EASTERN UNIVERSITY, SRI LANKA

SECOND EXAMINATION IN SCIENCE - 1996/97

(JUNE-AUGUST 2004)

EXTERNAL DEGREE

EXPH202 - ELECTRONICS

Time: 02 hours.

Answer FOUR questions only

1. What do you mean by intrinsic semiconductor. Explain how an intrinsic semiconductor, for example Germanium, may be converted into

   (i) an N-type semiconductor

   (ii) a P-type semiconductor

   Current density of a conductor is given by $J = \rho V$. By using this derive an expression for conductivity of an intrinsic semiconductor. The symbols have their usual meanings.
   Assume that the Avogadro's number is 6.02×10^{23} molecules/mole, Germanium atomic weight is $72.6g$ and the density of Germanium is $5.32gcm^{-3}$.

   (i) Find the concentration of atoms in Germanium.

   (ii) compute the value of conductivity of the intrinsic Germanium at $3000K$ assuming $\mu_n = 1800cm^2V^{-1}sec^{-1}$, $\mu_p = 3800cm^2V^{-1}sec^{-1}$ and $n = 2.53 \times 10^{13}$.

   (iii) Deduce the resistivity of the intrinsic Germanium at $3000K$.

2. Explain the operation of the Zener diode

   A regulated power supply is required for a load drawing a normal current $100mA$ at $15V$. An unregulated supply having open circuit output voltage of $12V$ and output resistant of 20Ω(Allowable power through the Zener diode is $200mW$ and $5V$).

   (i) By suitable assumption, obtain the required value of R_z(Zenor resistance)

   (ii) What is the maximum current can pass through the Zener diode?

   (iii) What are the maximum and minimum current this regulator can safely deliver?

   (iv) What voltage will be measured at the battery terminals when the design current is being drawn?

3. Explain using a circuit diagram the operation of the half-wave rectifier.

   Sketch and label clear diagrams for

   (i) Input wave form.

(ii) Output wave form across the resistance when the capacitor is absence.

(iii) Output wave form across the resistance when the capacitor is present.

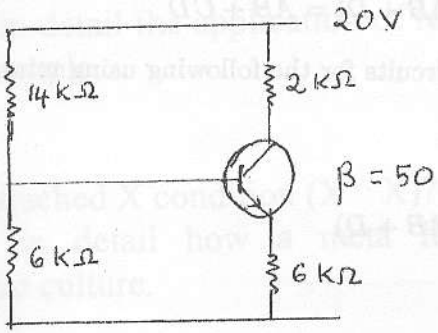
The output of a half wave rectifier is connected to a load resistance of $10K\Omega$ through a capacitor filter of $100\mu F$. The r.m.s value and the frequency of the input voltage to the primary coil of the transformer are $230V$ and $50Hz$ respectively. The turns ratio of the transformer is 2.5 : 1. Calculate

(i) r.m.s ripple voltage

(ii) d.c component of load voltage

(iii) total load power

4. Explain the behaviour of a bipolar junction transistor. Sketch and explain input and output characteristics of the transistor.



For the above *npn* transistor circuit find

(i) collector current

(ii) voltage drop across collector and emitter Neglect the voltage drop across base and emitter.

5. Briefly explain characteristics of an ideal operational amplifier. Find the relationship between input and output voltages of following Operational Amplifier.

(i) Inverting Amplifier

(ii) Integrator

(iii) Differentiator

For an integrator circuit, if the input is *dc* voltage draw the output voltage of the circuit.

6. Draw the symbols and truth table for the following.

(i) AND

(ii) OR

(iii) $NAND$

(iv) NOR

Prove the following Boolean identity.

(i) $A + \bar{A}B = A + B$

(ii) $AC + ABC = AC$

(iii) $(AB + C)(AB + D) = AB + CD$

Draw the logic circuits for the following using minimum gates.

(i) $\bar{A} + B$

(ii) $AB + C$

(iii) $(AB + C)(AB + D)$

(iv) $\bar{A}B + \bar{B}A$