M. Sc. (Sem. I) (CBCS) Examination

August - 2022
Physics : CT-02
(Solid State Electronic Devices & Circuits)
(New Course)

Time : $2\frac{1}{2}$ Hours]   [Total Marks : **70**

Instructions : (1) All questions carry equal marks.

(2) Attempt any five questions out of 10 questions.

1   Answer the following :   **14**

(a) Calculate transconductance (g_m) of JFET having the parameters :
IDSS = 16 mA, Vp = –4V for drain current ID = 4 mA

(b) Differentiate : Avalanche and Zener breakdown mechanisms.

(c) Implement two input OR gate by using all NAND gates.

(d) Distinguish between direct and indirect band gap materials.

(e) Define fan out for Transistor transistor logic (TTL).

(f) Calculate wavelength (λg) of light emission for GaAs having band gap energy E_g = 1.44 eV.

(g) Prove that product of all the maxterms of a Boolean function of N-variable is 0.

2   Answer the following :   **14**

(a) What is the relation between photometric unit lumen and radiometric unit watt ?

(b) What is the operational principle of Solar cell ?

(c) Obtain complement of the following Boolean function :

$F\left(x, y, z\right) = x \cdot \left(y' \cdot z' + y \cdot z\right)$

(d) Draw JFET transfer characteristic : drain current versus gate to source voltage and define Pinch-off voltage.

(e) What is the key difference in the physics of light emitting diode and semiconductor laser ?

(f) What is the advantage of MOS logic over other logic families?

(g) Write Boolean expression for two input exclusive OR gate.

3 (a) Compare : BJT and JFET. Describe the construction of N-channel JFET and explain its drain-source characteristics.   7

(b) Discuss various biasing methods for JFET.   7

4 (a) Draw the circuit of 2-input NAND gate using transistor-transistor (TTL) logic and explain its operation. Explain current sinking and current sourcing in TTL.   7

(b) Write a detailed note on MOS logic family.   7

5 (a) A logic circuit having three inputs should produce high output for its input binary numbers : 011, 101, 110 and 111. Design the logic circuit using K-Map and draw the circuit using gates.   7

(b) Simplify the following Boolean function using Karnaugh Map method :   7

$F(w, x, y, z) = \sum (2, 6, 14, 10)$ and don't cares are :

$d(w, x, y, z) = \sum (0, 4, 9)$.

6 (a) Draw basic structure and symbol of Silicon Controlled Rectifier. Explain the current voltage characteristics of SCR and derive anode current expression for forward blocking state.   7

(b) Write a note on characteristic and application of TRIAC.   7

7 (a) Discuss in detail the physics of photoconductive   7
        detectors hence derive expression for photoconductive
        gain. What are the photoconductive materials?

   (b) Write detailed note on photo diode and PIN photo   7
        diode.

8 (a) What is a thermistor ? Discuss its characteristic   7
        and application

   (b) Discuss briefly V-I characteristic of zener diode.   7
        Draw the circuit of Zener diode voltage regulator and
        explain its operation.

9 (a) Explain working of UJT relaxation oscillator with   7
        neat diagrams and derive formula for output frequency.

   (b) Write a note on transmissive field effect and reflective   7
        type liquid crystal displays.

10 (a) Explain the physics of light emission in LED. Explain   7
        in detail radiative recombination processes. Give a brief
        note on LED structure and LED materials.

   (b) Write a detailed note on semiconductor laser.   7

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