BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Environmental, Water Resource and Coastal Engineering
Term Final (Spring) Examination 2023: Jul-Sep 2023

Student Group: 0 <Earned Credit Hours ≤ 36

Subject: EECE 167, Basic Electrical Technology

Time: 3.00 hours **Full Marks: 180**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question-1** in **Section-A** and **Question-5** in **Section-B** are compulsory
c. Answer any other **TWO** questions out of **THREE** from each section.
d. Figures in the margin indicate full **marks**.
e. Assume reasonable data if necessary.
f. **Symbols** and **abbreviations** used have their usual meanings.

SECTION-A

Question 1 (Compulsory)

a. Apply any suitable circuit theorem to find i_0 for the network given in Fig. 1(a). Explain why would it be incorrect to add the responses of the individual sources in frequency domain to find the total response. **18**

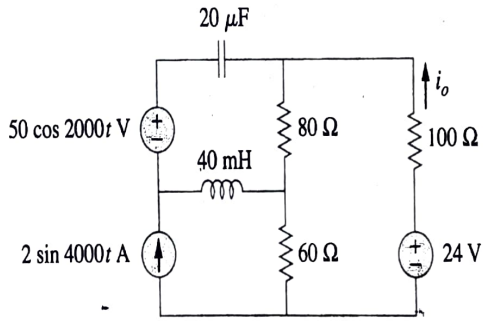


Fig. 1(a)

b. Calculate the equivalent resistance between the terminals a-b and determine the value of the source current I_0 from the circuit given in Fig. 1(b). **12**

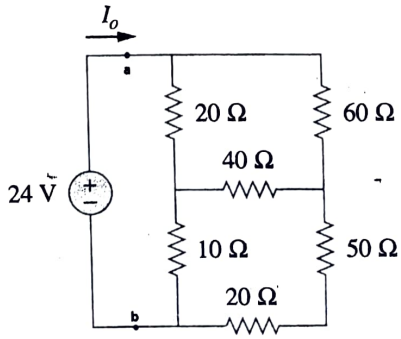


Fig. 1(b)

Question 2

a. State Thevenin's theorem. Consider that the variable resistance in Fig. 2(a). is adjusted until it absorbs the maximum power from the circuit. Apply maximum power transfer theorem to calculate **16**

(i) The value of R for the maximum power
(ii) The maximum power absorbed by R.

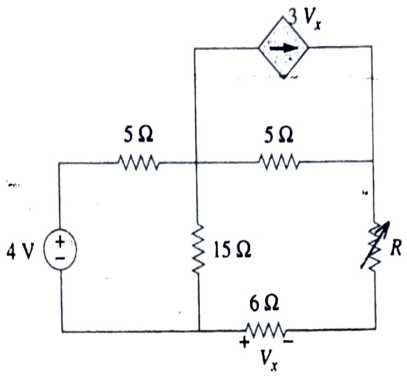


Fig. 2(a)

b. For the network in Fig. 2(b), apply mesh analysis to determine the mesh currents marked as i_1, i_2 and i_3. **14**

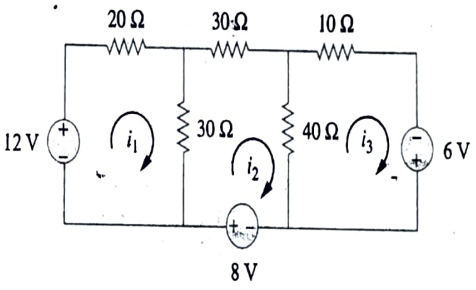


Fig. 2(b)

Question 3

a. Calculate the node voltages of the non-reference nodes of the network in Fig. 3(a). **18**

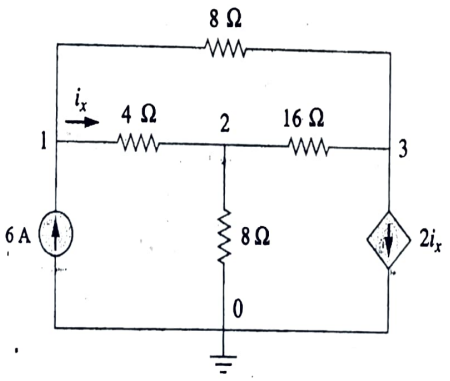


Fig. 3(a)

b. The voltage across any branch of an electrical network, $v(t)$ is expressed by the equation as follows. Find the voltage $v(t)$ using phasor approach. **12**

$$2\frac{dv}{dt} + 5v + 10\int vdt = 50\cos(5t - 30^\circ)$$

Question 4

a. For any three phase system, explain the following terms: **10**

i) Balanced three phase supply
ii) Balanced three phase load
iii) Phase sequence

b. Derive the relation between the line voltages and phase voltages of a Y – connected three phase source. Consider a positive phase sequence. **10**

c. Determine the rms value of the current i(t) as shown in Fig. 4(c). Also calculate the average power absorbed by a resistor , R = 2Ω, through which the current is passed. **10**

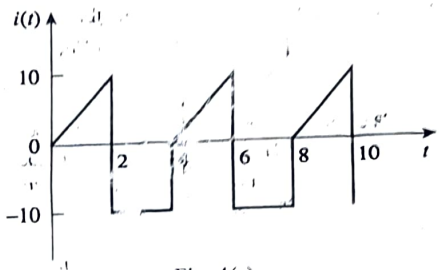


Fig. 4(c)

SECTION-B

Question 5 (Compulsory)

a. State Faraday's laws of Electromagnetic induction. With proper phasor diagrams and illustrations, explain the rotation of an induction motor. **12**

b. Explain 'slip' in an induction motor. A 4 – pole, 3 – phase induction motor operates from a supply whose frequency is 50 Hz. **10**
Calculate:

(i) The speed at which the magnetic field of the stator is rotating.
(ii) The speed of the rotor when slip is 0.04.
(iii)The frequency of the rotor slip is 0.03.
(iv)The frequency of the rotor current at standstill.

c. Apply the Ayrton shunt method to design an ammeter with a range of 0 – 1 mA and 0 – 50 mA. A PMMC movement with an internal resistance of 100 Ω and full scale current of 50 μA is used. **08**

Question 6

a. With brief explanation develop the relationship between generated EMF and terminal voltage per phase in an alternator. **08**

b. A 3 – phase , star – connected alternator supplies a load of 10 MW at a power factor of 0.85 (lagging) and at 11 kV (terminal voltage). Its resistance is 0.1 Ω per phase and synchronous reactance is 0.66 Ω per phase. Calculate the line value of EMF generated. **10**

c. Explain the use of synchronous motor as a means for power factor correction. **12**

Question 7

a. Consider the circuit shown in Fig. 7(a). A silicon PN – junction diode is connected in series with the resistor R. A zener diode with a zener voltage of $V_z = 10$ V is connected in parallel to the load resistor R_L. Now, **10**

(i) Determine V_L, V_R and I_z.
(ii) Determine V_L, V_R and I_z when $R_L = 3k\Omega$

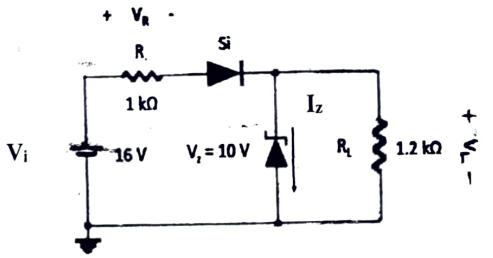


Fig. 7(a)

b. With appropriate phasor diagram show the process of measuring power using two wattmeters for a balanced 3 – phase circuit. **10**

c. Explain the conversion of AC supply to DC supply by a full wave bridge rectifier and thereby derive the average current found in this configuration. **10**

Question 8

a. Breifly describe the different types of semiconductors. Explain the V-I characteristics of PN–junction diode with appropriate illustrations. **12**

b. Determine the currents I_1, I_2 and I_{D2} for the circuit in Fig. 8(b). **08**

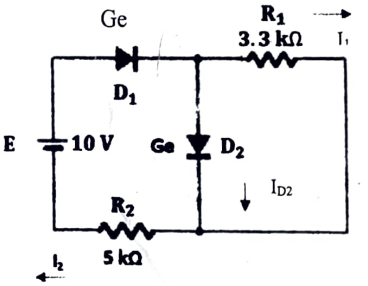


Fig. 8(b)

c. An NPN BJT is set up in two configurations as depicted in Fig. 8(c)(i) and Fig. 8(c)(ii) respectively. The first configuration carries a current of 0.2 μA, while the second configuration has a current of 20 μA. Now , determine the value of α, I_E and I_B, when the collector current is found to be 1 mA **10**

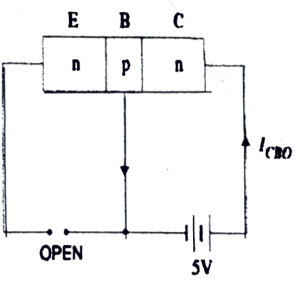


Fig. 8(c)(i)

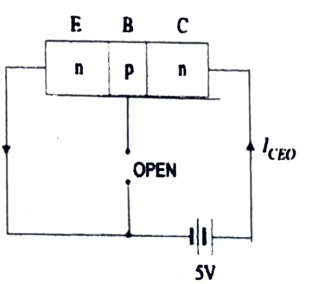


Fig. 8(c)(ii)