VAVUNIYA CAMPUS OF THE UNIVERSITY OF JAFFNA

First Examination in Information and Communication

Technology - 2015

Second Semester – January / February 2017

ICT 1223 Basic Electronics and Digital Logic Design

Answer Five Questions only

Time: Three hours

Q1. (a) Explain the difference between conductors, insulators and semiconductors on the basis of energy band? (Marks 20)

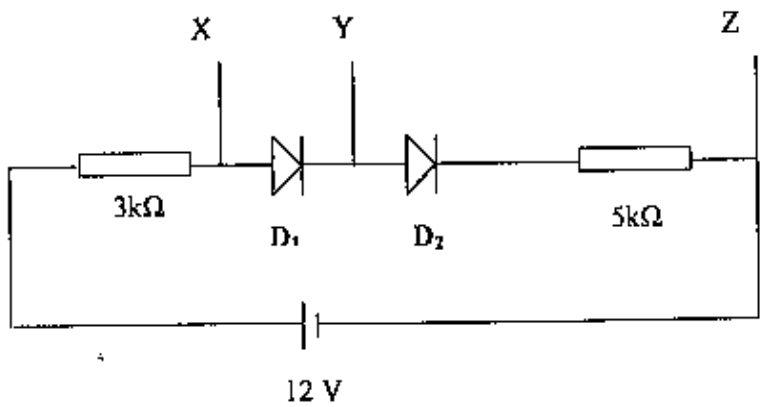
(b) Name three acceptor and three donor materials for doping of a semiconductor. (Marks 20)

(c) Explain the formation of depletion region and barrier potential of a p–n junction. Hence illustrate Charge density, Electric field strength and Potential variation across the junction. (Marks 40)

(d) Calculate the conductivity at 300K for Silicon with 10^{24} m^{-3} phosphorus atoms. Mobility of electrons in silicon at 300K is 0.135 m^2 $V^{-1}s^{-1}$. (Marks 20)

Q2. (a) Explain the forward and reverse bias characteristic of a p-n junction Diode. (Marks 20)

(b) Figure shows a series circuit containing resistors of 3kΩ, 5 kΩ and silicon diodes D_1, D_2. The knee voltage of the silicon diodes is 0.7 V.



Calculate

(i) the current through the circuit.
(ii) the voltage between X and Z
(iii) the voltage between Y and Z

If D_2 is connected in the opposite direction find the followings:

(i) the voltage between X and Z
(ii) the voltage between Y and Z

(Marks 50)

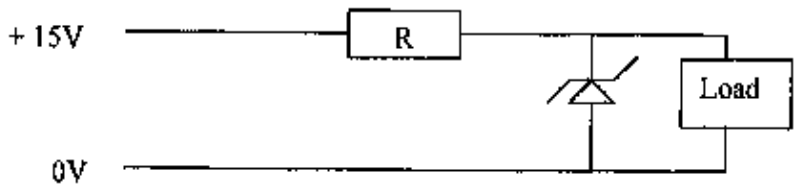
(b) Draw a full – wave bridge rectifier circuit and explain the action of each electronic components briefly. (Marks 30)

Q3. (a) Zener diode is one of the special diode used in the electronic circuits. Explain how they are usually doped and the size of the depletion region. (Marks 20)

(b) Sketch and explain the I – V characteristic of a Zener diode. Hence state the use of Zener diode in power supply unit.

(Marks 30)

(c) Figure shows a regulated voltage supply circuit. It produces a stabilized output of 6 V from a nominal 15 V supply. The current passing through load is 100mA. The minimum diode current needed to function is 10mA.



(i) What voltage rating should be chosen for the diode?

(ii) Calculate the Value of the resistor R.

(iii) If the Load is removed from the circuit, calculate the power dissipated by the Zener diode.

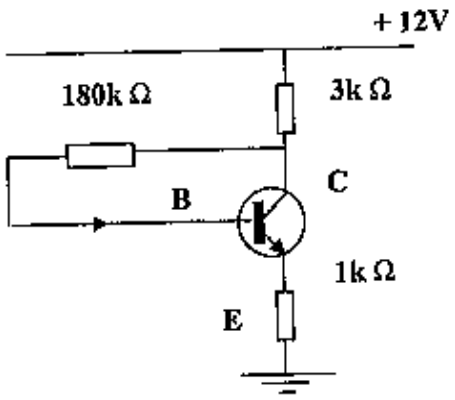
(Marks 50)

Q4. (a) Illustrate and explain the three regions and its partial importance in the output characteristics curve of a common emitter configuration. (Marks 25)

(b) Explain how Transistor can be used as a switch with the help of a circuit diagram. Hence write the advantages of using transistor as switch. (Marks 25)

(d) Compute the collector current, base current, emitter voltage and collector voltage for the following circuit. (V_{BE}=0.7 V and dc currant gain $\beta = 200$)

(Marks 50)



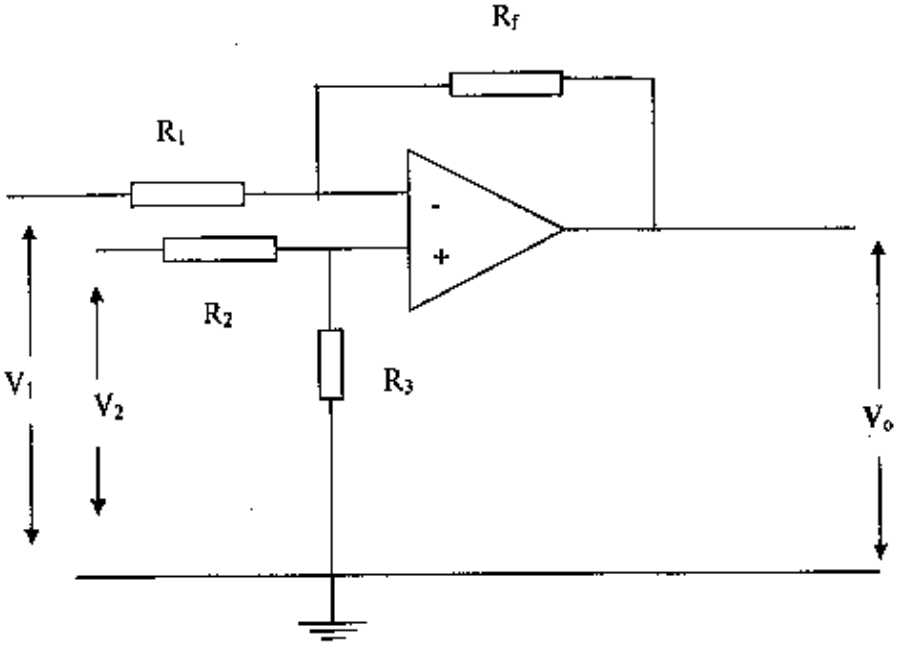
Q5. (a) List the advantages of using integrated circuits (ICs) compared to discrete circuits. (Marks 15)

(b) Show that the "closed loop gain" **A** and "open – loop gain" $\mathbf{A_o}$ of an operational amplifier can be related as $A = \frac{A_o}{1+\beta A_o}$ where β is the feedback factor. (Marks 20)

(c) Write the fundamental properties of operational amplifier. (Marks 15)

(d) Show that the output V_o of the following Differential Amplifier(refer the figure on the next page) is given by

$$V_0 = V_2 \frac{(R_f + R_1)R_3}{(R_3 + R_2)R_1} - V_1 \frac{R_3}{R_1}$$ (Marks 50)



Q6. (a) A logic gate has the following truth table

A	B	Q
0	0	1
0	1	0
1	0	0
1	1	0

(i) Name the type of the logic gate.

(ii) Draw and label the symbol for this logic gate. (Marks 30)

(b) A chemical process gives out a warning signal (W = 1) when the process operates incorrectly. A logic circuit is used to monitor the process and to determine whether W = 1.

Input	Binary Values	Description of plant status
C	1	Chemical rate= 20 litres/ second
	0	Chemical rate < 20 litres/ second
T	1	Temperature = 91°C
	0	Temperature > 91°C
X	1	Concentration > 5M
	0	Concentration = 5M

A warning signal (W = 1) will be generated if: either (a) Chemical rate < 20 litres/second or (b) Temperature > 91°C and Concentration > 5M or (c) Chemical rate = 20 litres/second and Temperature > 91°C . Construct a truth table to show all the possible situations when the warning signal could be received. Draw a logic circuit. (Marks 70)

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