Roll No. 2022 UG 3008

Indian Institute of Information Technology Ranchi

Department of Electronics & Communication Engineering
B. Tech Mid Semester Examination – Autumn Semester 2022-23

Semester: First

Course Code: EC-1001

Course Instructor: Prof. S. K. Mandal, Dr. Rashmi Panda

Course Name: Electronics Devices and Circuits

QUESTION PAPER

Duration: 2 hrs.

Instructions: Max Marks: 60
(1). Number in [ ] indicates marks.
(2). Any missing data can be assumed suitably.
(3). Symbols have their usual meaning.

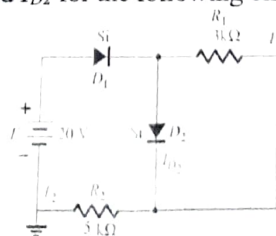## Section A
(Answer All)

1.   (a)   Write short notes on varactor diode.   [2]

(b)   How Zener diode acts as a voltage regulator?   [2]

(c)   For the circuit shown below, V_z for Zener diode is 50V, find (i) the output voltage across   [2]
10kΩ resistance (ii) the voltage drop across 5kΩ resistance (iii) the current through zener
diode.
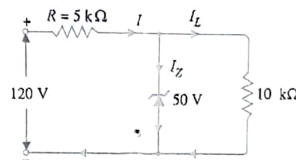
(d)   Define Fermi energy level in semiconductors and how does it vary with temperature?   [2]

(e)   Discuss the crystal structure of P-type semiconductor.   [2]

(f)   An N-type silicon bar 0.1 cm long and 100 μm² in cross-sectional area has a majority carrier   [2]
concentration of 5×10^{20}/m³ and the carrier mobility is 0.13 m²/V·s at 300K. If the charge
of an electron is 1.6×10^{-19} C, then calculate the resistivity of the bar.

(g)   A sample of germanium is doped with both donor and acceptor impurities with donor   [2]
concentration of 10^{14} donor atoms/cm3 and acceptor concentration of 10^{15} acceptor
atoms/cm3. Calculate the resistivity of the semiconductor material.
(given that the mobility of holes and electrons in germanium is 1800 cm²/V·s and 3800
cm²/V·s, respectively)

(h)   How does the addition of impurities affect the energy bands in a semiconductor?   [2]

(i)   Determine the currents I_1, I_2, and I_{D2} for the following circuit having Silicon diodes   [2]

(j)   Implement a logic OR gate using diodes (here, 10 Volts can be considered as logic 1 and 0   [2]
volt as logic 0).

Section B

2. (a) What is a clipper circuit? differentiate between series and parallel clipper. Draw the output [1..] waveform for the following clipper circuit with appropriate explanations. (Practical diodes are used in the circuit, $V_1 = V_2 = 5$ V and $V_m = 20$ V)

(b) What is a clamper circuit?

[10]

Draw the output waveform for the following clamper circuit where Silicon diode is used with appropriate explanations.
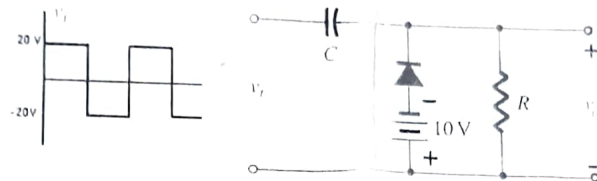
3. Explain the operation of bridge full wave rectifier. Derive the expression for DC and RMS value [20] of the rectified output. Find out the maximum efficiency and PIV rating of the same.

4. Write Short notes on the followings

[5x4]

    (a) Photodiode

    (b) Diffusion and Drift current

    (c) Avalanche and Zener breakdown

    (d) Diode capacitances

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