BIRZEIT UNIVERSITY

Electrical and Computer Engineering Department

Network Analysis I, ENEE2304

Name: Second Makeup Exam 2018-05-13

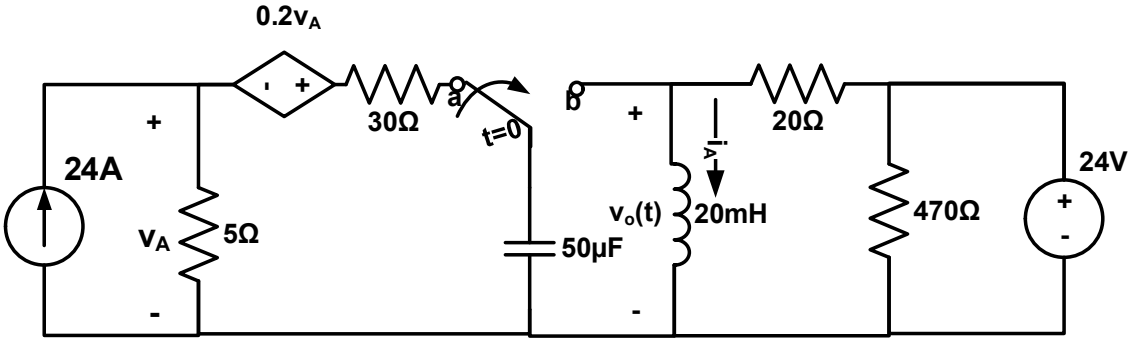
No.: Sec:

Q1) For all the time prior to zero, the switch is at position (a), at t=0 the switched was moved to position (b).

a) Find $V_L(0^+)$ and $i_L(0^+)$? (5 marks)

b) Show that type of damping is under damped? (5 marks)

c) For $t \geq 0$ find $i_A(t)$? (15 marks)



$$V_A(0^-) = 24 * 5 = 120V$$

$$V_L(0^+) = V_c(0^-) = V_A(0^-) + 0.2V_A(0^-) = 144V$$

$$i_L(0^+) = i_L(\infty) = i_L(0^-) = \frac{24}{20} = 1.2A$$

$$V_c(\infty) = 0V$$

d) Show that type of damping is under damped? (10 marks)

$$\alpha = \frac{1}{2RC} = \frac{1}{2(20)(5 * 10^{-5})} = 500$$

$$\omega = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{0.02 * 5 * 10^{-5}}} = 1000$$

$$\alpha^2 < \omega^2$$

$$\omega_d = \sqrt{\omega_o^2 - \alpha_o^2} = \sqrt{10^6 - 25 * 10^4} = 1118$$

e) For $t \geq 0$ find $i_A(t)$? (15 marks)

$$i_A(t) = i_L(\infty) + (B_1 cos\omega_d t + B_2 sin\ _d t)e^{-\alpha t}$$

$$= 1.2 + (B_1 cos1118t + B_2 sin1118t)e^{-500}$$

$$i_A(0) = i_L(0) = i_L(\infty) + B_1 = 1.2 + B_1 = 1.2$$

$$B_1 = 0$$

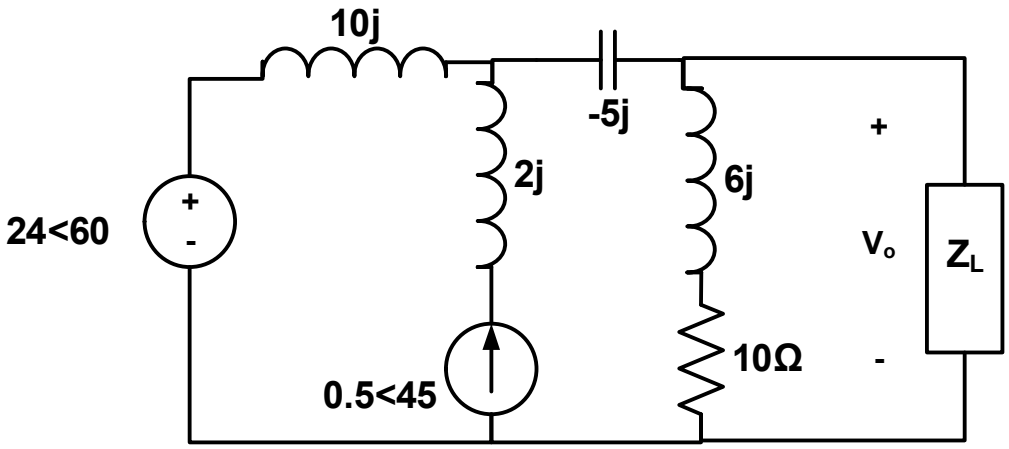
$$di_L/dt\,(0) = \frac{V_L(0^+)}{L} = -\alpha B_1 + \omega_d B_2 =$$

$$= (-0 + 1118B_2) = \frac{144}{0.2}$$

$$B_2 = 0.644$$

$$= 1.2 + 0.644\sin(96.8t)e^{-500t}A$$

Q2) Find the load Z_L that absorbs the maximum power? (15 marks)



$$Z_{th} = \frac{(-5j + 10j) * (10 + 6j)}{(-5j + 10j) + (10 + 6j)} = 1.13 + 3.76i = 3.92\angle 73.27\Omega$$

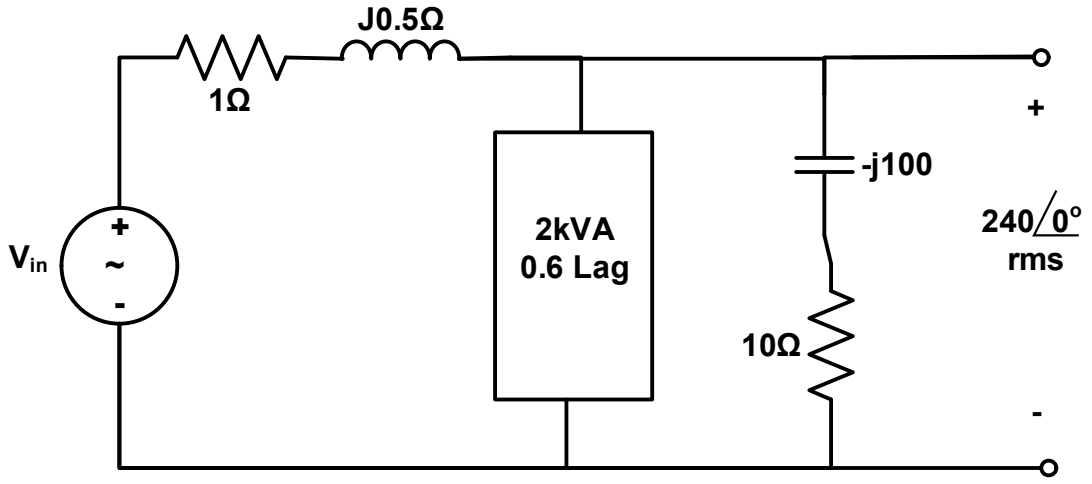
$$Z_L = Z_{th}^* = 1.13 - 3.76i = 3.92\angle -73.27\Omega$$

Q3) a) Plot the phasor diagram of voltage and current in the capacitor (5 marks)

b) Calculate the average power that absorbs by the resistor 10Ω. (5 marks)

c) Find the input voltage V_{in} in phasor and its power factor. (15 marks)

d) Calculate the reactive power that absorbs by the inductor 0.5Ω.(5 marks)



a) Plot the phasor diagram of voltage and current in the capacitor (5 marks)

$$I_c = \frac{240\angle 0}{10 - 100j} = 0.24 \ + \ j2.38A = 2.4\angle 84A_{rms}$$

$$V_c = -100j * (0.24 \ + \ j2.38) = 238 - j\ 23.8 = 239\angle 5.7V_{rms}$$

b) Calculate the average power that absorbs by the resistor 10Ω. (5 marks)

$$P_{av} = I_c^2 R = 10 * 2.4^2 = 57.6W$$

c) Find the input voltage V_{in} in phasor and its power factor. (15 marks)

$$I_T = I_L + I_c$$

$$S_L = 2k\angle \cos^{-1} 0.6 = 2k\angle 53$$

$$I_L^* = \frac{S_L}{240\angle 0} = \frac{2k\angle 53}{240\angle 0} = \frac{25}{3}\angle 53 = 8.33\angle 53 = 5 + j6.67$$

$$I_L = 5 - j6.67 = 8.33\angle -53$$

$$I_T = 5 - j6.67 + 0.24 \ + \ j2.38 = 5.24 - j4.29A_{rms} = 6.77\angle -39.3A_{rms}$$

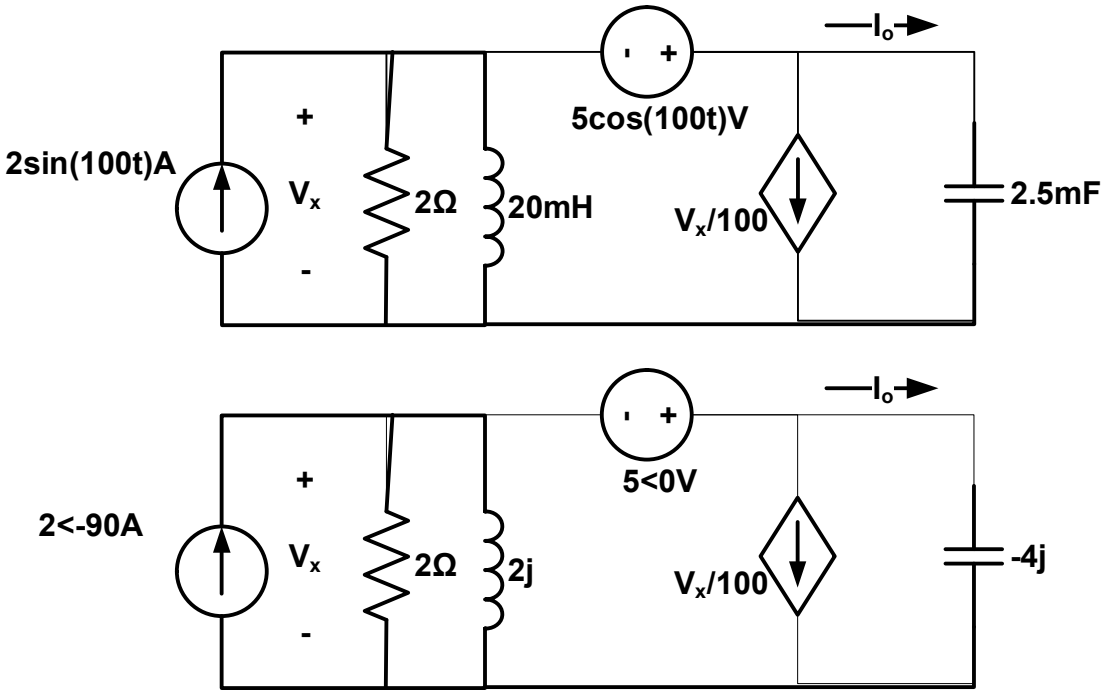
$$V_{in} = I_T(1 + 0.5j) + 240\angle 0 = 247.39 - j1.67 = 247.58\angle -12.7V_{rms}$$

$PF = \cos(-12.7 - -53) = 0.76$ Laging

d) Calculate the reactive power that absorbs by the inductor 0.5Ω.(5 marks)

$$Q_L = \omega L I_{rms}^2 = 0.5 * (6.77)^2 = 22.9VAR$$

Q4) a) Find i_o (t)? (25 marks)
b) Find the voltage source power factor?. (5 marks)



$$I_S = 2\sin(100t) = 2\angle -90$$

$$-2\angle -90 + \frac{V_x}{2} + \frac{V_x}{2j} + \frac{V_x}{100} + \frac{V_x + 5\angle 0}{-4j} = 0$$

$$(0.51 - 0.25j)V_x = -3.25j$$

$$V_x = -5.14 - 2.52j = 5.72\angle -153V$$

$$I_o = \frac{V_x + 5\angle 0}{-4j} = \frac{-5.14 - 2.52j + 5}{-4j} = 1.28 + 1.88j = 2.27\angle 55.8A$$

$$I_o = 2.27\sin(100t + 55.8)$$

b) Find the voltage source power factor?. (5 marks)

$$I_s = 1.28 + 1.88j + \frac{-5.14 - 2.52j}{100} = 1.31 + 1.83j = 2.25\angle 54.4A$$

$PF = \cos(0 - 54.4) = 0.58$ Leading