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(NEP-2020)

(1st Semester)

ELECTRONICS (MAJOR)

(Circuit Analysis)

Full Marks : 75

Time : 3 hours

The figures in the margin indicate full marks for the questions

Simple calculator may be used in this paper

(SECTION : A—OBJECTIVE)

(Marks : 10)

Tick (✓) the correct answer in the brackets provided :

1×10=10

1. The RMS value of alternating current is

(a) $0.637 I_m$ () (b) $0.707 I_m$ ()

(c) $0.375 I_m$ () (d) $0.5 I_m$ ()

2. When the two quantities pass through zero values at the same time but rise in opposite direction, the phase difference is

(a) 90° () (b) 360° ()

(c) 180° () (d) 0° ()

3. The sum of resistance through which two current loops are passing is called
- (a) mutual resistance ()
 - (b) self resistance ()
 - (c) internal resistance ()
 - (d) input resistance ()
4. To get the Norton's current, you have to
- (a) open the voltage source ()
 - (b) open the load resistor ()
 - (c) short the voltage source ()
 - (d) short the load resistor ()
5. Superposition theorem can be applied only to circuit having _____ elements.
- (a) non-linear ()
 - (b) passive ()
 - (c) linear bilateral ()
 - (d) resistive ()
6. In an a.c. circuit containing a pure capacitor only, the current leads the voltage by
- (a) 0° ()
 - (b) 90° ()
 - (c) 180° ()
 - (d) 360° ()
7. The voltage applied across an R - L circuit is equal to _____ of V_R and V_L .
- (a) arithmetic sum ()
 - (b) algebraic sum ()
 - (c) phasor sum ()
 - (d) sum of the squares ()

8. At resonance, bandwidth includes the frequency range that allows _____ percent of the maximum current to flow.
- (a) 33.33 ()
 - (b) 66.67 ()
 - (c) 50 ()
 - (d) 70.7 ()
9. The value of form factor in a half-wave rectified alternating current is
- (a) 1.11 ()
 - (b) 1.57 ()
 - (c) 1.27 ()
 - (d) 0.48 ()
10. The power factor at resonance in $R-L-C$ parallel circuit is
- (a) zero ()
 - (b) 0.08 lagging ()
 - (c) 0.8 leading ()
 - (d) unity ()

(SECTION : B—SHORT ANSWERS)

(Marks : 15)

Answer *five* questions, taking at least *one* from each Unit : 3×5=15

UNIT—I

1. Define the terms alternating quantity, waveform and amplitude.
2. Discuss the RMS value of a sinusoidal wave.

UNIT—II

3. Prove that the maximum power is transferred to the load when internal impedance is equal to load impedance.
4. State and explain ladder method of network analysis.

UNIT—III

5. Show that an ideal inductor does not consume any power in an a.c. circuit.
6. What is a resonance curve? Discuss about the resonance curve of a typical R - L - C series circuit.

UNIT—IV

7. Derive the expression for Q -factor of a parallel resonant circuit in terms of R , L and C .
8. Write a short note on r.m.s. value of half-wave rectified alternating current.

(SECTION : C—DESCRIPTIVE)

(Marks : 50)

Answer *five* questions, taking at least *one* from each Unit :

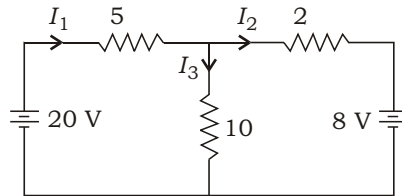
10×5=50

UNIT—I

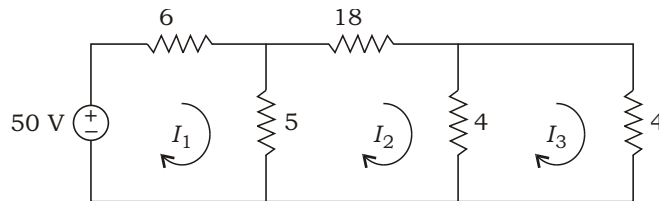
1. (a) Differentiate between the following : 2+2=4
 - (i) Alternation and Cycle
 - (ii) Time period and Frequency
- (b) Derive the equation of instantaneous value of the alternating current. 6
2. (a) An alternating current is given by $i = 141.4 \sin 314t$. Find—
 - (i) the maximum value;
 - (ii) frequency;
 - (iii) time period;
 - (iv) the instantaneous value when t is 3 ms. 4
- (b) Define average value of an alternating current. Derive the average value of an alternating current by analytic method. 1+5=6

UNIT—II

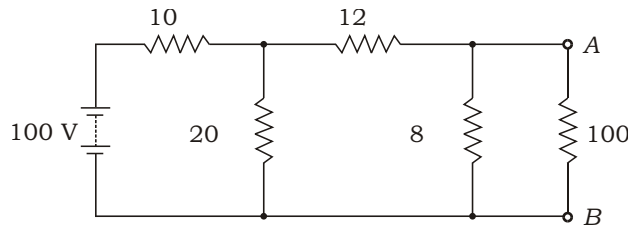
3. (a) Define superposition theorem. 2
 (b) Calculate the voltage and current in the following network using node voltage analysis : 4



- (c) Find I_1 , I_2 and I_3 using Mesh analysis : 4



4. (a) Using Thevenin's theorem, find the current through 100 Ω resistance connected across terminals A and B in the circuit given below : 4



- (b) State and prove reciprocity theorem. 6

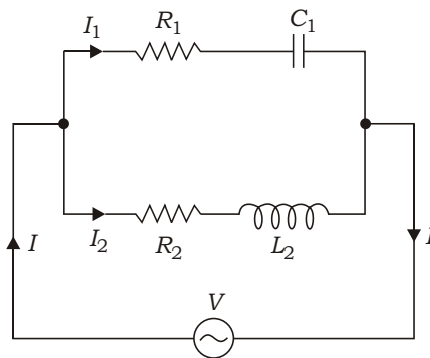
UNIT—III

5. (a) An a.c. voltage $V_m \sin t$ is applied to a series R - L - C circuit. Use the phasor diagram to obtain expressions for (i) impedance of the circuit, (ii) phase angle between the applied voltage and the resulting current in the circuit. What happens, when (i) $X_L = X_C$, (ii) $X_C > X_L$ and (iii) $X_L > X_C$? 7
 (b) An inductor coil is connected to a supply of 250 V at 50 Hz and takes a current of 5 A. The coil dissipates 750 W. Calculate (i) power factor, (ii) resistance of coil and (iii) inductance of coil. 3

6. (a) Show that the voltage lags behind the current in R - C series a.c. circuit. 5
- (b) What is Q -factor of a series resonant circuit? A series R - L - C circuit which resonates at f_r 500 kHz has L 100 H, R 25 and C 1000 pF. Determine (i) the Q -factor of the circuit, (ii) the new value of C required to resonate at 500 kHz when the value of L is doubled and new Q -factor. 2+3=5

UNIT—IV

7. (a) With a suitable circuit diagram, obtain the expression for resonant frequency of a parallel a.c. circuit. Also, derive the expression for impedance and line current at parallel resonance. 5+2=7
- (b) Using an impedance-frequency curve, discuss about the bandwidth of a parallel resonant circuit. 3
8. (a) Using vector or phasor method, solve the parallel circuit given below and hence obtain the equation for current I and phase angle : 7



- (b) An alternating voltage $e = 200 \sin 314t$ is applied to a device which offers an ohmic resistance of 20 to the flow of current in one direction, while preventing the flow of current in opposite direction. Calculate RMS value, average value and form factor for the current over one cycle. 3
