1. (a) The source current(i_s) and the inductor current(i_l) for the circuit in Fig. 1(a):

$$i_l = \frac{V_m}{\omega L}[sin(\omega t + \phi) - sin(\omega t_o + \phi)]\ u(t - t_o)$$

$$i_s = \left(\frac{V_m}{R}cos(\omega t + \phi) + \frac{V_m}{\omega L}[sin(\omega t + \phi) - sin(\omega t_o + \phi)]\right) u(t - t_o)$$

(b) The voltage across the resistor(V_r) and the inductor current(i_l) for the circuit in Fig. 1(b):

$$i_l = I_m sin\omega t\ u(t - t_o)$$

$$V_r = I_m R sin\omega t\ u(t - t_o)$$

(c) The source current(i_s) and the capacitor current(i_c) for the circuit in Fig. 1(c):

Case 1: If $\omega t_o = n\pi$ (or) $t_o = \frac{n\pi}{\omega}$

$$i_c = CV_m \omega cos\omega t\ u(t - t_o)$$

$$i_s = [CV_m \omega cos\omega t + \frac{V_m}{R} sin\omega t]\ u(t - t_o)$$

Case 2: If $\omega t_o \neq n\pi$ (or) $t_o \neq \frac{n\pi}{\omega}$

$$i_c = CV_m[\omega cos\omega t\ u(t - t_o) + sin\omega t\ \delta(t - t_o)]$$

$$i_s = CV_m[\omega cos\omega t\ u(t - t_o) + sin\omega t\ \delta(t - t_o)] + \frac{V_m sin\omega t}{R}\ u(t - t_o)$$

(d) The voltage across the resistor(V_r) and the capacitor current(i_c) for the circuit in Fig. 1(d):

$$i_c = I_m cos(\omega t + \phi)\ u(t - t_o)$$

$$V_r = I_m R cos(\omega t + \phi)\ u(t - t_o)$$

2. The expression for the load voltage($V_l(t)$), given the op-amp to be in ideal condition:

$$V_l(t) = -\frac{V_m}{\omega RC}[sin(\omega t + \phi) - sin(\phi)]$$

3. Impulse response of circuit shown in Fig. 1(a):

$$i(t) = \frac{u(t - t_o)}{L} + \frac{\delta(t - t_o)}{R}$$

As $t \to \infty, i(t) \to \frac{1}{L}$, which is a constant. Hence, the system is **marginally stable**.

Similarly, the impulse response of circuit shown in Fig. 1(d):

$$V(t) = \frac{u(t - t_o)}{C} + R\delta(t - t_o)$$

As $t \to \infty, V(t) \to \frac{1}{C}$, which is a constant. Hence, the system is **marginally stable**.

4. The current through the inductor($i_l(t)$) is:

$$i_l(t) = (t - t_o)e^{-2t}\ u(t - t_o)$$