BRAINWARE UNIVERSITY

Course – B. Sc. (CS)

Introduction to Electrical circuits and Basic Electronics I (EC101/BCSG101)

(Semester – 1)

Time allotted: 3 Hours **Full Marks: 70**

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

Group –A

(Multiple Choice Type Questions) 10 x 1 = 10

1. *Choose the correct alternative from the following*

(i) The band gap of semiconductor lies in the range

a. 5 to 10 eV b. 0.2 to 2.5 eV

c. 0.01 to 0.1 eV d. 0.001 to 0.09 eV

(ii) For a coil with N-turns, the self-inductance will be proportional to

a. N b. N^2

c. $1/ N^2$ d. 1/ N

(iii) If Zener breakdown voltage is V_z while avalanche break down voltage is V_a then

a. $V_z > V_a$ b. $V_z < V_a$

c. $V_z = V_a$ d. none of these

(iv) The Norton equivalent source of network at two of its terminals is

a. an independent voltage source b. a dependent voltage source

c. an independent current source d. a dependent current source

(v) The depletion layer width of a p-n diode is about

a. 0.5 cm b. 0.5 mm

c. 0.5 μm d. 0.5 nm

(vi) For a p-n-p transistor in CE mode, β=100, then the value of α of the transistor is

a. 0.99 b. 0.099

c. 9.9 d. 99

(vii) The efficiency in case of maximum power transfer is

a. 100 %
b. 50 %
c. less than 50 %
d. greater than 50 %

(viii) Energy stored in a capacitor is

a. $\frac{1}{2}$ CV
b. $\frac{1}{2}$ QV^2
c. $\frac{1}{2}$ CV^2
d. CV

(ix) The intrinsic carrier concentration of a semiconductor at 0 K is

a. Zero
b. infinity
c. 10^{10} m^{-3}
d. 10^{15} m^{-3}

(x) Which among the following is regarded as 'Dual of Thevenin's Theorem'

a. Norton's Theorem
b. Superposition Theorem
c. Maximum Power Transfer Theorem
d. none of these

Group – B

(Short Answer Type Questions) 3 x 5 = 15

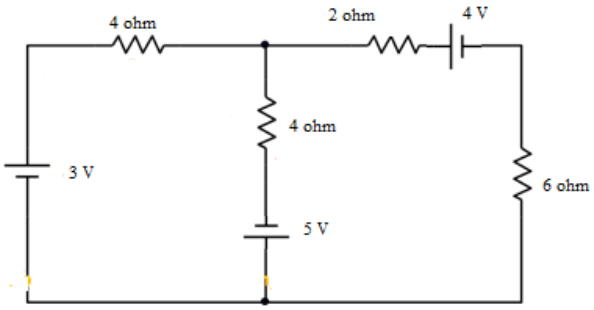
Answer any *three* from the following

2. (a) Draw the circuit diagram of Zener diode as voltage regulator. [2]

(b) For a Zener diode 12 V, 3.6 W which can operate at a minimum diode current of 2 mA, the supply voltage is 15 V. Calculate the value of Zener series resistance which prevents burning of Zener diode. [3]

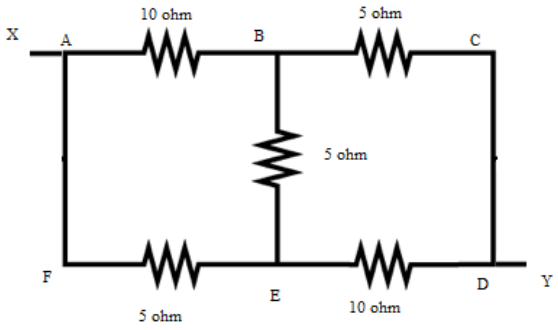
3. Draw the circuit diagram of full wave rectifier using junction diodes. Explain clearly its action. Also explain how the pulsating potential across the load can be smoothed out by the use of L-C filter. [1+2+2]

4. Find current in 6 ohm resistor using Norton's theorem for the network shown in figure. [5]



5. Sketch both input and output characteristics of a p-n-p transistor operating in the common emitter mode. Briefly explain those. [5]

6. Find the equivalent resistance between the points X and Y of the network of resistances. [5]



Group – C

(Long Answer Type Questions) 3 x 15 = 45

Answer any *three* from the following

7. (a) What do you mean by effective mass of a current carrier in a semiconductor? Distinguish between drift current and diffusion current. [2+3]

   (b) Deduce the relation $\sigma = (\mu_p n_p + \mu_e n_e) q$, where notations have their usual meanings. [7]

   (c) Determine the donor concentration in N-type Germanium semiconductor having conductivity $2.016(\Omega m)^{-1}$ and mobility 0.24 m^2/VS. [3]

8. (a) Find out the condition of maximum power transfer to the external resistance (load) of a purely resistive circuit. [5]

   (b) Find phase relation between voltage and current in purely inductive a.c circuit and also present it diagrammatically. [5]

   (c) An a.c voltage 200volt, 50Hz is supplied to an inductive coil. A current of 10A flows in the circuit and the current lags behind the voltage by 30^0. Calculate resistance, reactance and the value of inductance. [5]

9. (a) Draw the circuit diagrams of a forward-biased and reverse-biased junction diode. Write down the current voltage relationship for a p-n junction diode. Draw the corresponding curve. Define the static resistance and the dynamic resistance of p-n junction diode. What is the origin of reverse saturation current in p-n junction diode? [2+2+2+2+2]

(b) The current flowing through a p-n junction silicon diode is 60 mA for a forward bias of 0.9 V at 300 K. Determine the static and dynamic resistance. (Given Boltzmann constant (k)= 1.38 X 10^{-23} J/K). [1+4]

10. (a) Explaining Hall effect, deduce expressions for Hall coefficient for both positive and negative carriers of electricity. State its applications. [9+1]

(b) A rectangular semiconductor specimen 2 mm wide and 1 mm thick gives Hall coefficient 10^{-2} m^3/C. When a current of 1 mA is passed through the sample, a Hall voltage of 1 mV is developed. Find the magnetic field and Hall field. [3+2]

11. (a) Explain the term resonance in electrical circuits subjected to alternating voltage. Find the condition for resonance in case of series L-C-R circuit fed by alternating voltage. In series L-C-R circuit at resonance, potential difference across which of L, C and R equal the applied voltage? Justify. [2+5+2]

(b) An alternating voltage 100 V, 1000 Hz is applied to series combination of a 100 Ω resistor and 10 μF capacitor. Calculate circuit current, potential difference across the capacitor and potential difference across the resistor [6]