ELECTRONICS- PQs

11. (a) (i) Differentiate the three energy bands in solid crystal. **(3marks)**

(ii) Explain the effect of temperature on conductivity of semiconductor. **(2 marks)**

(iii) Define the term doping and briefly explain the two types of extrinsic semiconductor. **(3marks)**

(b) An intrinsic Germanium has a resistivity of 0.47Ωm at room temperature. Find the intrinsic carrier concentration if the mobility of electrons and holes are 0.39m^2/Vs and 0.19 m^2/Vs respectively. **(2 marks)**

12. (a) (i) Define the term rectification. **(1 mark)**

(ii) Differentiate between photodiode and Light Emitting Diode (LED). **(2 marks)**

(b) The circuit below contains two diodes each with a forward resistance of 50Ω and with infinite reverse resistance. If the battery voltage is 6V, what is the current passing through a100Ω resistor? **(2 marks)**

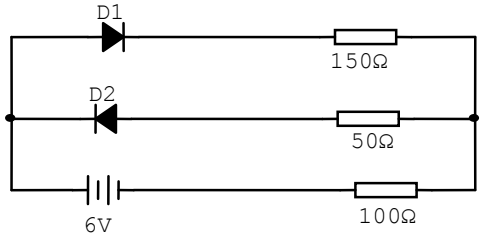

Figure 1

(c) The circuit below shows a CE amplifier circuit. Study it carefully and then answer the questions which follow. Given β =100, V_{BE} = 0.7V and the input resistance of the transistor is 1.6kΩ

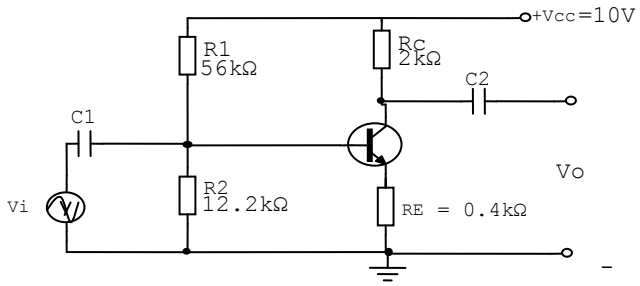

Figure 2

(i) State the functions of capacitors C_1 and C_2. **(1 mark)**

(ii) Calculate the collector current and the collector emitter voltage. **(2 marks)**

(iii) Calculate the power gain of the circuit. **(2 marks)**

13. (a) (i) What is an Opamp? **(1 mark)**

(ii) Differentiate between positive feedback and negative feedback. **(2 marks)**

(iii) Figure below is an Opamp circuit where V_1 and V_2 are input voltages. What values of R_1 and R_2 would give an output voltage; $V_o = -(4V_1 + 0.5V_2)$?

(2 marks)

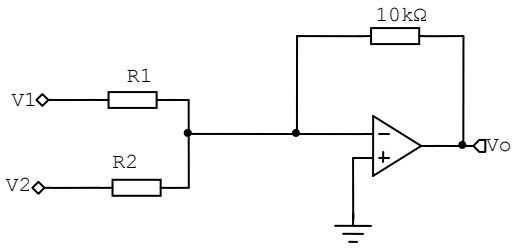

Figure 3

11. (a) (i) Define semiconductor **(1mark)**

(ii) Explain two way of increasing conductivity of intrinsic semiconductor.

(2 marks)

(b) Define the following terms as used in Op Amp

(i) Closed loop gain **(1mark)**

(ii) Negative feedback **(1mark)**

(c) The diagram below (figure 2) shows a differential op-amp circuit

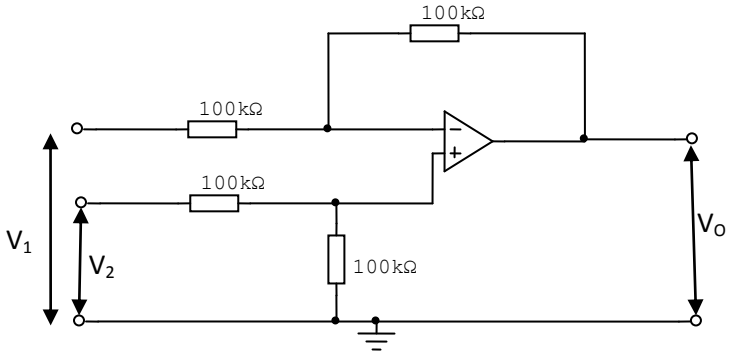

Figure 2

(i) Write down the relation between output voltage V_o and input voltages V_1 and V_2 as applicable. **(3marks)**

(ii) What will be the output voltage V_o when $V_1 = 0.5V$ and $V_2 = 2.0V$

(2marks)

12. (a) With the aid of the basic system(diagram) explain how a radio receiver works when the amplitude modulated (AM) wave arrives at the aerial . **(4 marks)**

(b) Why is it desirable to amplify the R.F signal before demodulation? **(1 mark)**

(c) Speech signals in the signal frequency range 300Hz to 3400Hz are used to amplitude –modulate a wave carrier wave of frequency 200kHz. Determine

(i) The band width of the resultant modulated signals **(1 marks)**

(ii) The frequency range of the lower side band **(2 marks)**

(iii) The frequency range of the upper side band **(2 marks)**

13. (a) (i) Define a term Logic gate ? **(1 mark)**

(ii) From the logic circuit below, draw the truth table and hence state a single gate which can perform equivalently as this circuit. **(3 marks)**

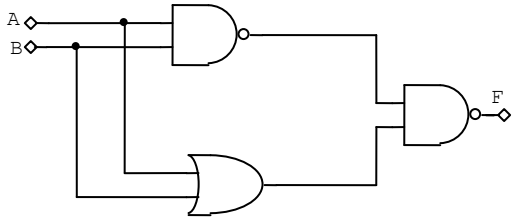

Figure 3

(b) A simple logic circuit is required to operate the alarm when it is dark and the door is opened. Given that when the door is opened (high) and when closed (low) ,when it is dark (high) and viseversa.The output is low(no sound) and high (the alarm does sound)

(i) Draw its truth table **(3 marks)**

(ii) Design a circuit that will give the truth table shown above.**(2 marks)**

(b) (i) Explain the term "thermal run away" as regards a transistor amplifier. [03 Marks]

(ii) With the help of clear diagrams, explain how you would overcome thermal run away in a voltage amplifier. [05 Marks]

(c) Figure (1) shows a junction transistor voltage amplifier circuit. If $R_1 = 100k\Omega$, $R_2 = 1k\Omega$, $V_{cc}=6.0V$, $V_{BE} = 0.6$ and $h_{FE} = 60$; calculate:

(i) The voltage across R_1 [02 Marks]

(ii) The value of I_B [01 Mark]

(iii) The value of I_c [01 Mark]

(iv) The voltage across R_2 [02 Marks]

(v) The collector - emitter voltage [02 Marks]

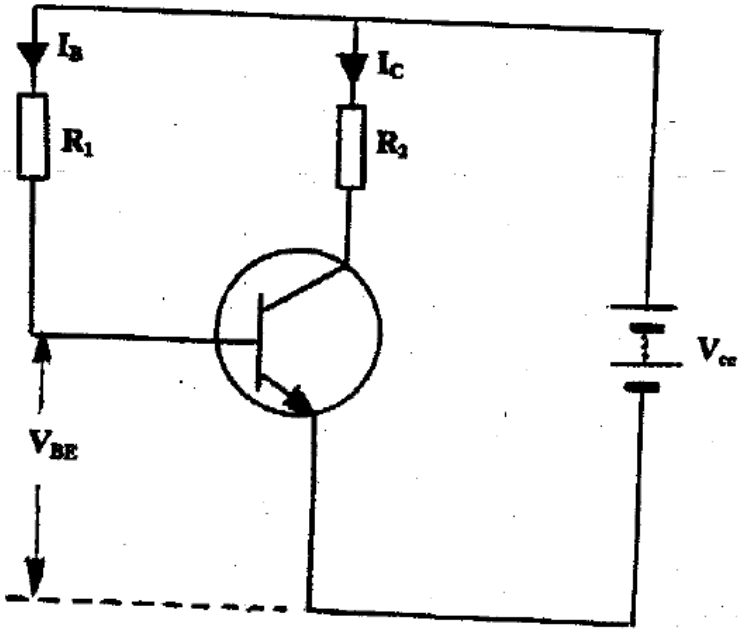

Figure 1

11. (a) Distinguish between metals and semiconductors in terms of energy bands. (3 marks)

(b) Briefly discuss the formation of the potential difference barrier (depletion layer) of a p-n junction diode. (2 marks)

(c) (i) What is a rectifier? (2 marks)

(ii) Using p-n junction diodes, draw the arrangement of a full-wave rectifier and briefly explain how it works. (3 marks)

8. (a) Mention any three uses of a transistor (1½ mark)

(b) A certain transistor has a current gain $\beta = 55$. If it is used in a circuit with common-base configuration, how much change occurs in the collector current if an emitter current is changed by 100μ A? (Assume the collector potential to be constant and neglect the small collector – current due to the minority current carriers). (4 marks)

(c) (i) What is an operational amplifier (2 marks)

(ii) List three desirable features of an operational amplifier. (2 marks)

(i) In almost all cases, where an operation amplifier is used as a linear voltage amplifier, negative feedback is employed. State the advantage of negative feedback. (3 marks)

(d) Figure 1 shows a circuit which incorporates an operational amplifier (2 marks)

(i) Explain why port P is regarded as being at earth potential. (4 marks)

(ii) Show that the ratio of output voltage, V_o, to input voltage, V_i, is given by

$$\frac{V_o}{V_i} = -\frac{R_1}{R_2}$$ (4 marks)

(iii) Explain the significance of the negative sign in the expression (d) (ii) above. (½ mark)

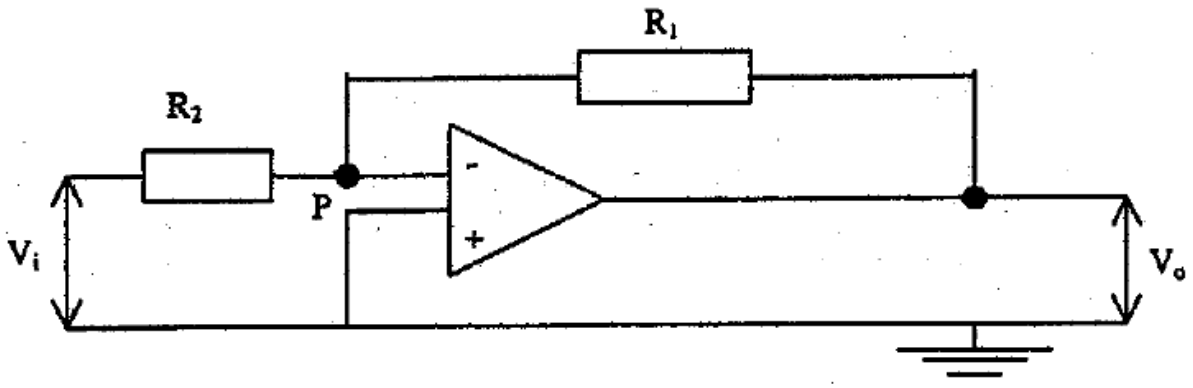

Figure 1.

(a) What do you understand by the following

(i) Semiconductor **(1mark)**
(ii) Diode **(1mark)**
(iii) Transistor **(1mark)**
(iv) Depletion layer **(1mark)**

(b) (i) Explain why the base layer of transistor is made thinner than that of collector and emitter? **(2 marks)**

(ii) Compute the base current I_B and the potential difference between the collector and the emitter V_{CE}, given that R = 150kΩ, R_L = 750Ω and a current gain of 80. Assuming the potential difference between B and E is negligible. **(4 marks)**

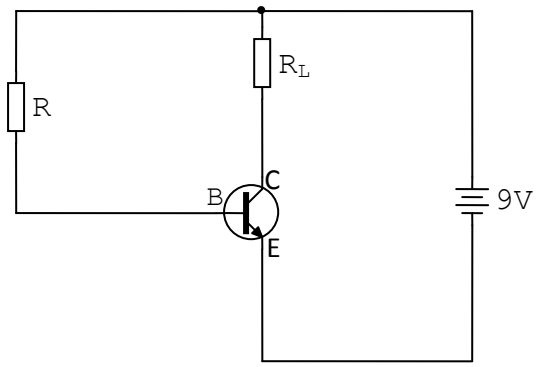

Figure 4

11. (a) Distinguish between metals and semiconductors in terms of energy bands. (3 marks)

(b) Briefly discuss the formation of the potential difference barrier (depletion layer) of a p-n junction diode. (2 marks)

(c) (i) What is a rectifier? (2 marks)

(ii) Using p-n junction diodes, draw the arrangement of a full-wave rectifier and briefly explain how it works. (3 marks)