MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

Paper Code : ES-101

BASIC ELECTRICAL AND ELECTRONIC ENGINEERING – I

Time Allotted : 3 Hours | *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

PART – I (ELECTRICAL)

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *five* of the following : 5 × 1 = 5

i) An open circuit may be considered as a resistor of value

a) zero b) 100 Ω

c) infinity d) 10 MΩ.

ii) The admittance of a parallel circuit is $0.5 \angle -30°$. The circuit is

a) inductive b) capacitive

c) resistive d) in resonance.

iii) Which statement is true for resonance condition of RLC series circuit ?

a) Both impedance and current are maximum

b) Impedance is maximum & current is minimum

c) Impedance is minimum & current is maximum

d) Both impedance & current are minimum.

iv) An ideal voltage source should have

a) large value of e.m.f.

b) small value of e.m.f.

c) infinite source resistance

d) zero source resistance.

v) When a source is supplying maximum power to a resistive load, the efffivency of the circuit is

a) 80 % b) 50 %

c) less than 50 % d) 100 %.

vi) The form factor of a current waveform is 1. Its shape is

a) Sinusoidal b) Triangular

c) Square d) Sawtooth.

vii) In a series R – L circuit, the phase difference between the applied *ac* voltage & current increases when

a) R is increased

b) X_L is increased

c) X_L is decreased

d) input voltage is increased.

GROUP - B

(Short Answer Type Questions)

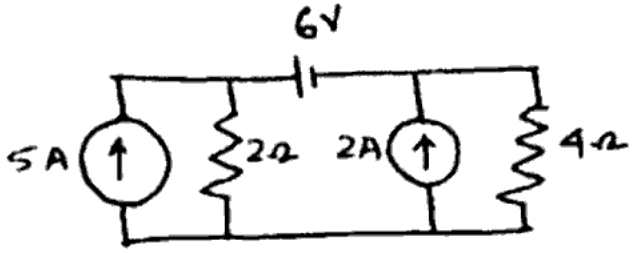
Answer any *two* of the following $2 \times 5 = 10$

2. Deduce an expression of average and RMS value of a half wave rectified voltage wave.

3. a) State and explain Biot-Savart law.

b) Deduce an expression of magnetic field due to an infinite length of wire carrying current J ampere, using Ampere's circuital law. $2 + 3$

4. Determine the current through 4 Ω resistor for the circuit shown below :



5. Two coils *A* of 1000 turns and *B* of 500 turns are mutually coupled with 80% coupling. If a current of 5A in coil *A* produces a flux of 0.25 mWb, find the mutual inductance and co-efficient of coupling between the coils.

GROUP – C

(Long Answer Type Questions)

Answer any *two* of the following. $2 \times 10 = 20$

6. a) Define power factor. Show that the active power of a purely capacitive circuit over a complete cycle is zero.

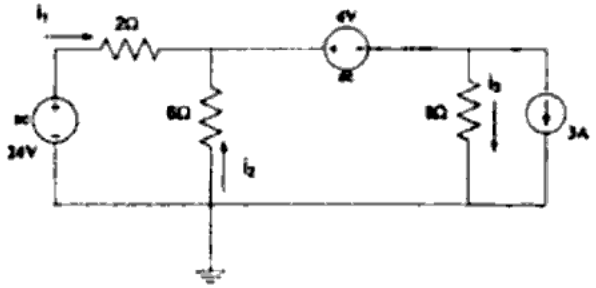
b) A coil of resistance 10 Ω and inductance 0.02 H is connected in series with another coil of resistance 6 Ω & inductance 15 mH across a 230 V, 50 Hz supply.

Calculate i) impedance of the circuit

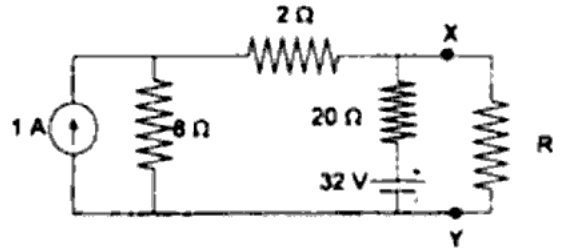
ii) the voltage drop across each coil

iii) the total power consumed by the circuit. $4 + 6$

7. a) For the circuit shown below, determine the currents i_1, i_2, i_3 using nodal analysis : 5 + 5



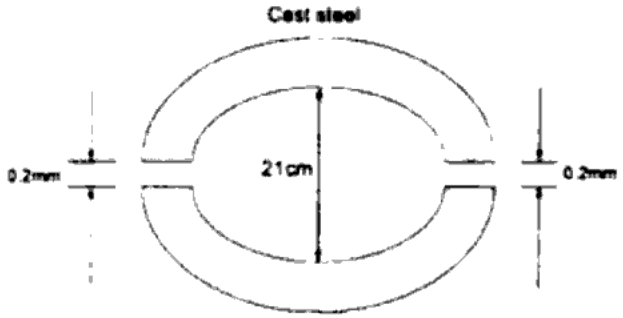
b) Find the Thevenin's equivalent circuit of the following figure between the terminals X-Y.



8. a) What do you mean by the terms 'Hysteresis' and 'Eddy current losses'.

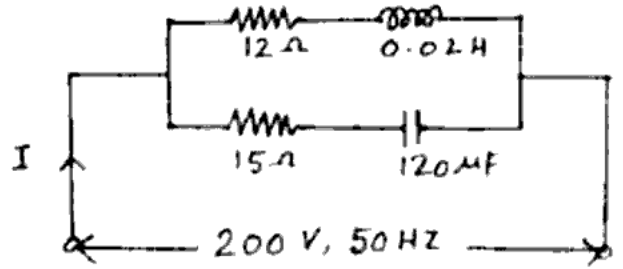
b) A ring having a mean diameter of 21cm and a cross-section of 10cm^2 is made of two semi-circular sections of cast-iron and cast-steel respectively with each joint having reluctance equal to air-gap of 0.2 mm as shown in figure. Determine the ampere-turns required to produce a flux of 0.8 mWb. The relative permeabilities of cast-iron

and cast-steel are 166 and 800 respectively. Neglect fringing and leakage effects.



9. a) What is resonance ? Deduce the expression of frequency in a series RLC cricuit at resonance & its 'Q' factor.

b) Find the net current I of the ac parallel circuit shown in figure below.



5 + 5

PART – II (ELECTRONIC)

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *five* of the following : $5 \times 1 = 5$

i) If the cut-in voltage of Ge *p-n* diode is $V_{\gamma 1}$ and that of a Si *p-n* diode is $V_{\gamma 2}$, then

a) $V_{\gamma 1} = V_{\gamma 2}$ b) $V_{\gamma 1} < V_{\gamma 2}$

c) $V_{\gamma 1} > V_{\gamma 2}$ d) none of these.

ii) The Fermi level of an *n*-type semiconductor lies

a) near the conduction band

b) near the valence band

c) at the middle of the forbidden gap

d) none of these.

iii) If temperature of the collector junction of the transistor increases to 20°C, the corresponding change in reverse saturation current

a) will become double

b) reduce to four times of its initial value

c) no change

d) becomes four times of its initial value.

iv) The temperature coefficient of the Zener breakdown voltage is

a) positive b) negative

c) zero d) none of these.

v) The ripple factor in the case of half-wave rectifier is

a) 0 b) 0.75

c) 1.21 d) 1.5.

vi) Band gap of germanium is

a) 5.89 eV b) 0.92 eV

c) 0.72 eV d) 1.1 eV.

vii) Avalanche breakdown primarily depends on the phenomenon of

a) particle collision

b) impurity doping

c) ionization

d) direct rupture of covalent.

viii) Which one of the following BJT bias configurations is most stable ?

a) Fixed bias

b) Emitter stabilized bias

c) Voltage divider bias

d) Collector feedback bias.

GROUP – B

(Short Answer Type Questions)

Answer any *two* of the following $2 \times 5 = 10$

2. a) Explain Fermi-Dirac function.

   b) "Semiconductor behaves as an insulator at 0 K". Interpret. 3 + 2

3. Construct the energy band diagram of a *p-n* junction diode when (i) unbiased (ii) forward biased (iii) reverse biased.

4. a) Differentiate between avalanche breakdown and Zener breakdown.

   b) Explain why a Zener diode is used as reference diode. 4 + 1

5. Draw and explain the input and output characteristics of a transistor in CE configuration.

GROUP – C

(Long Answer Type Questions)

Answer any *two* of the following. $2 \times 10 = 20$

6. a) Explain the term 'transistor biasing'. What are the factors that effect bias stability of a transistor ?

   b) What is self bias ? Draw the circuit diagram showing the self bias of an *n-p-n* transistor in the CE configuration. 2 + 3 + 2 + 3

7. a) What is Q-point and what is its significance ?

   b) A full-wave rectifier uses a double diode, the forward resistance of each element being 200 ohm. The rectifier supplies current to a load resistance of 1000 ohm. The primary-to-total secondary turns ratio of the centre-tapped transformer is 1:3. The transformer primary is fed from a supply of 240 V(rms). Find (i) the *dc* load current, ii) the direct current in each diode, iii) the *dc* power output iv) the ripple voltage across the load resistance, v) the percentage regulation, vi) the efficiency of the rectification. 5 + 5

8. a) Derive an expression for conductivity of a semiconductor in terms of carrier concentrations.

   b) Pure silicon has an electrical resistivity of 3000 Ω-m. If both electron and hole concentration in the sample is $5 \times 10^{22}\ m^{-3}$ and electron mobility is three times that of hole mobility, evaluate the values of electron & hole mobilities. 5 + 5

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

a) Self-biasing of BJT

b) Zener diode

c) Linear piecewise model of diode

d) BJT as an amplifier.

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