Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH (NEW)/SEM-1/ES-101/2010-11

2010-11

BASIC ELECTRICAL & ELECTRONICS ENGINEERING-I

Time Allotted : 3 Hours *Full Marks* : 70

THIS QUESTION BOOKLET CONSISTS OF 2 PARTS — PART I & PART II.

TO ANSWER THE QUESTIONS USE SEPARATE ANSWER BOOKS FOR SEPARATE PARTS.

DO NOT ANSWER BOTH THE PARTS IN THE SAME ANSWER-BOOK.

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

(Marks : 35)

GROUP – A

(Multiple Choice Type Questions)

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

i) The form factor of a wave is 1. Its shape is

a) sinusoidal b) triangular

c) square d) sawtooth.

ii) The admittance of a parallel circuit is $0{\cdot}5 \angle -30°$. The circuit is

a) inductive b) capacitive

c) resistive d) in resonance.

iii) The force experienced by a small conductor of length L, carrying a current I, placed in a magnetic field $\vec{B}$ at an angle θ with respect to $\vec{B}$ is given by

a) BIL b) $BIL \sin \theta$

c) $BIL \cos \theta$ d) zero.

iv) The mutual inductance between two coupled coils is 10 mH. If turns of one coil are doubled and that in other are halved, the mutual inductance will be

a) 5 mH b) 10 mH

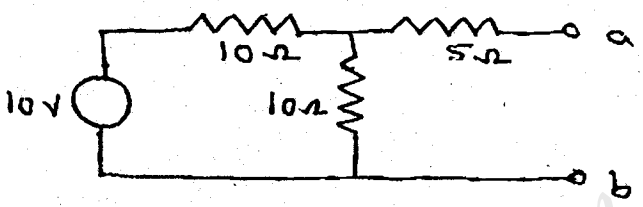
c) 14 mH d) 20 mH.

v) Three resistors of 4 Ω, 6 Ω and 8 Ω are connected in parallel. The maximum power dissipation will occur in

a) 4 Ω b) 6 Ω

c) 8 Ω d) equal in all resistors.

vi) For the circuit shown, the Thevenin's voltage and resistance as seen at *ab* are



a) 5 V, 10 Ω b) 10 V, 10 Ω

c) 5 V, 5 Ω d) 15 V, 15 Ω.

GROUP – B

(Short Answer Type Questions)

Answer any *two* of the following. 2 × 5 = 10

2. State and prove maximum power transfer theorem.

3. Compare electric and magnetic circuits with respect to their similarities and dissimilarities.

4. What is resonance ? Deduce the expression of frequency in a series RLC circuit at resonance.

5. At t = 0, the instantaneous value of a 50 Hz, sinusoidal current is 5 Amp and increases in magnitude further. Its R.M.S. value is 10 Amp.

   a) Write the expression for its instantaneous value

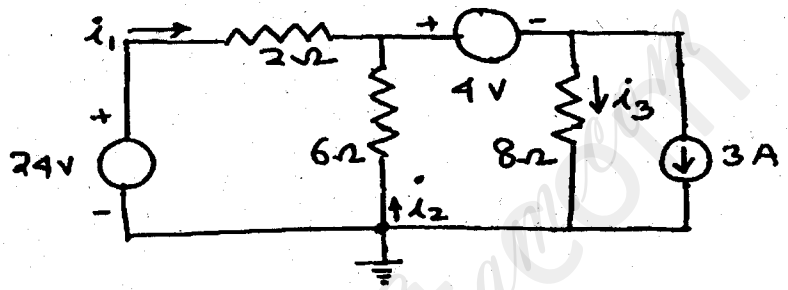
   b) Find the current at t = 0·01 and t = 0·015 sec

   c) Sketch the waveform indicating these values.

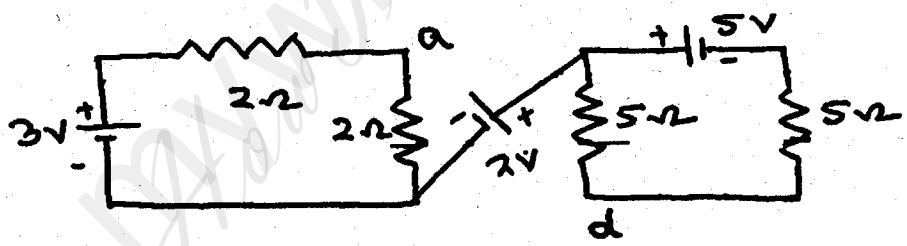
GROUP – C
(Long Answer Type Questions)

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

6. a) For the circuit shown below, determine the current I_1, I_2, I_3 using nodal analysis :



b) For the circuit shown below, find the potential difference between a and d :



6 + 4

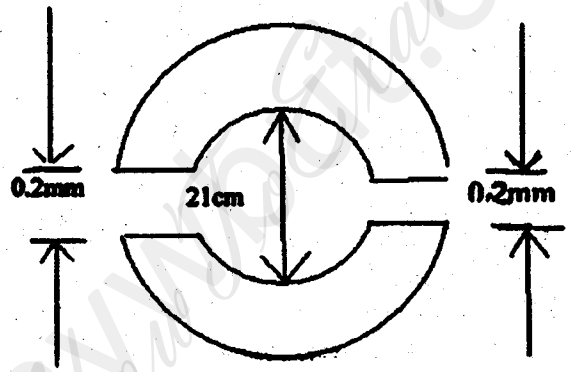
7. a) Explain what are meant by phase and phase difference of sinusoidal waves.

b) A coil of resistance 30 Ω and inductance 320 mH is connected in parallel to a circuit consisting of 75 Ω in series with 150 μF capacitor. The circuit is connected to a 200 volt, 50 Hz supply. Determine supply current and circuit power factor. 2 + 8

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

b) A ring having a mean diameter of 21 cm and a cross-section of 10 cm^2 is made of two semicircular 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. 4 + 6

Cast steel



Cast steel

9. a) Prove that current in purely resistive circuit is in phase with applied A.C. voltage and current in purely capacitive circuit leads applied voltage by 90° and draw their waveforms.

b) A circuit consists of series combination of elements as reistance of 6 Ω, inductance of 0·4 H and a variable capacitor across 100 V, 50 Hz supply. Calculate (i) value of capacitance at resonance, (ii) voltage drop across capacitor and (iii) Q factor of coil. 5 + 5

USE SEPARATE ANSWER-BOOK TO ANSWER PART-II QUESTIONS.

PART – II

(Marks : 35)

GROUP – A
(Multiple Choice Type Questions)

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

i) Barrier potential of Ge diode is

a) 0·3 V b) 0·7 V

c) 0·4 V d) 0 V.

ii) With both junctions reverse biased the transistor operates in

a) active region b) cut-off region

c) saturation region d) inverted region.

iii) If a resistor has the colour code (brown-black-red), the value of the resistor equals

a) 1000 Ω b) 10 kΩ

c) 110 Ω d) 100 Ω.

iv) For full-wave rectifier

a) one centre-tapped transformer is required

b) two centre-tapped transformers are required

c) more than two centre-tapped transformers are required

d) centre-tapped transformer is not required.

v) *X* has high current, voltage, power gain. *X* is

a) CE amplifier b) CB amplifier

c) CC amplifier d) none of these.

vi) α and β of a BJT are related as

a) $\alpha = \frac{(\beta + 1)}{\beta}$ b) $\beta = \frac{\alpha}{(1 - \alpha)}$

c) $\beta = \frac{\alpha}{(1 + \alpha)}$ d) $\alpha = \frac{\beta}{(\beta - 1)}$.

GROUP – B

(Short Answer Type Questions)

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

2. Differentiate between Avalanche and Zener breakdowns.

3. a) Explain with appropriate diagram why a semiconductor acts as an insulator at about 0 K and why its conductivity increases with increasing temperature.

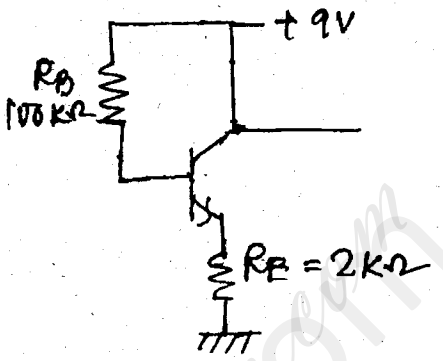
b) If a donor type of impurity is added to the extent of one atom in 10 million Ge atoms, calculate the resistivity and conductivity of the *N*-type material so formed. What is the percentage of increase in the conductivity compared to the intrinsic Ge at 399 K. Given at 300 K, atoms/m^3 of Ge = $4{\cdot}4 \times 10^{28}$, Ni = $2{\cdot}5 \times 10^{19}$, $\mu = 0{\cdot}38\ m^2/V\text{-}s$, $\mu = 0{\cdot}18\ m^2/V\text{-}s$. 2 + 3

4. Compare two types of full-wave recitifier :

a) Centre tapped transformer

b) Bridge type.

5. Find the values of (i) I_B, (ii) I_E, (iii) V_{CE}, (iv) V_E and V_B for the following circuit. Assume $\beta = 49$ and $V_{BE} = 0{\cdot}7$ V.



GROUP – C
(Long Answer Type Questions)

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

6. a) What is thermal runaway ? Can we interchange the emitter and collector of a transistor ? In what region of the characteristic curve does a transistor operate when it is used as a switch. 4 + 3 + 1

   b) What do you mean by load line for a transistor circuit ? 2

7. Define *h*-parameters used in hybrid model of transistor with diagram. Compare the characteristics of CE, CC and CB transistors. 6 + 4

8. a) Explain the principle of *n*-channel depletion MOSFET.

   b) Write a short note on CMOS. 6 + 4

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

   i) Clipper circuit

   ii) Ripple factor

   iii) Varactor diode.