2016

ELECTRONICS

(Major)

Paper : 2.2

(Electric Circuits)

Full Marks : 60

Time : 3 hours

The figures in the margin indicate full marks for the questions

Answer Question Nos. **1** and **2** which are compulsory and **three** questions from Section—A, and **three** from Section—B

1. *(a)* A network contains linear resistors and ideal voltage sources. If the values of all the resistors are doubled, then the voltage across each resistor is

(i) halved

(ii) doubled

(iii) increased by four times

(iv) not changed

(b) If each branch of a delta network has resistance $\sqrt{3}R$, then each branch of the equivalent star network has resistance

(i) $\frac{R}{\sqrt{3}}$ (ii) $3R$

(iii) $3\sqrt{3}R$ (iv) $\frac{R}{3}$

(c) The maximum power that can be transferred to the load R_L from the voltage source in Fig. 1

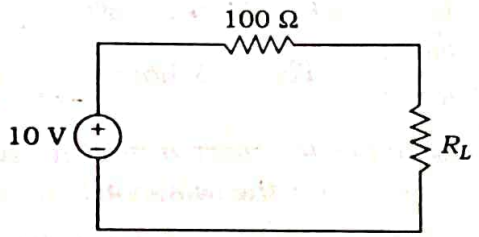

Fig. 1

is

(i) 1 W
(ii) 10 W
(iii) 0·25 W
(iv) 0·5 W

(d) Superposition theorem is not applicable to networks containing

(i) non-linear elements
(ii) dependant voltage source
(iii) dependant current source
(iv) transformers

(e) The average value of the current $i = 200 \sin t$ from $t = 0$ to $t = \pi/2$ is

(i) $400\,\pi$ (ii) $400/\pi$

(iii) $1/400$ (iv) $\pi/400$

(f) A boiler at home is switched on to a.c. mains supplying power at 230 V, 50 Hz. The frequency of instantaneous power consumed is

(i) 0 Hz
(ii) 50 Hz
(iii) 100 Hz
(iv) 150 Hz

(g) In a series *R-L-C* resonant circuit, the current is maximum at a frequency

(i) equal to the resonant frequency
(ii) greater than the resonant frequency
(iii) less than the resonant frequency
(iv) None of the above 1×7=7

2. (a) Two coupled coils with $L_1 = L_2 = 0{\cdot}6$ H have a coupling coefficient of $K = 0{\cdot}8$. What will be the turns ratio N_1 / N_2?

(b) Four resistances 80 Ω, 50 Ω, 25 Ω and R are connected in parallel. Current through 25 Ω resistor is 4 A. Total current of the supply is 10 A. Then what is the value of R?

(c) Explain in short the basic principle of a potentiometer.

(d) What is power in an a.c. circuit? Differentiate between active power and reactive power. 2×4=8

SECTION—A

Answer *any* **three** questions

3. Find the equivalent resistance between A and B in the network shown in Fig. 2. 5

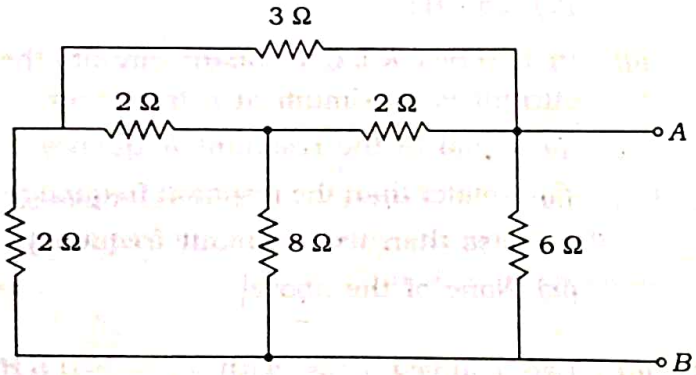

Fig. 2

4. From the defining equation for energy

$$W = \int_{-\infty}^{t} V(t)i(t)\,dt$$

show that the energy stored by a capacitor is

$$W_C = \frac{1}{2}CV^2$$

5

5. Determine the current through the 5 Ω resistor of the network shown in Fig. 3 using mesh analysis : 5

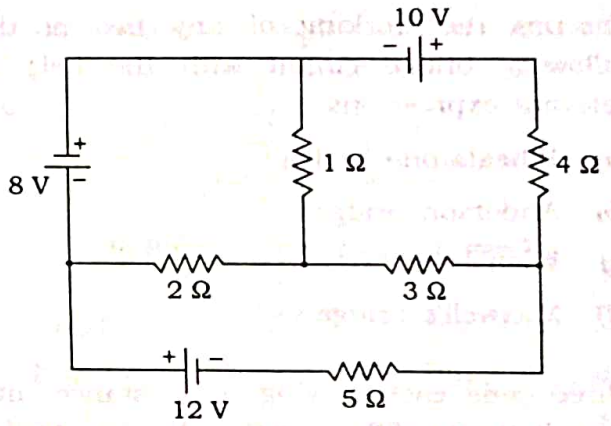

Fig. 3

6. Determine the current in the 5 Ω resistor of the network shown in Fig. 3 using superposition theorem. 5

7. Two impedances $z_1 = (20 + j10)\,\Omega$ and $z_2 = (10 - j30)\,\Omega$ are connected in parallel and this combination is connected in series with $z_3 = (30 + jX)\,\Omega$. Find the value of X which will produce resonance. 5

SECTION—B

Answer *any* **three** questions

8. Discuss the working of any two of the following bridge circuit with the help of relevant expressions : 5×2=10

(a) Wheatstone bridge

(b) Anderson bridge

(c) Wien bridge

(d) Maxwell's bridge

9. Three coils each having a resistance and an inductance of 8 Ω and 0·02 H respectively, are connected in star across a 3-phase, 230 V, 50 Hz supply. Find the—

(a) power factor;

(b) line current;

(c) power (real);

(d) reactive volt-ampere;

(e) total volt-ampere. 2×5=10

10. *(a)* Derive the relation for voltage, current and impedance of the primary side of an ideal transformer in terms of that of the secondary side and turns ratio. 6

(b) State the Thevenin's theorem and explain with suitable example. 4

11. Find the voltage V_2 in the circuit shown in Fig. 4 such that current in the left-hand loop (loop–1) is zero. 10

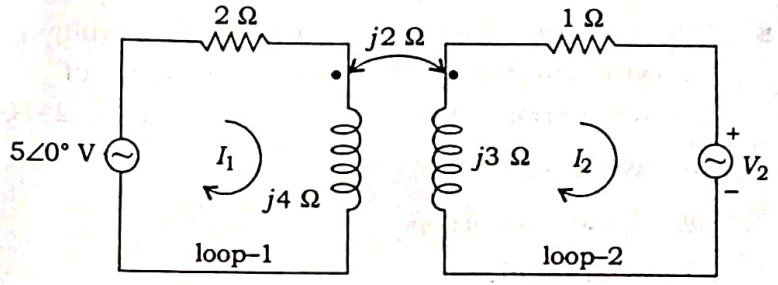

Fig. 4

12. A T-section low-pass filter has a series inductance of 60 mH having negligible resistance and a shunt element having a capacitance of 0·2 μF. Calculate—

(a) cut-off frequency;

(b) nominal impedance;

(c) characteristic impedance at frequency 1 KHz and 5 KHz. 10

13. Write short notes on any *two* of the following : 5×2=10

(a) Source transformation

(b) Independent and controlled sources

(c) Nodal analysis

(d) Short-circuit test in transformer

(e) Electromagnetism

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