University of Moratuwa, Sri Lanka

B Sc Engineering Degree Course

Final Part I Examination 1994/95

UEE 201 - THEORY OF ELECTRICTY

0900 - 1200 hrs October 1996

Answer **FIVE** Questions Only.
Question 1 carries 28 marks, and all other Questions carry 18 marks each.

1.

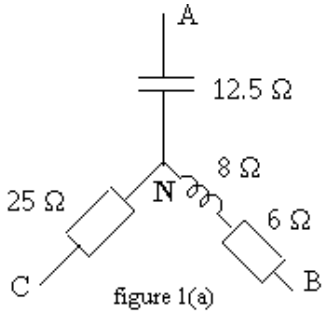


figure 1(a)

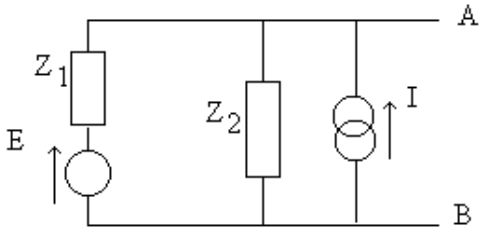
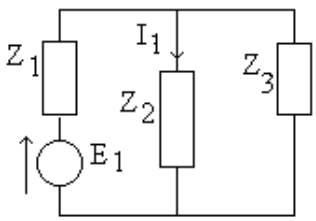
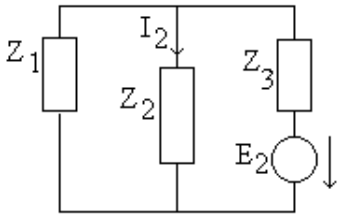


figure 1(b)

(a) For the start connected circuit shown in figure 1(a), using the **Star-Delta Conversion,** determine the impedance of arm AB in the equivalent delta . [5 marks]

(b) For the circuit shown in figure 1(b), determine the **Norton's equivalent circuit** across AB. [3 marks]





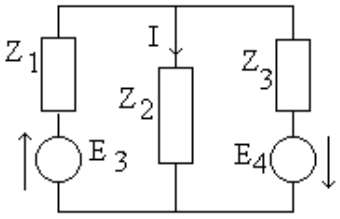


figure 1(c)

(c) Using **Superposition theorem** determine the current I in the circuit shown in figure 1(c) in terms of the remaining currents and voltages. [3 marks]

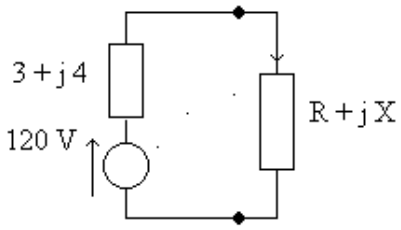


figure 1(d)

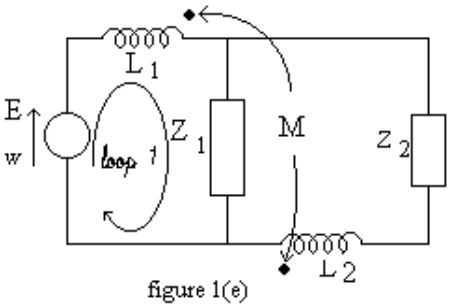


figure 1(e)

(d) Determine using the **Maximum Power Transfer Theorem** the maximum power transfer to the load shown in figure Q1(d). [3 marks]

(e) Write down **Kirchoff's voltage Law** equation for the loop 1 shown in figure Q1(e).

.[3 marks]

Q1 contd..

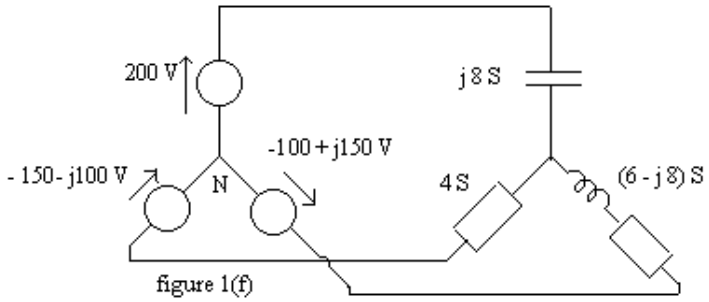


figure 1(f)

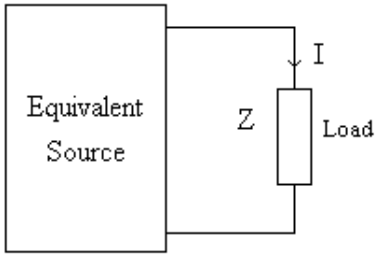


figure 1(g)

(f) For the circuit shown in figure 1(f) determine the star point voltage with respect to the neutral N. [6 marks]

(g) For the circuit shown in figure 1(g), the **Thevenin's equivalent** impedance of the source side is 10 $\underline{/60^o}$ Ω. The current I in the circuit for a purely resistive load of 10 Ω is $10\underline{/15^o}$ A. Using the **Compensation theorem** determine the current I when the load impedance is changed to (10 + j 1) Ω. [8 marks]

2. A certain a.c. voltage source has an emf of **1.05 E** and an internal impedance of **jx** . If the terminal voltage is to be maintained at **E** , determine the value of the maximum power that can be delivered to a load **(R + jX)** and the values of **R** and **X** under these conditions.

[18marks]

3. The circuit shown in figure Q3 is supplied from a 260 V, 50 Hz supply. The magnitude of the voltage across $\mathbf{L_1}$ is measured to be 100 V and that across the parallel combination to be 240 V. The magnitudes of currents through $\mathbf{L_1}$, $\mathbf{R_2}$ and $\mathbf{R_3}$ are measured to be 8 A, 10 A and 6 A respectively. Determine the values of all the components in the circuit. [18 marks]

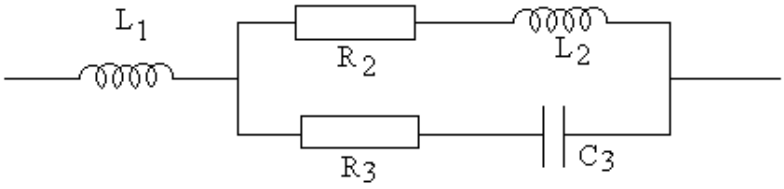


figure Q3

4. A 415 V, 50 Hz three-phase balanced supply feeds a three-phase star-connected balanced load consisting of arms of value (40 + j 10) Ω each. Each supply wire has an impedance of (2 + j 5) Ω. Determine (a) the line current, (b) the line voltage at the load, and (c) the supply power factor. [9 marks]

It is now required to improve the load power factor to unity be connecting a bank of delta-connected capacitors across the load. Determine the values of the capacitors. If the load voltage is to be maintained at the earlier value, what is the required supply voltage now ?

[9 marks]

5.

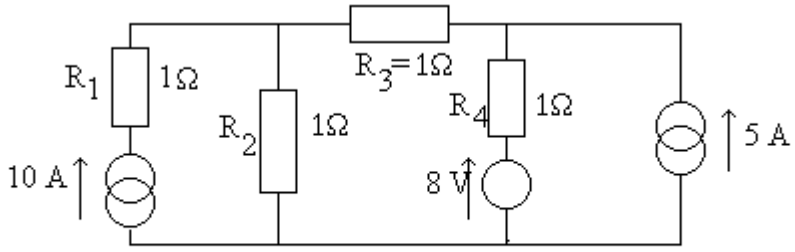


figure Q5

Convert the voltage source shown in figure Q5 to an equivalent current source. Write down the branch-node incidence matrix and the branch admittance matrix. Show how th nodal admittance matrix is determined. Using nodal analysis, determine the currents in all the branches. [18 marks]

6. (a) The ABCD parameters of a certain two-port network are **A = D = (1 + j 1), B = j 10 Ω,** and **C = (0.2 + j 0.1) S.** Determine the corresponding **impedance-parameters** of the network. [9 marks]

(b) The symmetrical components of a set of currents are $\mathbf{I_0 = 1\ \underline{/75^o}\ A}$, $\mathbf{I_1 = 2\ \underline{/15^o}\ A}$, and $\mathbf{I_2 = 1\underline{/-45^o}\ A}$,. Determine the corresponding phase quantities. [9 marks]

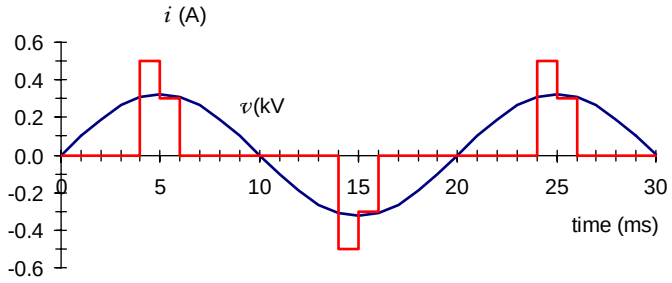


Figure Q7

7. The waveforms of a certain electronic type CFL are shown approximated in figure Q7. The voltage waveform is sinusoidal with peak value of 325 V, and the corresponding current waveform has a peak value of 0.5 A and is as shown in the figure. Determine the first 4 significant terms of the Fourier series of the CFL current waveform. [14 marks]

Determine also the form factor and the peak factor of the current, the power consumed and the overall power factor of the CFL. [4 marks]

8. Figure Q8 shows a circuit which has reached steady state with switch S open. If switch S is closed at time t = 0, determine expressions for the current through the inductor and the corresponding voltage across it, given that **ωCR = 1, 2 L ω = 9 R.** [18 marks]

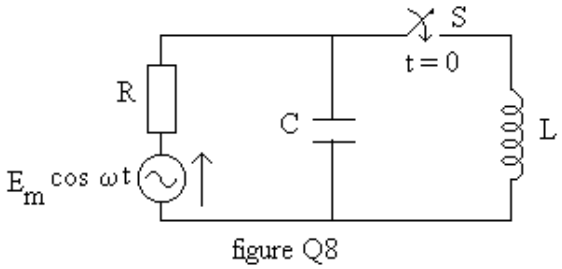


figure Q8