53 (EC 201) BSEL

2017

BASIC ELECTRONICS

Paper : EC 201

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions out of **seven**.*

1. *(a)* Differentiate between intrinsic and extrinsic semiconductors. Give *two* examples of each. 4

   (b) Derive the expression for conductivity of a semiconductor. 6

(b) Draw the block diagram of a Cathode Ray Oscilloscope (CRO) and discuss the function of its various parts. 8

(c) Differentiate between the operation of LCD and LED displays. 4

(c) If $n(x)$ is the concentration profile of electrons in the x-direction of a semiconductor material, evaluate the expression for electron diffusion current density in the $+x$ direction. Assume $\bar{l}_e$ and $\bar{t}_e$ as the mean free path and mean free time of electrons between collision, respectively. 6

(d) Discuss how the current across a *p-n* junction under open circuit condition remains zero although there exists an electric field at the junction. 4

2. (a) Derive the expression for minority carrier concentration profile when a *p-n* diode is forward biased. Plot the concentration profile as a function of distance from the depletion region. Calculate the forward bias current in terms of the applied voltage. 4+2+4=10

(b) Explain the operation of Zener diode in the breakdown region of operation with the help of energy band diagram. 4

(c) Explain the steps required in converting an AC voltage waveform to a DC waveform with the help of block diagram and necessary waveforms at the output of each stage. Discuss how ripple factor changes from stage to stage. 6

3. (a) Draw the output waveforms for the following diode circuits and identify its function. 4×2·5=10

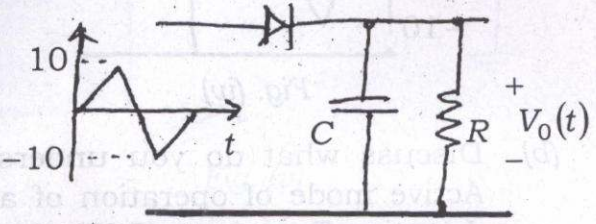

Fig. (i)

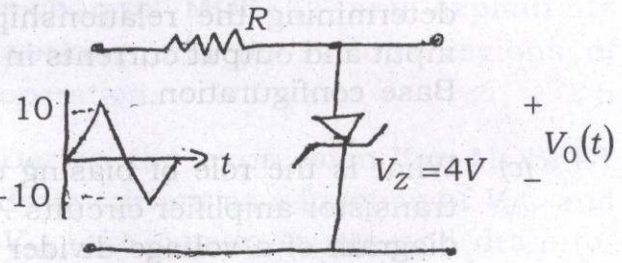

Fig. (ii)

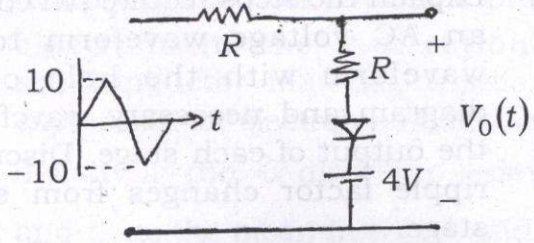

Fig. (iii)

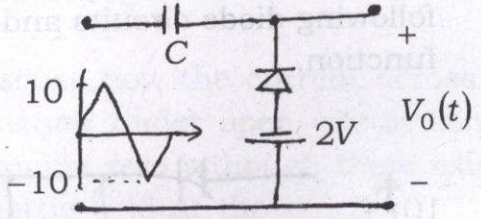

Fig. (iv)

(b) Discuss what do you understand by Active mode of operation of a Bipolar Junction Transistor (BJT). Explain the significance of emitter injection ratio and base transport factor in determining the relationship between input and output currents in Common-Base configuration. 2+4=6

(c) What is the role of biasing circuits in transistor amplifier circuits ? Draw the diagram of a voltage divider (self-bias) circuit and comment on its merits. 2+2=4

4. *(a)* In the circuit shown below *Fig. (v)*, a digital input with two levels, *0V* and *5V*, is given. Determine the operating point and mark it on the BJT output characteristics along with the load line. 5

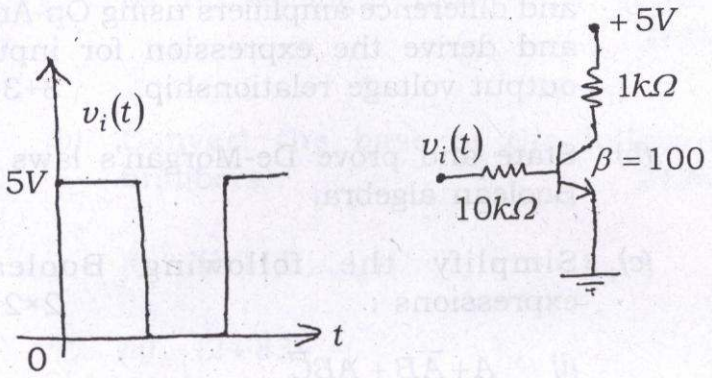

Fig. (v)

(b) Draw the schematic diagram of an *n*-channel MOSFET and explain its working and its various regions of operation. 5

(c) Derive the expression for MOSFET drain current as a function of V_{GS} and V_{DS}, the gate-to-source and drain-to-source potentials, respectively. Assume linear voltage drop along the channel. 6

(d) What do you understand by the transfer characteristics of an n-channel JFET ? Derive the expression for trans-conductance of a JFET from its current voltage relationship. 4

5. (a) Draw the circuit diagrams of summing and difference amplifiers using Op-Amp and derive the expression for input-output voltage relationship. 3+3=6

(b) State and prove De-Morgan's laws in Boolean algebra. 5

(c) Simplify the following Boolean expressions : 2×2=4

(i) $A+\overline{A}B+AB\overline{C}$

(ii) $\overline{A}\overline{B}C+AC+ABC+AB$

(d) Design a digital circuit which can Add $(M=0)$ *if* or Substract $(M=1)$ *if* two 4-bit numbers in 2's complement representation. Here M is the mode-selection input to decide between Add and Subtract operation. 5

6. *(a)* Draw the 2-input NAND gate based circuit diagram of an SR flip-flop and explain how it can be used to store one bit of information. Discuss how one can improve the performance of S-R flip-flop by introducing 3-input NAND gates. 3+3=6

(b) Convert the base of the following numbers : 2+2=4

(i) $(1.111.....)_2=(\quad)_{10}$

(ii) $(24{\cdot}83)_{10}=(\quad)_{16}$

(c) Draw a schematic diagram of a PMMC and discuss how it can be used to measure voltages and currents of various ranges using additional circuitry that contains a range selection switch. 10

7. *(a)* Discuss the operation of any digital voltmeter with necessary block diagram and waveforms. 8