B.Sc. Engg.(CSE), 2nd Sem. Date: August 27, 2019 (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid-Semester Examination
Course No.: Phy 4241
Course Title: Physics II

Summer Semester, A.Y. 2018-2019
Time: 90 Minutes
Full Marks: 75

There are **4 (four)** questions. Answer any **3 (three)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper. Symbols carry their usual meanings.

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1. a) An automobile battery is charged with a constant current of 2 A for five hours. The terminal voltage of the battery is $v = 11 + 0.5t$ V for $t > 0$, where t is in hours. 5

   i. Find the energy delivered to the battery during the five hours.
   ii. If electric energy costs 15 Tk./kWh, find the cost of charging the battery for five hours.

   b) The portable lighting equipment for a mine is located 100 meters from its dc supply source. The mine lights use a total of 5 kW and operate at 120 Vdc. Determine the required cross-sectional area of the copper wires used to connect the source to the mine lights if we require that the power lost in the copper wires be less than or equal to 5 percent of the power required by the mine lights. Assume that the resistivity of the copper is $1.7 \times 10^{-6}\ \Omega$. 6

   c) Most of us are familiar with the effects of a mild electric shock. The effects of a severe shock can be devastating and often fatal. Shock results when current is passed through the body. A person can be modeled as a network of resistances. Consider the model circuit shown in Fig. 1(c). Determine the voltage developed across the heart and the current flowing through the heart of the person when he or she firmly grasps one end of a voltage source whose other end is connected to the floor. The heart is represented by R_h. The floor has resistance to current flow equal to R_f, and the person is standing bare foot on the floor. This type of accident might occur at a swimming pool or boat dock. The upper-body resistance R_u and lower-body resistance R_L vary from person to person. 7

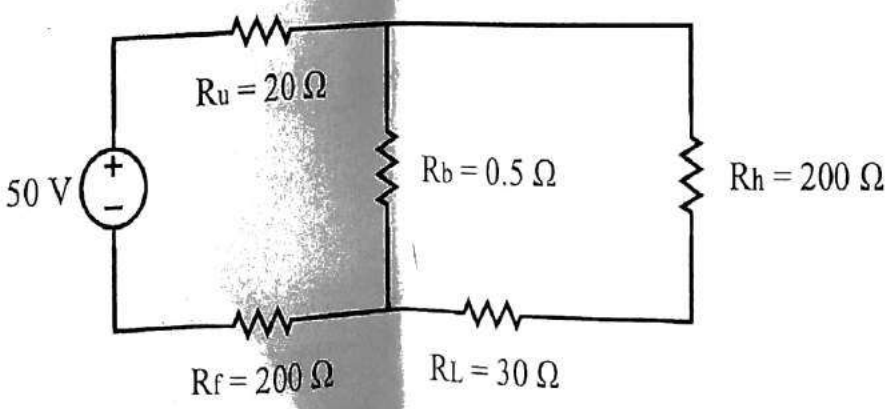

Fig. 1(c)

d) For the network in Fig. 1(d), find the resistance R_3 if the current through it is 2 A.

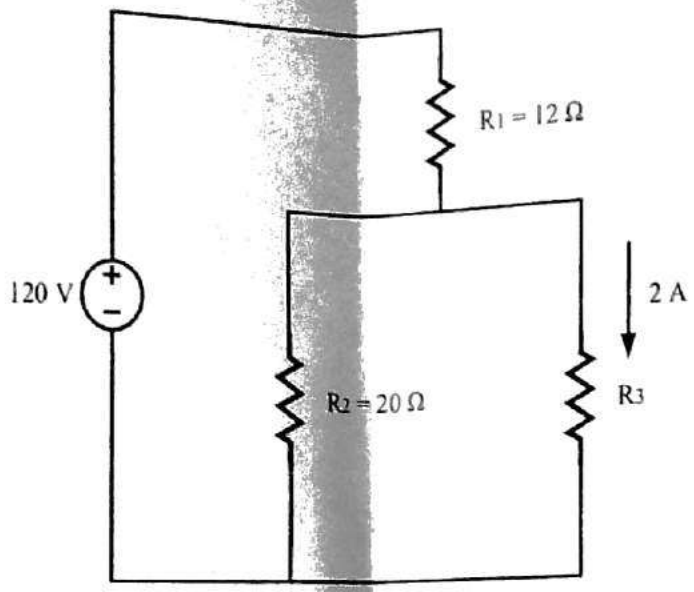

Fig. 1(d)

2. a) A phonograph pickup, stereo amplifier, and speaker are shown in Fig. 2(a.1) and redrawn as a circuit model as shown in Fig. 2(a.2). Determine the resistance R so that the voltage, V across the speaker is 16 V. Determine the power delivered to the speaker. 8

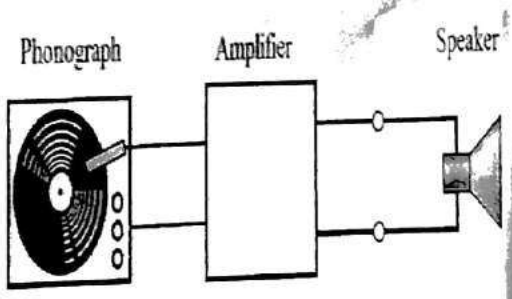

Fig. 2(a.1)

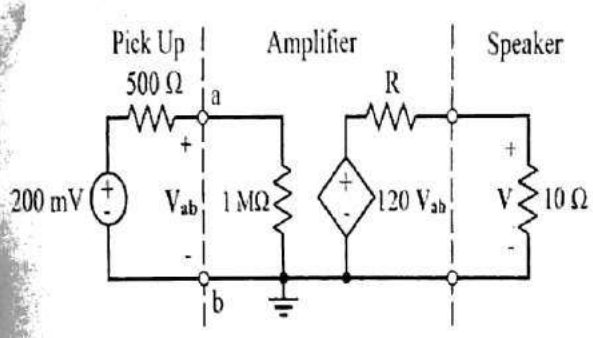

Fig. 2(a.2)

b) Find the power dissipated in the 3 Ω resistor of the circuit shown in Fig. 2(b). Also, find the energy stored in the 2 F capacitor and the 2 H inductor of the same circuit. 9

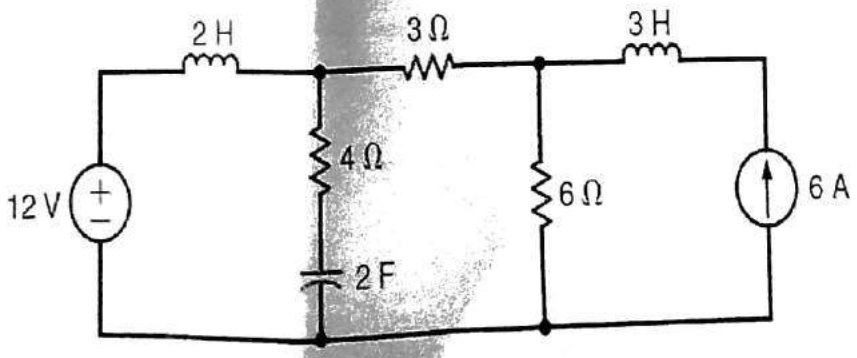

Fig. 2(b)

c) An electric current is applied to bone fractures that have not healed in the normal period of time. The process seeks to imitate natural electrical forces within the body. It takes only a small amount of electric stimulation to accelerate bone recovery. The direct current method uses an electrode that is implanted at the bone. This method has a success rate approaching 80 percent. 8

The implant is shown in Fig. 2(c.1), and the circuit model is shown in Fig. 2(c.2). Find the energy delivered to the cathode during a 24-hour period. The cathode is represented by the dependent voltage source and the 100 kΩ resistor.

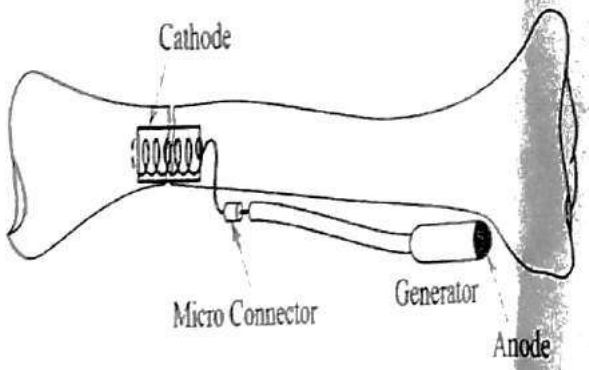

Fig. 2(c.1)

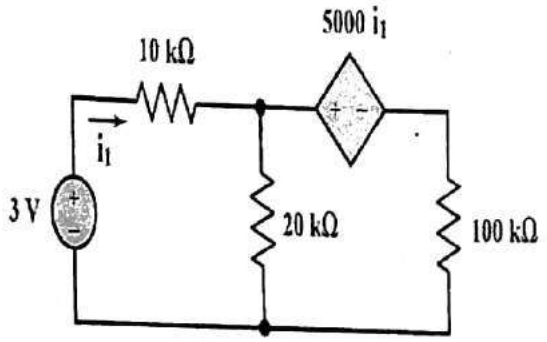

Fig. 2(c.2)

3. a) The circuit in Fig. 3(a) is a direct-current version of a typical three wire distribution system. The resistors R_a, R_b and R_c represent the resistances of the three conductors that connect the three loads R_1, R_2 and R_3 to the 125/250 V voltage supply. The resistors R_1 and R_2 represent loads connected to the 125 V circuits, and R_3 represents a load connected to the 250 V circuit. 12

i. Calculate V_1, V_2 and V_3 using nodal analysis.
ii. Calculate the power delivered to the load R_1, R_2 and R_3.

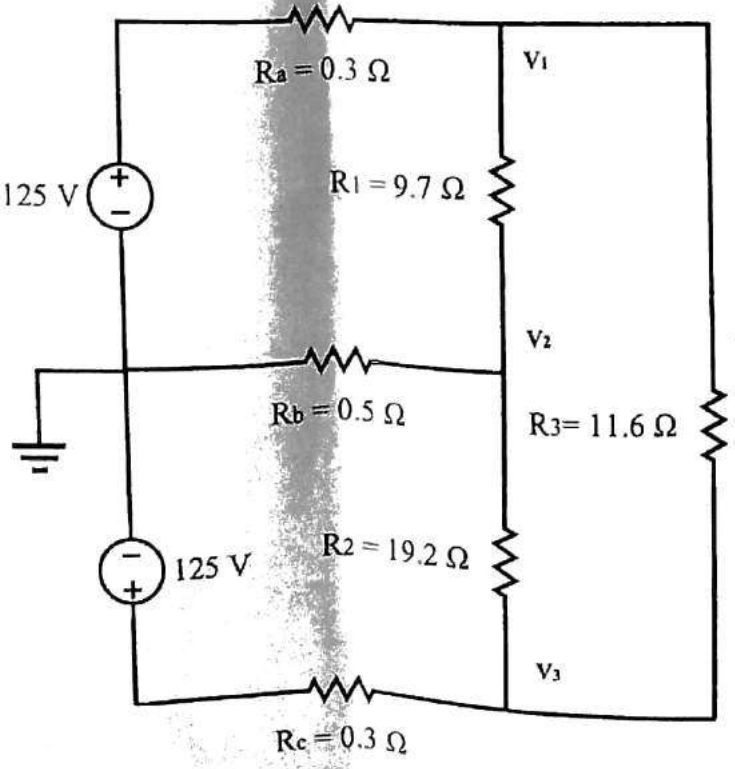

Fig. 3(a)

b) Find V_0 in the circuit of Figure 3(b) using mesh current analysis. 13

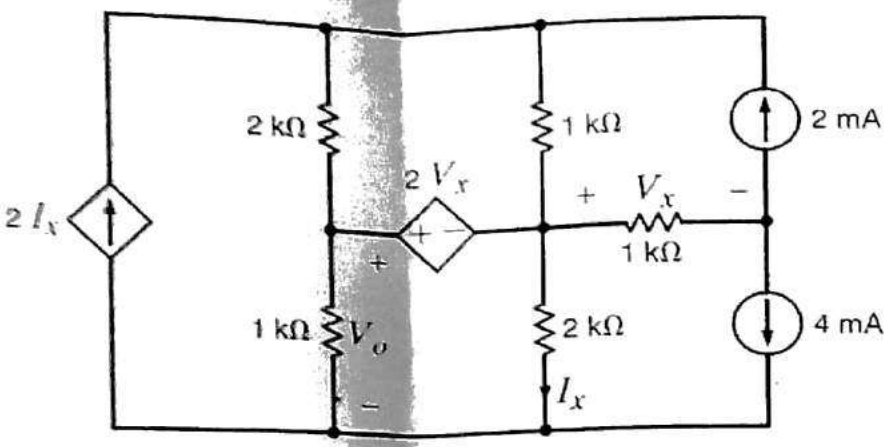

Figure 3(b)

4. a) Find I_0 in the circuit of Fig. 4(a) using superposition. 12

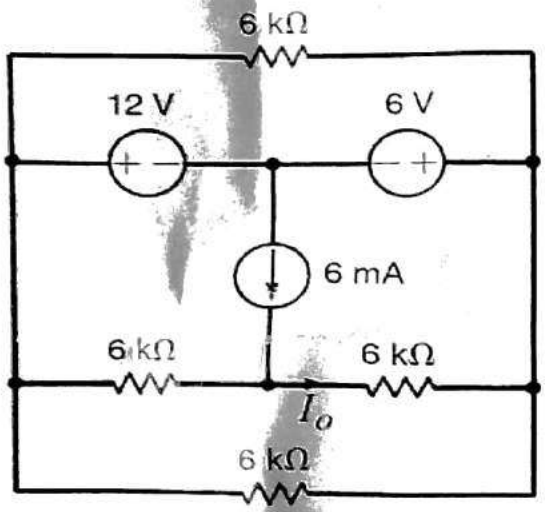

Fig. 4(a)

b) Find R_{Th} , V_{Th} at the *a-b* terminal from Fig. 4(b). 13

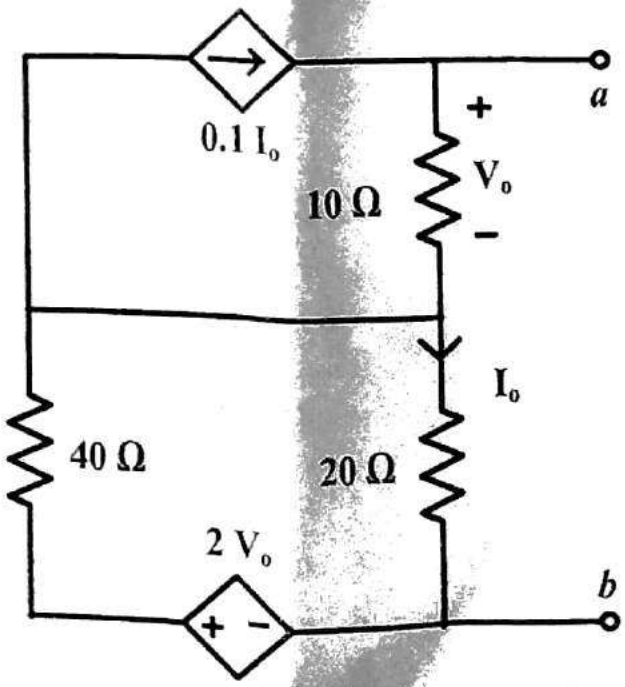

Fig. 4(b)