SASTRA DEEMED UNIVERSITY

(A University under section 3 of the UGC Act, 1956)

End Semester Examinations

February 2023

Course Code: **EEE104**

Course: **PRINCIPLES OF ELECTRICAL ENGINEERING**

QP No. :**U037R-1**

Duration: **3** hours

Max. Marks:**100**

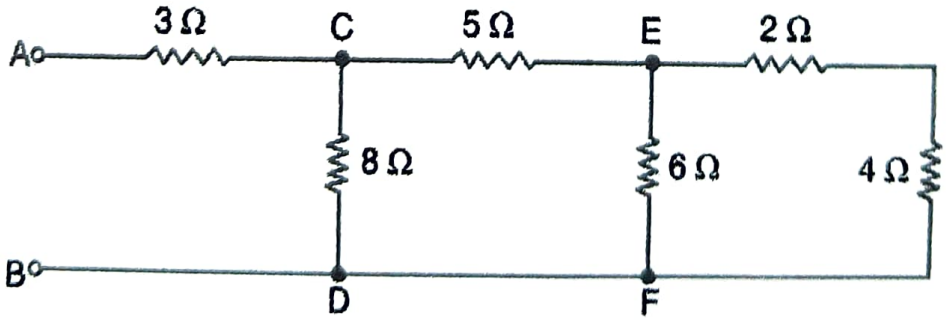
PART – A

Answer all the questions **10 x 2 = 20 Marks**

1. Using only 1kΩ resistors, synthesize a resistor of 3/5 kΩ. Use no more than four 1kΩ resistors.

2. The voltage at the terminals of a battery is 52V when no load is connected and 48.8V when a load taking 80A is connected. Find the internal resistance of the battery. What would be the terminal voltage when a load taking 20A is connected?

3. Find the equivalent resistance between terminals A & B.



4. A rechargeable flashlight battery is capable of delivering 90 mA for about 12 h. How much charge can it release at that rate? If its terminal voltage is 1.5 V, how much energy can the battery deliver?

5. Two AC sinusoidal waveforms with different frequencies are available. Is it possible to draw a phasor diagram for the two AC waveforms with different frequencies?

6. 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?

7. List the different types of electrical measuring instruments suitable for measuring both AC and DC power supply.

8. Why are transformers rated in kVA (kilo Volt – Ampere)?

9. If 5A, 10A, and 13A fuses are available, state which is most appropriate for the following appliances, which are connected to a 240V supply.
   (a) Electric toaster having a power rating of 1kW
   (b) Electric heater having a power rating of 3kW.

10. List the different factors to be considered to decide between a single-phase and three-phase supply connection for a newly constructed home.

PART – B

Answer any FOUR questions **4 x 15 = 60 Marks**

11. **a)** Draw a star circuit using resistors and write the required expressions to transform the circuit to a delta circuit. (5)
b) 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 Ω 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 Ω, and the corresponding values for battery B are 120 V and 2 Ω. Battery C has an e.m.f. of 30 V and negligible internal resistance. Determine:
   i. the value and direction of the current in each battery (5 Marks)
   ii. the terminal voltage of battery A. (5)

12. An electric vehicle battery pack is constructed from eight cells (4.7 V, 3000 mAh) in the following way. First, two modules are built, where each module comprises four of these cells wired in series. Next, these two modules are wired parallel to make the battery pack. Draw the circuit for the above-said connection and calculate the following

    i. the nominal energy capacity of the battery (in Wh)
    ii. the nominal capacity of the battery (in Ah)
    iii. total discharge time if discharged at a '4C' rate
    iv. total time taken to charge if charged at '1C' rate
    v. voltage rating of the battery pack (15)

13. A typical household has three loads connected to a 230V, 50Hz AC supply through individual switches. A power system operator visits this home to survey the type of loads and use the collected data to plan future power generation. The power system operator utilizes specialized equipment to measure different electrical quantitates. The individual impedances of the loads are measured as $10\angle -30°\ \Omega$, $20\angle 60°\ \Omega$ and $40\angle 0°\ \Omega$ respectively, under standard operating conditions. Based on the available data, determine the admittance and equivalent impedance of the entire household when all the loads are turned on. Calculate the power consumed by the entire household and the corresponding power factor. (15)

14. The core of a 100kVA, 11000/550 V, 50 Hz, single-phase core-type transformer has a cross-section of $20cm \times 20cm$. Find the following:

    i. Number of primary turns per phase
    ii. Number of secondary turns
    iii. Voltage and current transformation ratio
    iv. EMF per turn if the maximum core density is not to exceed 1.3 Tesla
    v. Primary current (15)

15. Classify DC motors based on excitation and describe their working principle. (15)

16. **a)** Explain in detail about different types of wiring systems and accessories. (10)

b) Compare the moving coil and moving iron instruments. (5).

PART – C

Answer the following **1 x 20 = 20 Marks**

17. **a)** An amateur electronics enthusiast found few air-cored coils in the laboratory. These coils have a unique behaviour of dissipating different voltage drops when all three series-connected coils are connected across an AC and DC supply. When 1A flows through three air-cored coils, A, B and C, in series, the voltage drops are 6V, 3V and 8V on DC and 7V, 5V and 10V on AC power supply. Comment on the possible reasons for different voltage drops across the same coil when connected with AC or DC supply. Find (i) the power factor and power dissipated in each coil and (ii) the power factor of the entire circuit. (10)

b) There are some 24 million households in a country. If every household replaces a single 100 W tungsten filament lamp with a low-energy bulb of 20 W,

i. Calculate the reduction in annual demand if the bulbs are switched on for 3 hours per day.

ii. What are the CO_2 emissions savings at 1 kg/kW h?

iii. Compare the energy savings with the annual output of a 1000 MW power station having an 80 per cent capacity factor.

iv. What conclusions might be drawn from this for a national energy policy? (10)

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