1. (5%) (a) Consider the circuit in Figure 1. The ammeter has an internal resistance of 4 Ohms. Find the current i_1.
   (5%) (b) What is the power dissipated on R_1?

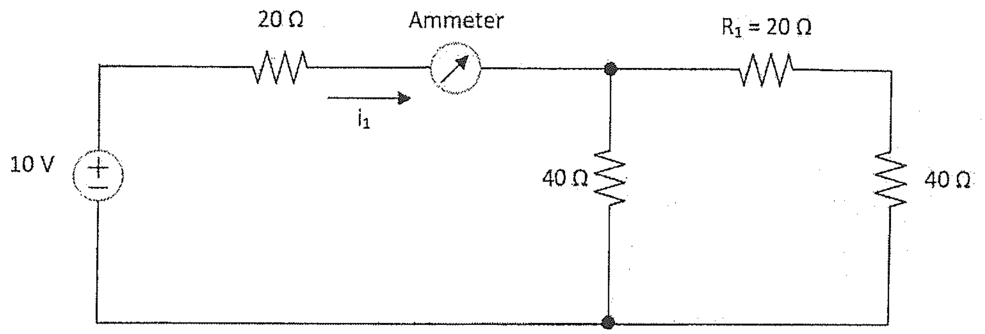

Figure 1.

2. (10%) For the circuit shown in Figure 2, determine the Thévenin and Norton equivalent circuits at terminals a and b.

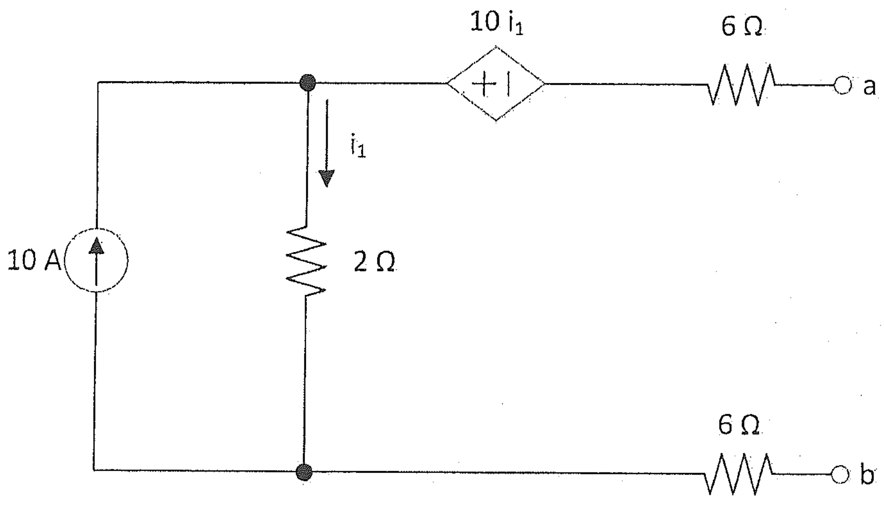

Figure 2.

3. (10%) For the circuit shown in Figure 3, determine $v_c(t)$ for t > 0.

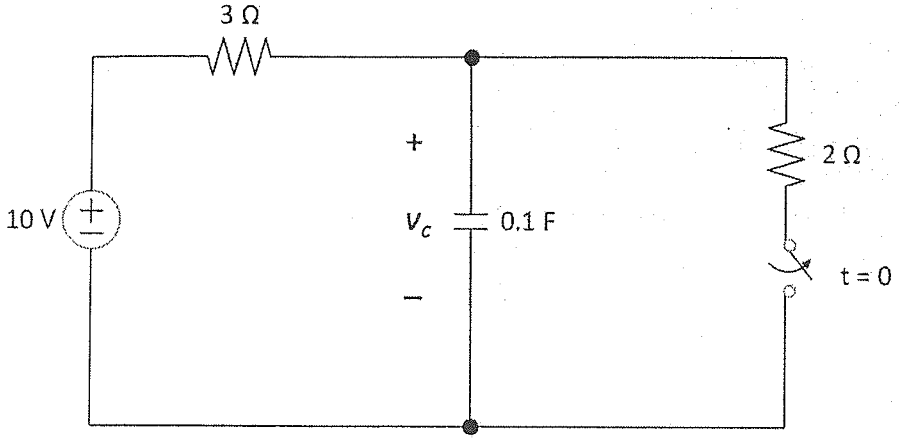

Figure 3.

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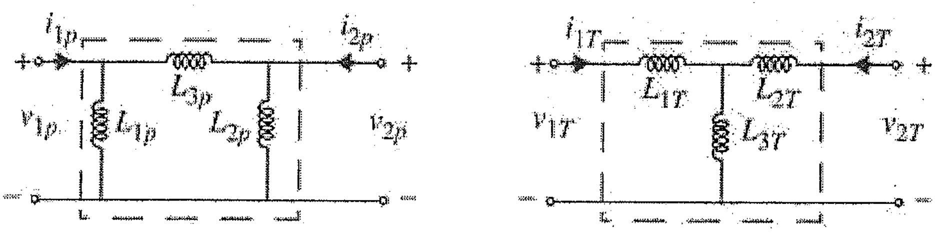
4. (10%) Figure 4 shows two inductive two-port networks. Fig. 4(a) is a "π"network, and Fig. 4(b) is a "T" network.
   (i) (2%) For the π network, find v_{1P} and v_{2P} as functions of i_{1P} and i_{2P}.
   (ii) (2%) For the T network, find v_{1T} and v_{2T} as functions of i_{1T} and i_{2T}.
   (iii) (6%) How must L_{1P}, L_{2P}, and L_{3P} be related to L_{1T}, L_{2T}, and L_{3T} for both networks to have the same terminal relations?



(a) (b)

Figure 4.

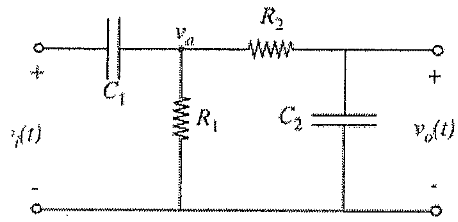


Figure 5.

5. (10%) Consider the second-order circuit containing resistors and capacitors shown in Figure 5. We are interested in deriving $v_o(t)$ for an input of the form $v_i(t) = V_i \cos(\omega t)$. Let $V_0(s)$ and $V_i(s)$ be these Laplace transforms of $v_o(t)$ and $v_i(t)$, respectively, and $R_1 = 1$ kΩ, $R_2 = 1$ kΩ, $C_1 = 1$ mF, and $C_2 = 1$ mF.
   (i) (4%) Find the transfer function $V_0(s)/V_i(s)$.
   (ii) (6%) Determine the time-domain output voltage $v_o(t)$ if all capacitors are initially uncharged.

6. (20%) A load as shown in Figure 6 has an impedance of Z=100+j100 Ω. Find the parallel impedance Z_p required correct the power factor to (a) 0.95 lagging and (b) 1.0. Assume the generator operates at ω =377 rad/s.

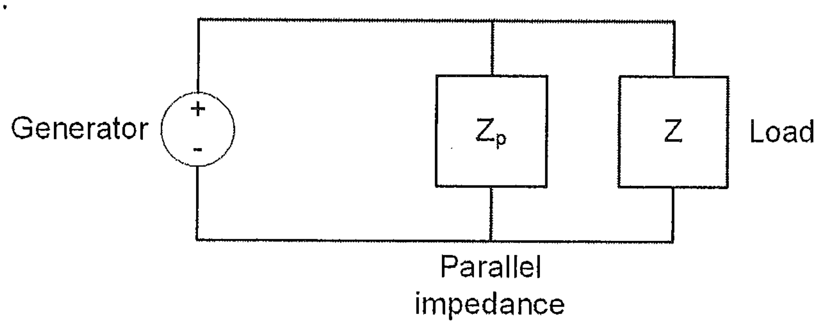


Figure 6.

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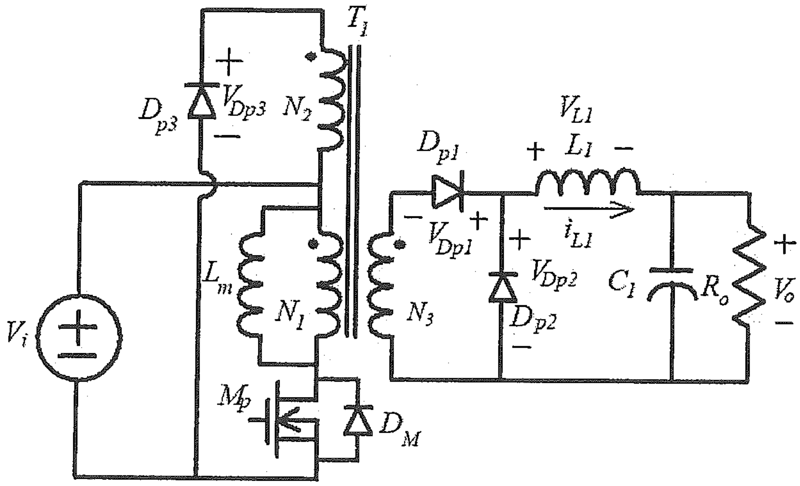
7. (10%) A balanced three-phase source has a Y-connected source with $v_a = 10\cos(2t + 30^\circ)$ connected to a three-phase Y load. Each phase of the Y-connected load consists of a 4-Ω resistor and a 8-H inductor. Each connecting line has a resistance of 2 Ω. Determine the total average power delivered to the load.

8. A forward converter is sketched as follows and operated in continuous conduction mode. Determine:
(9%) (A) the voltage stresses imposed on diodes D_{P1}, D_{P2} and D_{P3}.
(3%) (B) the voltage stress imposed on switch M_P.



9. A flyback converter with magnetizing inductance L_m is shown as follows. When it is operated in continuous conduction mode and with a duty ratio of D, determine
(4%) (A) the v_o/v_i transfer function in terms of D, and
(4%) (B) the voltage stresses V_{ds} and V_d imposed on switches S_M and D_M, respectively.