 SASTRA <small>DEEMED TO BE UNIVERSITY</small> <small>THANJAVUR KUMARAKOIAM CHENNAI</small>	<p align="center">School of Electrical and Electronics Engineering</p> <p align="center">CIA III Examinations January 2023</p> <p align="center">Course Code: EEE104</p> <p align="center">Name: Principles of Electrical Engineering</p> <p align="center">Duration: 90 Min Max Marks: 50</p>
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PART – A

5 x 2 = 10 Marks

ANSWER ALL THE QUESTIONS

1. Using only 470 Ω resistors, synthesize an equivalent resistance of 282 Ω . Use no more than four 470 Ω resistors. Draw the circuit diagram.
2. A balanced three-phase system with a line voltage of 300 V is supplying a balanced Y-connected load with 1200 W at a leading power factor of 0.8. Find the line current and the per-phase load impedance.
3. A transformer steps up the voltage from primary to secondary in the ratio of 1:10. Can we expect the output power to be the same as the input power?
4. Classify secondary measurement instruments based on their functions.
5. If 5A, 10A and 13A fuses are available, state which is most appropriate for the following appliances which are both connected to a 240V supply.
 - (a) Electric toaster having a power rating of 1kW
 - (b) Electric heater having a power rating of 3kW.

PART – B

3 x 10 = 30 Marks

ANSWER ANY THREE QUESTIONS

6. A.) The core of a 100kVA, 11000/550 V, 50 Hz, single-phase core-type transformer has a cross-section of 20cm x 20cm. Find

the following:

- i. Number of primary turns per phase
- ii. Voltage and current transformation ratio
- iii. EMF per turn if the maximum core density is not to exceed 1.3 Tesla (5 Marks)

B.) Write short notes on types of earthing. (5 marks).

7. State Kirchhoff's laws as applied to an electrical circuit. Two batteries A and B are joined in parallel. Connected across the battery terminals is a circuit consisting of a battery C in series with a $25\ \Omega$ resistor, the negative terminal of C being connected to the positive terminals of A and B. Battery A has an e.m.f. of 108 V and internal resistance of $3\ \Omega$, and the corresponding values for battery B are 120 V and $2\ \Omega$. Battery C has an e.m.f. of 30 V and a negligible internal resistance. Draw the circuit diagram and determine:

- i. the value and direction of the current in each battery (5 Marks)
- ii. the terminal voltage of battery A. (5 Marks)

8. **A.)** It has been observed that two different circuits have the same time constant of 0.005 second. The first circuit is an R-L series circuit, and the second one is an R-C series circuit with a known resistance of $2\ M\Omega$. With the constant DC supply of 10 V applied to the two circuits, it is found that the steady-state current of the circuit is 2000 times the initial current of the circuit. Find unknown resistor, inductor and capacitor values. (5 Marks)

B.) Write short notes on different transducers used to measure electrical signals. (5 marks).

9. **A.)** Compare the moving coil and moving iron instruments. (5 marks).

- B.) A homeowner consumes 700 kWh in January. Determine the electricity bill for the month using the following residential rate schedule:

Base monthly charge of 45.00 rupees

First 100 kWh per month at 2.50 rupees/kWh.

Next 200 kWh per month at 3.5 rupees/kWh.

Over 300 kWh per month at 5 rupees/kWh.

Calculate the average cost per kWh if only 350 kWh are consumed in July when the family is on vacation most of the time. (5 marks)

PART – C

1 x 10 = 10 Marks

COMPULSORY QUESTION ✓

10. A service technician attending an appliance failure at home accidentally short-circuited two terminals left open during wiring. The short circuit eventually led to the tripping of the miniaturized circuit breaker in the lab. After tracing the wiring in the home, the service technician identified the equivalent circuit for the home connection, as shown in Figure 1, where the terminals 'a-b' is the exact point which was short-circuited. Assume yourself as a service technician and deploy a suitable network theorem to identify the magnitude of the short circuit current between the terminals 'a-b'. Comment on the rating of the circuit breaker to handle the short-circuit current. (10 marks)

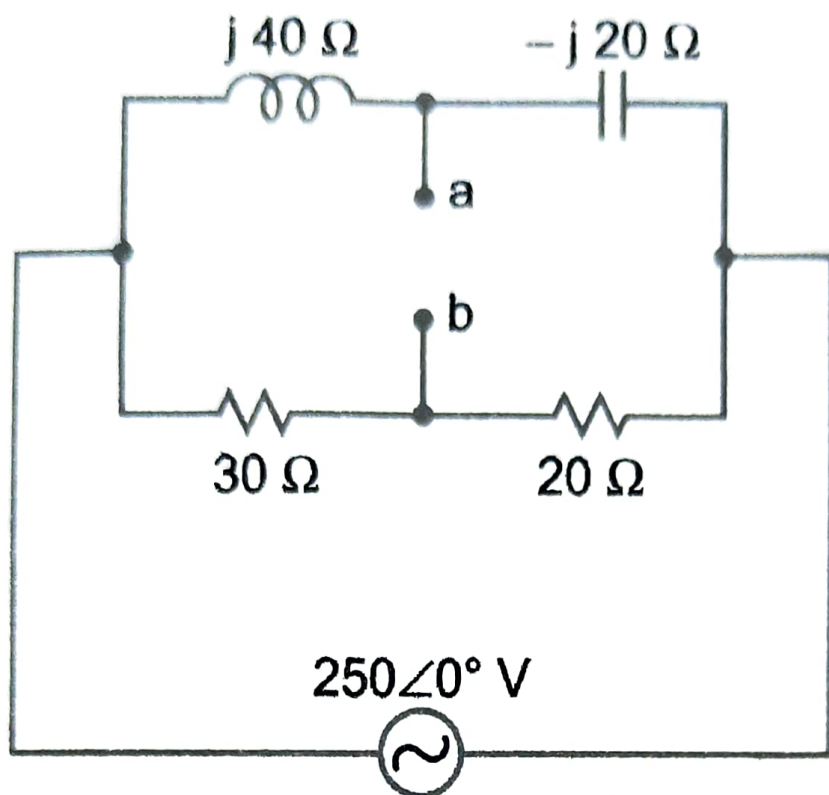


Figure 1
