# Question (01)

Q-01. The graph in Figure (Q-01) 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*]

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

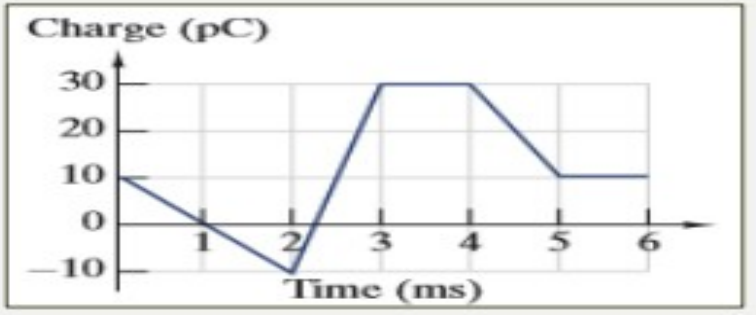



Figure Q-01

# Question (Q-02)

Q-02. (a) Identify the first five harmonics of the square wave $v(t)$ expressed in the Fig 1. Consider $V$ = +2 Volt, T = 628 msec

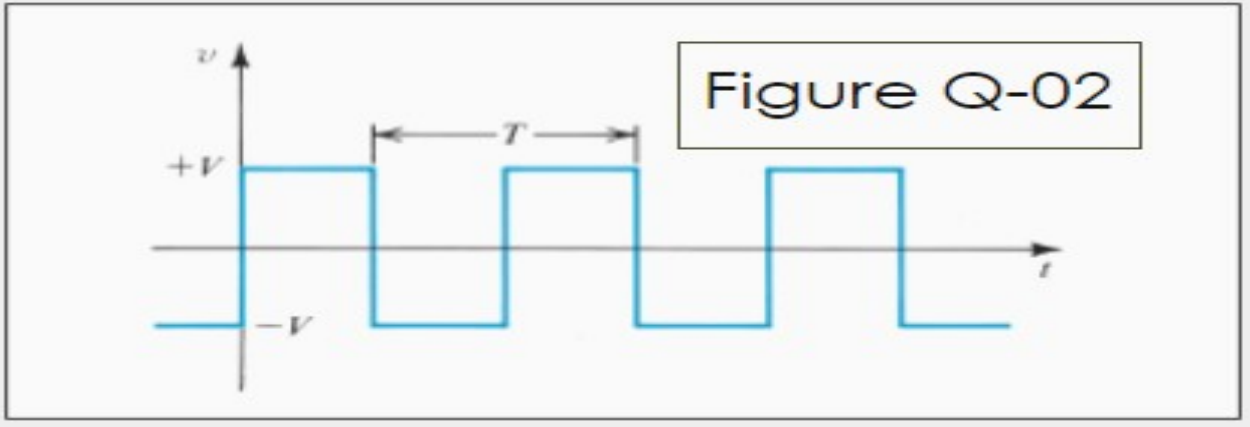



Figure Q-02

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

# Question (Q-03)

Q-03. (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, Software Plot]

# Question (Q-04)

Q-04. Graphically sketch the waveform described

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

[Graph Paper, Software Plot]

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

# Question (Q-05)

Q-05(a) Express the Gated Pulse Waveform of Fig.Q-05 in terms of Step functions u(t).

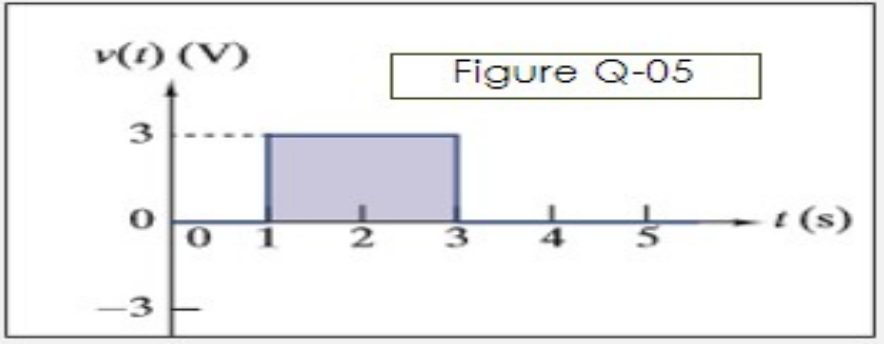


Figure Q-05

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

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

# Question (Q-06)

Q-06. (a) Plot $v(t)$ expressed by

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

[Graph Paper, Software Plot]

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

# Question (Q-07)

Q-07. Find equivalent resistance seen from terminal A-B using Y - Δ transformation in Figure (Q-07); $R_L$ = 10 Ω; **($R_{AB}$ = 27.18 Ω)**

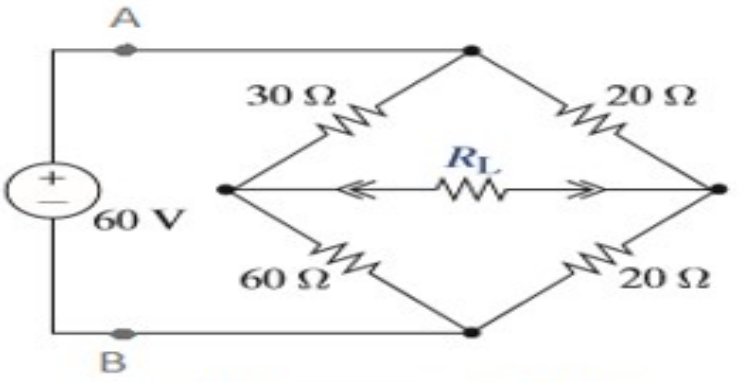



Figure Q-07

# Question (Q-08)

Q-08. For a second-order low pass filter derived by cascading two first order RC low pass filter stage connected through an isolator or buffer stage with Gain, $A_v$ =1 as shown below. Assume that the capacitor is at a zero state initially i.e. $V_C(t=0) = 0\,V$.

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

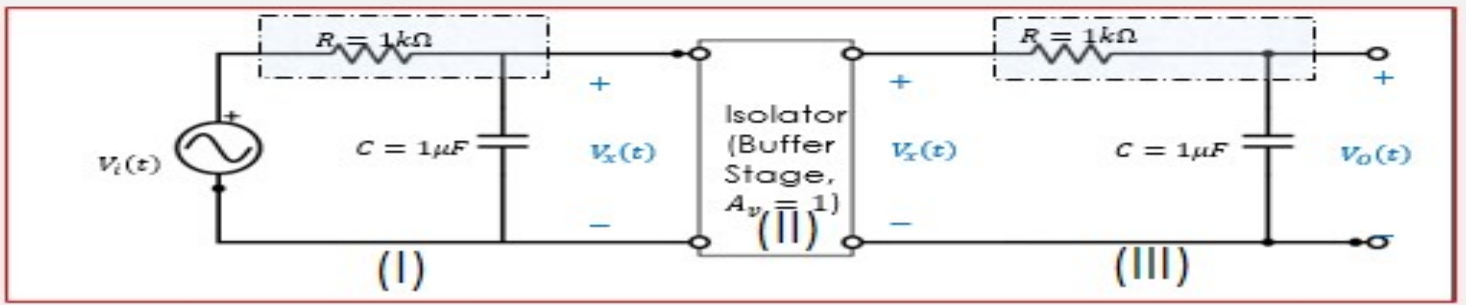
(b)Find transfer function in $s$-domain for Stage (I), Stage (II) and overall transfer function i.e. $T_I(s) = \frac{V_X(s)}{V_I(s)}$ , $T_{III}(s) = \frac{V_O(s)}{V_X(s)}$ and $T(s) = \frac{V_o(s)}{V_i(s)}$ respectively

(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, $\omega_o$ 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. $\frac{\omega}{\omega_o}$ .



# Question (Q-09)

Q-09. For the second-order series *R-L-C* resonator circuit as shown below,

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

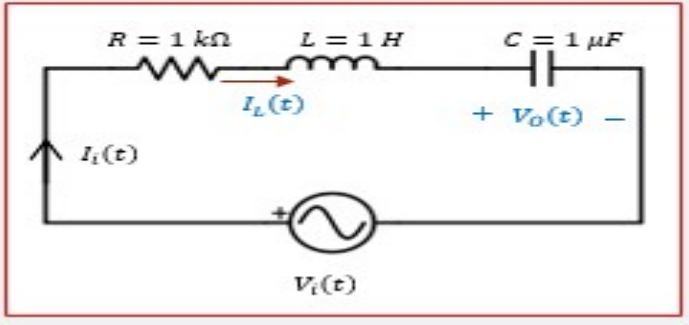
(b) Find impedance offered by the circuit in *s*-domain i.e. $\mathrm{Z}(s) = \frac{V_I(s)}{I_I(s)}$

(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, $\omega_o$ 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 $V_C(t = 0) = 0\ V$



# Question (Q-10)

Q-10. Figure Q-10 shows the voltage across a 0.5μF capacitor. Determine the time varying current, energy and power of the capacitor [GP/S]

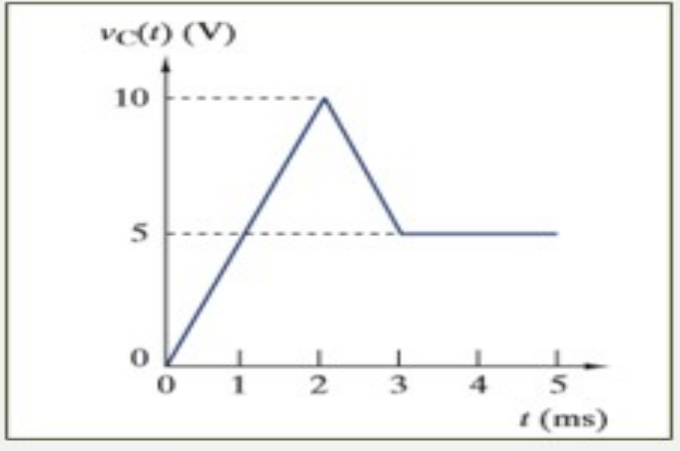



Fig. Q-10

# Question (Q-11)

Q-11. 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. [GP/S]