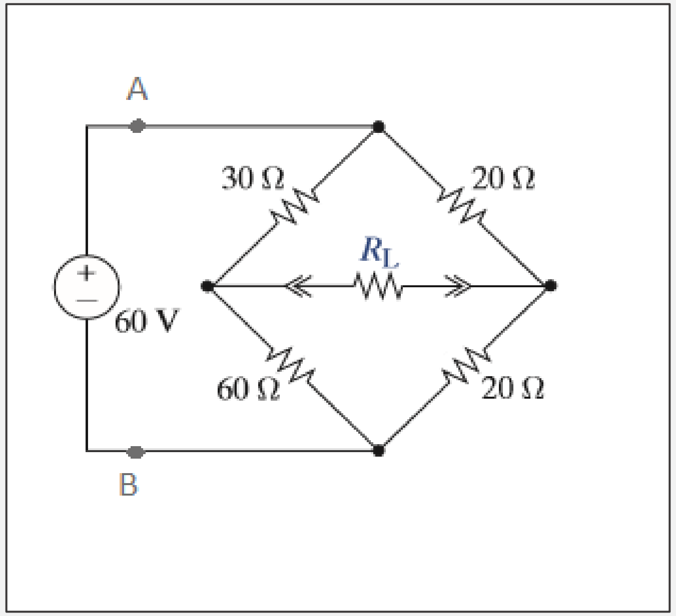


Fig. 3

Question

7. The graph in Fig.4 shows the charge q(t) flowing past a point in a wire as a function of time

(a) Sketch the variation of i(t) versus time [Graph paper preferred]

(b) Find the current i(t) at 1; 2.5; 3.5; 4.5, and 5.5 msec

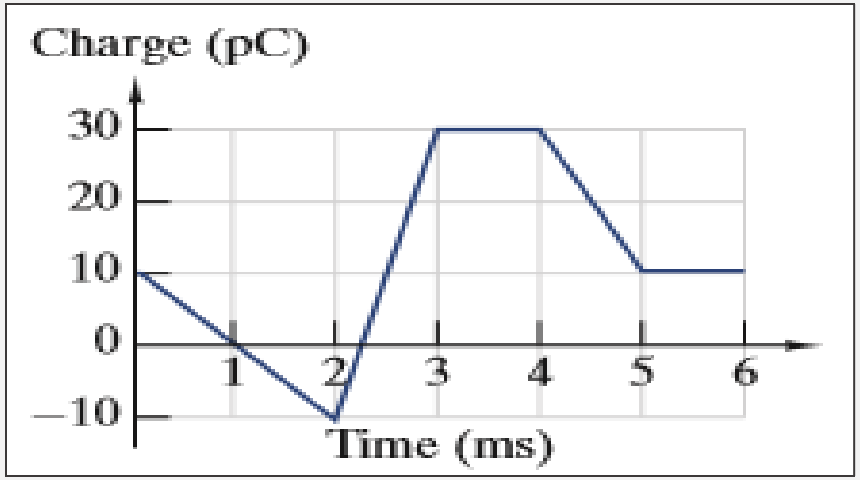


Fig. 4

Question

8. Figure 5 shows the voltage across a 0.5-μF capacitor. Determine the time varying current, energy and power of the capacitor [Graph Paper Preferred]

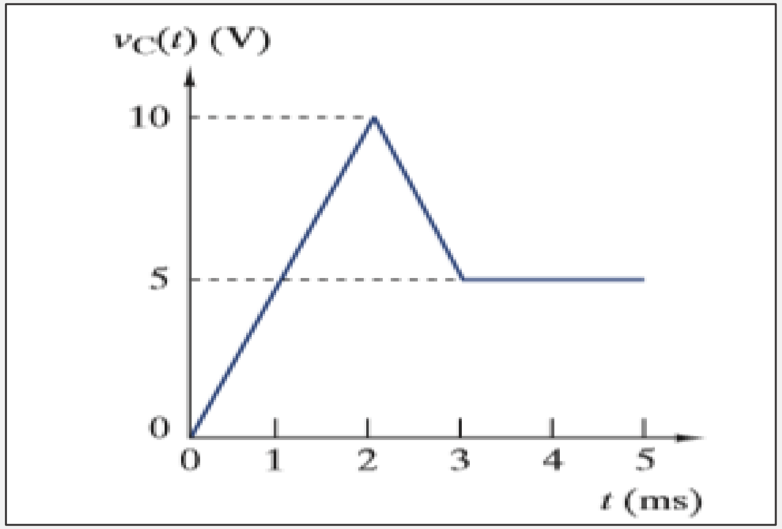


Fig. 5

Question

9. The current through a 2.5-mH inductor

$$i(t) = 10 \cdot (e^{-500t}) \cdot (\sin 2000t)$$

Plot the waveforms of the element current, voltage, power, and energy. [Graph Paper Preferred]

Question

10. For the first-order low pass filter as shown below,

(a) Draw s-domain transformed circuit for the filter.

(b) Find transfer function in s-domain i.e $T(s) = \frac{V_O(s)}{V_i(s)}$.

(c) Hence find transfer function for physical frequencies i.e $T(j\omega)$ by $s = j\omega$ and derive expression for magnitude response, $|T(j\omega)|$

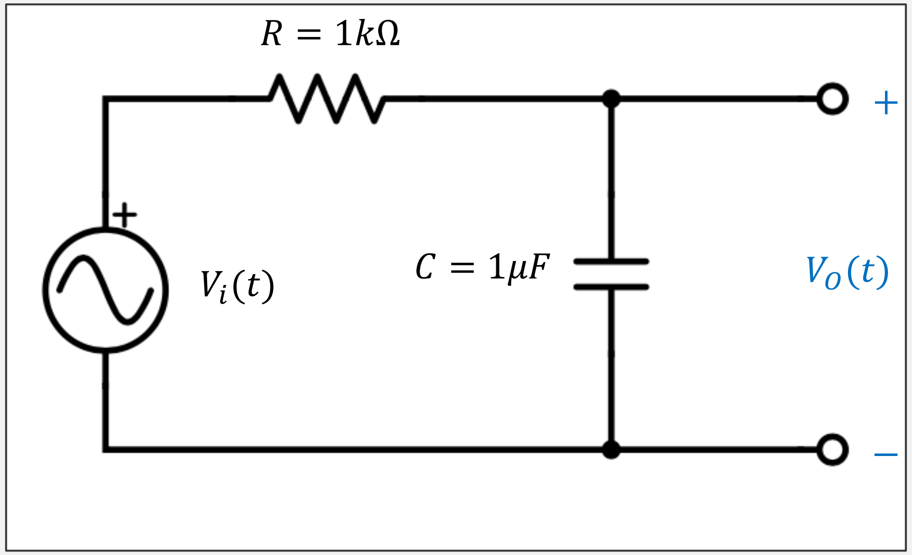
(d) Also calculate the 3-dB frequency or corner frequency, ω_o for the filter.

(e) Find the transmission or gain at $\frac{\omega}{\omega_o} = 0.1$, $\frac{\omega}{\omega_o} = 1$ and at $\frac{\omega}{\omega_o} = 10$

(f) Plot magnitude response, $|T(j\omega)|$ vs. $\frac{\omega}{\omega_o}$

Assume that the capacitor is at a zero state initially

i.e. $V_C(t = 0) = V(t = 0) = 0\ V$



Question

11. For the first-order *R-L* circuit as shown below,

(a) Draw s-domain transformed circuit for the filter.

(b) Find transfer function in *s*-domain i.e $T(s) = \frac{V_o(s)}{V_i(s)}$.

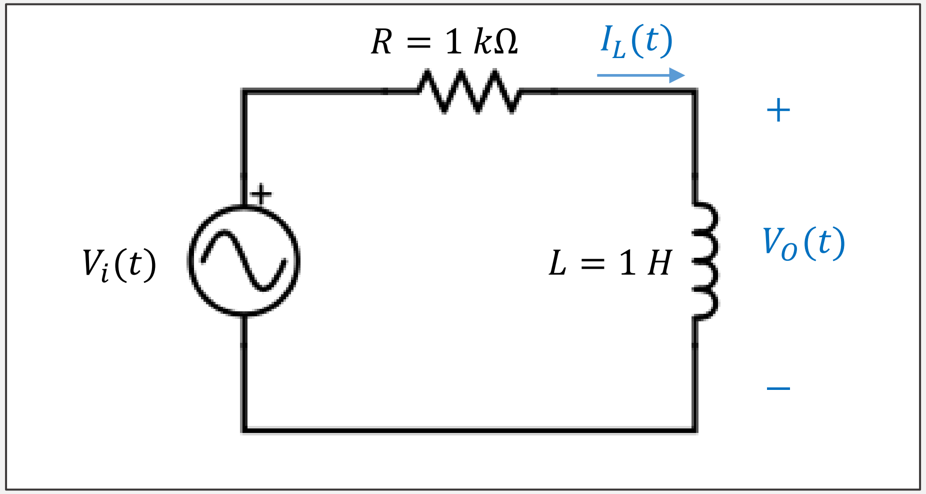
(c) Hence find transfer function for physical frequencies i.e $T(j\omega)$ by $s = j\omega$ and derive expression for magnitude response, $|T(j\omega)|$

(d) Also calculate the 3-dB frequency or corner frequency, ω_o for the filter.

(e) Find the transmission or gain at $\frac{\omega}{\omega_o} = 0.1$, $\frac{\omega}{\omega_o} = 1$ and at $\frac{\omega}{\omega_o} = 10$

(f) Plot magnitude response, $|T(j\omega)|$ vs. $\frac{\omega}{\omega_o}$

Assume that the inductor is at zero state initially i.e. $I_L(t = 0) = 0\ A$.



Question

12. For a second-order low pass filter derived by cascading two first order RC low pass filter stage as shown below,

(a) Draw s-domain transformed circuit for the filter.

(b)Find transfer function in s-domain for Stage (I), Stage (II) and overall transfer function i.e. $T_I(s) = \frac{V_X(s)}{V_I(s)}$, $T_{II}(s) = \frac{V_O(s)}{V_X(s)}$ and $T(s) = \frac{V_o(s)}{V_i(s)}$ respectively

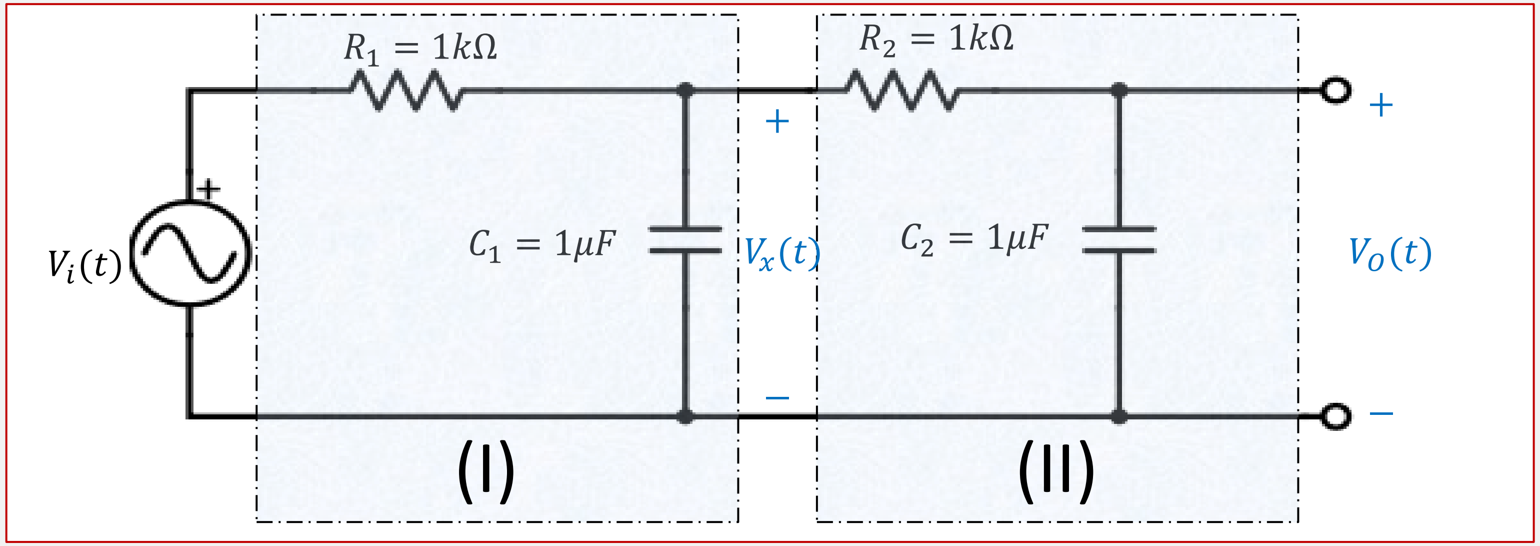
(c) Hence find transfer function for physical frequencies i.e $T(j\omega)$ by $s = j\omega$ and derive expression for magnitude response, $|T(j\omega)|$

(d) Also calculate the corner frequency, ω_o for the filter.

(e) Find the transmission or gain at $\frac{\omega}{\omega_o} = 0.1$, $\frac{\omega}{\omega_o} = 1$ and at $\frac{\omega}{\omega_o} = 10$

(f) Plot magnitude response, $|T(j\omega)|$ vs. $\frac{\omega}{\omega_o}$

Assume that the capacitor is at a zero state initially i.e. $V_{C_1}(t=0) = V_{c_2}(t=0) = 0\,V$, also **$R_1 = R_2$, $C_1 = C_2$**



Question

13. For the second-order series *R-L-C* resonator circuit as shown below,

(a) Draw s-domain transformed circuit for the resonator

(b) Find impedance offered by the circuit in *s*-domain i.e. $\mathrm{Z}(s) = \frac{V_I(s)}{I_I(s)}$

(c) Hence find impedance for physical frequencies i.e $\mathrm{Z}(j\omega)$ by considering $s = j\omega$ and derive expression for magnitude response, $|Z(j\omega)|$

(d) Determine the resonant frequency, ω_o where the circuit offers purely resistive impedance

(e) Plot $|\mathrm{Z}(j\omega)|$ and $|Y(j\omega)| = \frac{1}{|\mathrm{Z}(j\omega)|}$ versus normalised frequency, $\frac{\omega}{\omega_o}$

Assume that the inductor and capacitor are at zero state initially i.e. $I_L(t = 0) = 0\ A$ and $V_C(t = 0) = 0\ V$