53 (EC 201) BSEL

2017

BASIC ELECTRONICS

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)* Draw the energy band diagram semiconductors. Discuss what happens if we introduce impurities to obtain *n*-type and *p*-type semiconductors. 6

   (b) State and prove the law of mass action for *n*-type and *p*-type semiconductors. 4

   (c) With necessary mathematical steps, derive the expressions for electron drift and diffusion current densities in a semiconductor. 6

(d) Show that the change in minority carrier concentration near to the depletion region depend on the magnitude of applied potential across the *p-n* junction. 4

2. (a) Draw the energy band diagram of tunnel and avalanche diodes and explain the differences in their breakdown mechanism. 6

(b) Find the output waveform of the circuit shown in *Fig.* 1. 4

Here D_1 is a zener diode and D_2 is an ideal diode

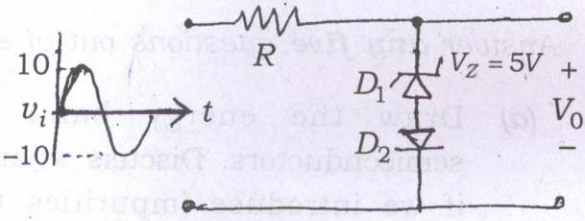

Fig. 1

(c) Evaluate the output waveform of the circuit shown in *Fig.* 2. 4

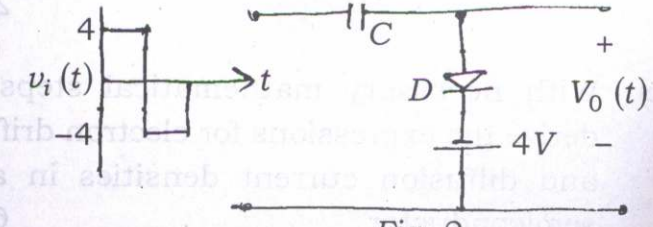

Fig. 2

(d) Derive the expressions for rectification efficiency, η and ripple factor, γ at the output of a full wave rectifier. 6

3. (a) Explain why, when a BJT is biased in active mode, the collector current depends on the emitter current and not on the base-collector reverse bias voltage ? 5

(b) Draw the self-bias (voltage divider) circuit for BJT and explain the procedure to determine the operating point (Q-point) of the transistor. 5

(c) Draw the schematic diagram of an *n*-channel JFET and distinguish its working in ohmic and saturation region of operation. 5

(d) Derive the expression for drain current, I_D in an n-channel MOSFET when $V_{DS} << V_{GS} - V_T$. Here V_T is the threshold voltage. 5

4. (a) Draw the circuit diagram of a Wein-bridge oscillator and find out the condition under which it will give sustained oscillatory output. 10

(b) Discuss the desirable characteristics of any good voltage amplifier. 4

(c) For the circuit shown in *Fig.* 3, evaluate the expression for the output voltage, V_0. 6

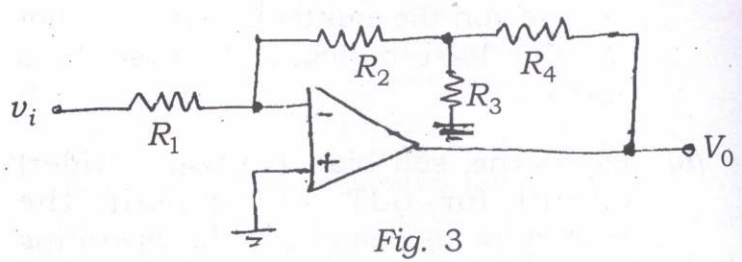

Fig. 3

5. (a) Evaluate the following :

(i) $(323)_8 + (425)_8 = (\quad)_8$

(ii) $(43)_{10} = (\quad)_{16}$

(iii) $(0{\cdot}25)_{10} = (\quad)_2$

(iv) $(1217)_8 = (\quad)_{16}$ 4

(b) Simplify the Boolean function

$F(w, x, y, z) = \Sigma(0, 1, 2, 4, 5, 6, 8, 9, 12, 13, 14)$ 4

(c) Implement the Boolean function, $F = AB + CD + E$ using NAND gates alone. 2

(d) Design a 4-bit adder-subtractor circuit and explain its working. 5

(e) Implement the Boolean function, $F(A, B C) = \sum (1, 3, 5, 6)$ using a multiplexer. 5

6. (a) What are sequential circuits ? Explain the working of a clocked master-slave JK flip-flop with the help of a neat circuit diagram. 8

(b) Explain the working of a permanent magnet moving coil (PMMC) meter. Explain how one can design a PMMC based voltmeter, given its internal resistance $R_m = 100\Omega$ and full-scale deflection current $I_f = 100\mu A$, to measure voltages in three different ranges, *viz* $0-1V$, $0-10V$ and $0-100V$. 12

7. (a) Draw a neat diagram of Cathode Ray Tube (CRT) and explain its working. 8

(b) Draw the circuit diagram for generating the sweep waveform (Saw-tooth waveform) of different slope for the input of *X*-deflection plates of the CRO. Explain its working. 6

(c) With a neat schematic diagrama explain the working principle of LCD display. 6
