UESTC 1007: Analogue Electronics (50 marks)

Attempt ALL questions

Q1: (a) Explain in your own words which element, a short circuit or an open circuit, should replace a current source when the amplitude of the current source is set to 0 A and why this element is used. [2]

(b) The analysis technique is superposition. Draw the circuits that will be used to calculate the current I_V and the voltage V_I given the original circuit shown in Figure Q1. [6]

(c) Calculate the values of I_V and V_I in the original circuit when you apply superposition. [12]

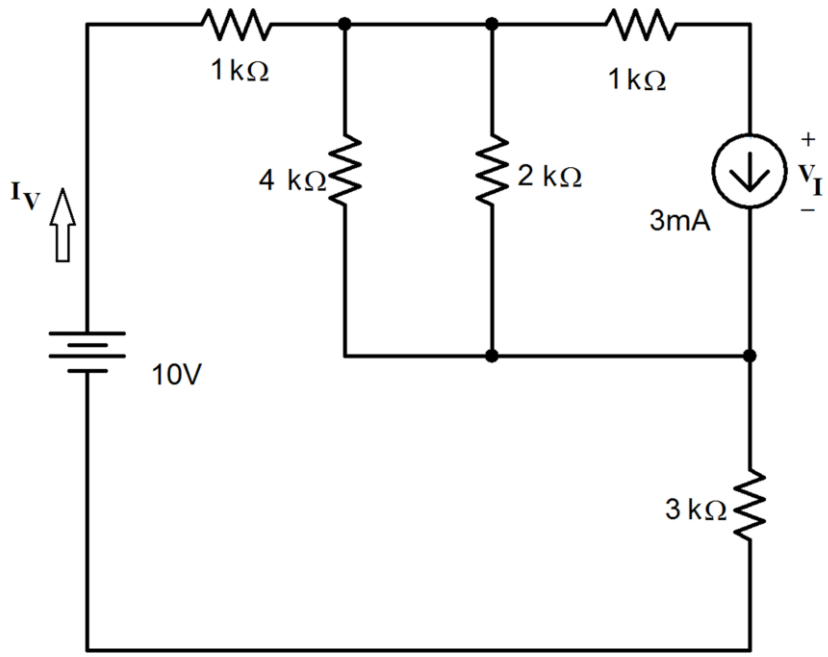

Figure Q1.

Q2: For the circuit shown in Figure Q2:

(a) Calculate the impedances for R, L, and C when ω = 500 rad/s. Write the impedances in two ways. One way is using rectangular coordinates. The second way is to write them using phasor notation. [6]

(b) Draw the Norton equivalent circuit where the load impedance Z_L is the series combination of R_L and Z_X (shown in the dotted circuit in Figure Q2). Calculate the values for all components in the Norton equivalent circuit. Write the impedances in rectangular coordinates. [8]

(c) Draw the Thévenin equivalent circuit where the load impedance is the series combination of R_L and L_L. Calculate the values for all components in the Thévenin equivalent circuit. Write the impedances in rectangular coordinates. [4]

(d) Calculate for R_L and Z_X such that the current flowing through ZL is in phase with the Thévenin voltage V_{th} and the maximum power is transferred to the load. Determine whether Z_X should be an inductor, capacitor, or resistor and its value in Ω, H, or F. [3]

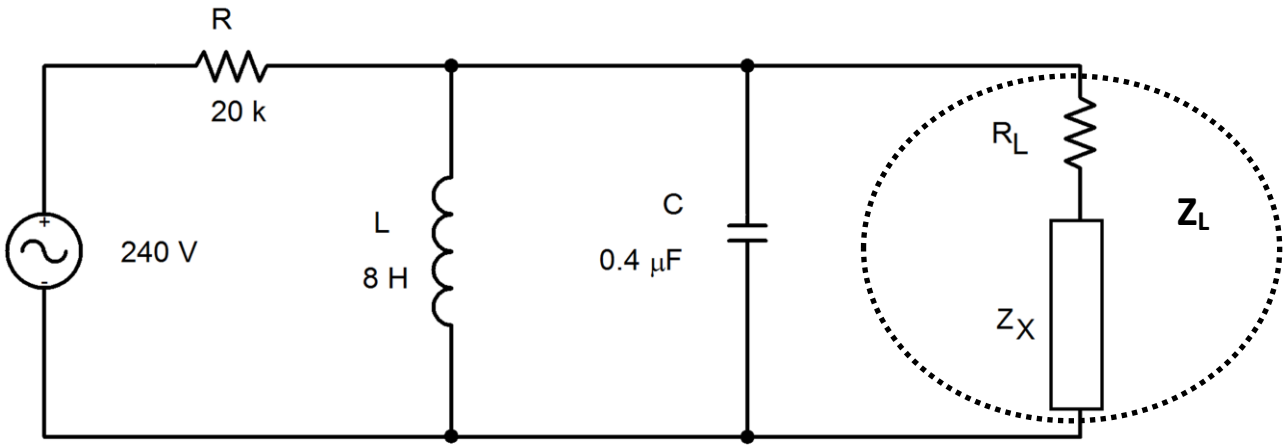

Figure Q2.

Q3: For the circuit shown in Figure Q3,

(a) Calculate the voltage gain, V_o/V_{in}. [3]

(b) Calculate the current I_L, which flows through R_L, and the current I. [4]

(c) Determine the minimum and maximum values for V_{in} such that the operational amplifier circuit is operating in the linear region when $V^+ = 30$ V and $V^- = -18$ V. [2]

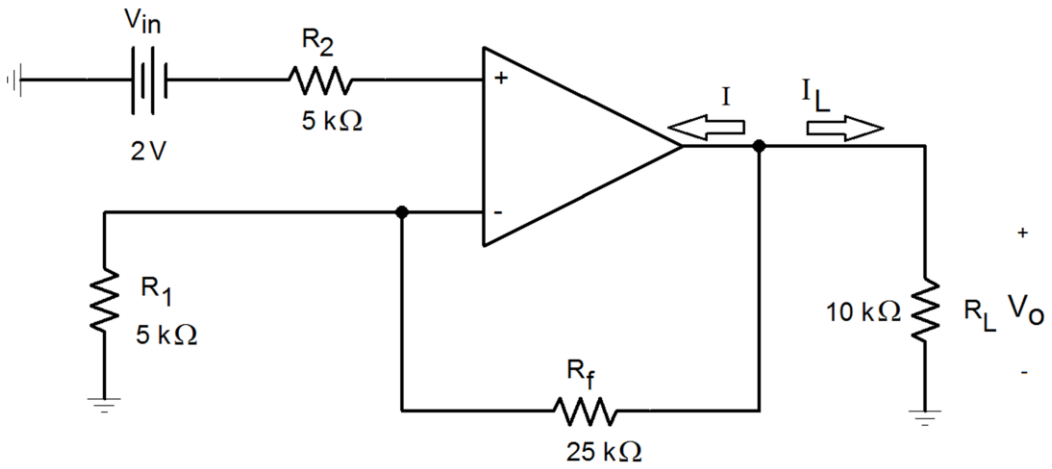

Figure Q3.