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

November/December – 2017

CT-02 : Solid State Electronic Devices & Circuits

(New Course)

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

Instructions : (1)　All questions are compulsory.

(2)　Figures on the right hand side indicate marks.

1　Answer the following : (any seven)　　　　　　　　　　**14**

(a)　Draw transfer characteristic of JFET. Define : Transconductance.

(b)　Show that dual and complement of Boolean expression of 2-input exclusive OR gate are same.

(c)　Which one is the fastest logic family ?

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

(e)　Calculate transconductance $\left(g_m\right)$ of JFET having the parameters : $I_{DSS} = 16\,mA$, $V_p = -4V$ for drain current $I_D = 1\,mA$.

(f)　Calcualte wavelength $\left(\lambda_g\right)$ of light emission for GaP having band gap energy $E_g = 2.26\,eV$.

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

(h)　How many Lumens make one watt of radiant energy ?

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

(j)　Simplify the following Boolean function :

$F = \left(A + B\right)' \cdot \left(A' + B'\right)$.

2   Answer the following : (any two)   **14**

   (1)   Comapre : BJT and JFET. Describe the construction of N-channel JFET and explain its drain-source characteristics.

   (2)   Discuss various DC biasing methods for JFET with neat diagrams. What is the advantage of self biasing over fixed biasing ?

   (e)   Write a detailed note on various types of MOSFETs.

3   Answer the following :   **14**

   (a)   Draw the circuit of 2-input NAND gate using transistor-transistor logic and explain its operation in detail.

   (b)   Prepare truth table for the Boolean function :

   $F = A + B' \cdot C \cdot$

<div align="center">

OR

</div>

3   Answer the following :   **14**

   (a)   A logic circuit having three inputs should produce high output when its input binary number has majority of bits high. Design the logic circuit using K-Map and draw the circuit using AND-OR implementation.

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

   $$F\left(w, x, y, z\right) = \sum \left(3, 6, 7, 11, 14, 15\right).$$

   And don't cares are : $d\left(w, x, y, z\right) = \sum \left(0, 2, 10\right).$

4   Answer the following : (any two)   **14**

   (a)   What are thyristors ? Enumerate various types of thyristors. 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.

   (b)   What is meant by direct band gap and indirect band gap semiconductors ? Explain the physics of light emission in LED. Give a brief note on LED materials.

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

5 Write short notes on any two :   **14**

    (a) Solar cell : Principle, structure and characteristics

    (b) Thermistors and applications

    (c) Zener diode voltage regulator

    (d) Uni-junction transistor and UJT relaxation oscillator.

————