Find the Thevenin equivalent for the circuit shown in Fig. 2. The rms voltage of the sinusoidal voltage source is 230 V, frequency 50 Hz and phase angle 0°. R1 = 36 Ω, R2 = 10 Ω, L1 = 190 mH, L2 = 50 mH and C = 79 μF.

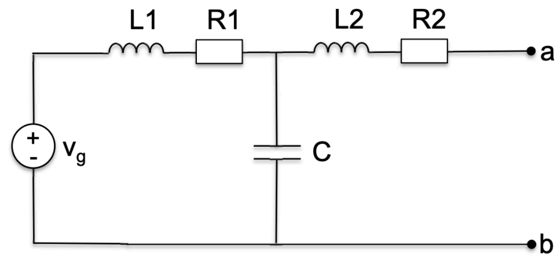


Fig. 2.

Find symmetrical components of the following three-phase voltage phasors. Draw the phasor diagrams of the original voltage phasors and the symmetrical components.

i) $$\begin{bmatrix} V_a \\ V_b \\ V_c \end{bmatrix} = \begin{bmatrix} 1\angle 47° \\ 1\angle 287° \\ 1\angle 167° \end{bmatrix} \text{ p.u.}$$

Y-Y-connected three-phase transformer has the following rating plate values:100 kVA, 10000/400 V, Z_k = 11.2 % (short circuit impedance), P_k = 1620 W (nominal load losses).

i) Determine a transformer equivalent circuit suitable for load flow studies at the primary potential.

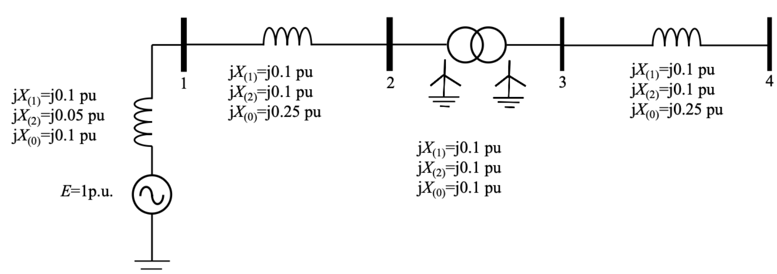
ii) A constant impedance load having nominal power of 50 kVA and power factor 0.9 lagging is connected to the transformer secondary. Reflect the load impedance to the primary side of the transformer.

iii) Calculate the load current when the voltage is nominal.

i) Draw the positive, negative and zero sequence networks for the power system in the figure.

ii) Calculate the Thevenin's impedances as seen from node 4 for each of the networks.

iii) Calculate the fault current when a single-line-to-ground fault occurs at node 4 with fault impedance Z_f = 0 Ω. In this type of fault, the fault current is calculated by connecting the sequence networks in series through an impedance $3Z_f$. Note that for this type of fault, the sequence currents are the same i.e. $I_{a1} = I_{a2} = I_{a0}$. Utilize this when calculating the real fault current from the sequence currents.



The electric circuit in Figure 2 comprises three nodes in addition to the reference node 0 (ground), two voltage sources, reactive branches and one transformer connected as shown in the Figure 2. All the relevant parameter values are given in Figure 2. (2pts/sub-question)

a) Determine the nodal admittance matrix of the electric circuit.

b) Calculate the voltage at node 2.

c) Determine the powers injected by two voltage sources at nodes 1 (S_1) and 3 (S_3) and the power flowing between nodes 1 and 2 (S_{12}).

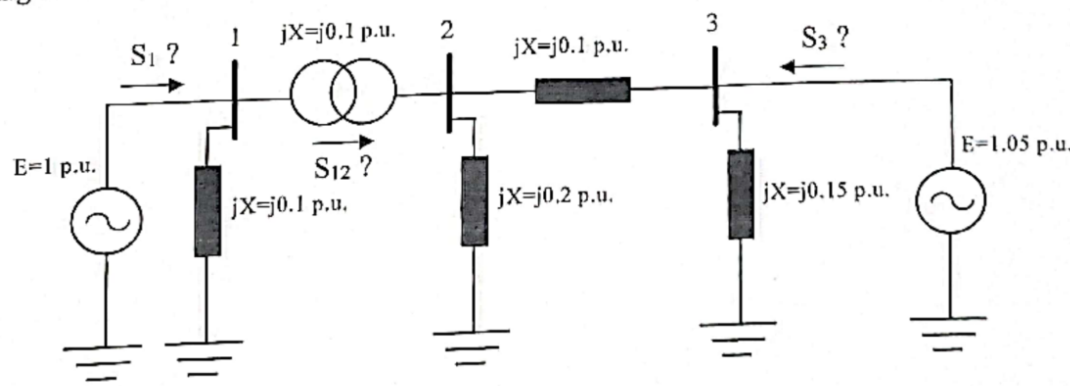


Figure 2. The electric circuit of Question 3.

Fig. 6.1 shows an RC circuit. Compute the time-domain response of the output voltage u_o when a step change of 10 V is applied to the input voltage u_{in}.

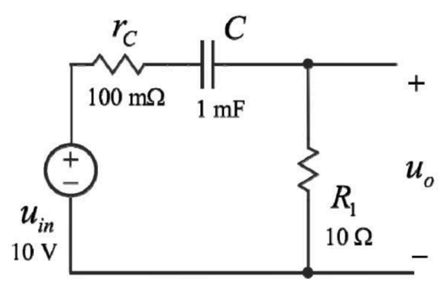


Fig. 6.1