M.Sc. 1st Semester Examination, 2024

ELECTRONICS

PAPER – ELC-102(U1 & U2)

Full Marks : 50

Time : 2 hours

Answer **all** questions

The figures in the right hand margin indicate marks

Candidates are required to give their answers in their own words as far as practicable

UNIT – I

(*Electronic Materials*)

GROUP – A

Answer any **two** questions : 2×2

1. Mention different types of interatomic bonds.

2. Define electron mobility and electrical conductivity. 1 + 1

3. What is a dielectric loss ?

4. What do you understand by quantum wire and quantum dot ? 1 + 1

GROUP – B

Answer any **two** questions : 4 × 2

5. What is mean by crystal imperfections ? Classify them in the order of their geometry. 1 + 3

6. Find an expression of electronic polarization of a gas atom of radius R. Does the electronic polarization vary with temperature ?-Explain. 3 + 1

7. Explain the phenomena electronic inter-band and intra-band transitions. 2 + 2

8. What is spontaneous magnetization in a ferromagnetic substance ? Obtain a relation

to show the temperature dependence of the spontaneous magnetization. 1 + 3

GROUP – C

Answer any **one** question : 8×1

9. Define Fermi energy. Obtain a general expression for the Fermi energy of electrons in solids at OK. Show that at the same temperature, the average energy of the electron is $(3/5)^{th}$ of the Fermi energy. $1+4\frac{1}{2}+2\frac{1}{2}$

10. Distinguish between type-I and type-II superconductors. Explain dc Josephson effect and ac Josephson effect. For lead, the critical field at OK is 6.39×10^4 A/m and the critical temperature for zero magnetic field is 7.18K. Find the critical field for lead at 4K. 2 + 2 + 2 + 2

[Internal Assessment – 5 Marks]

UNIT – II

(*Electronic Devices*)

GROUP – A

Answer any **two** questions : 2×2

11. Prove that under thermal equilibrium and no applied bias the Fermi level must be constant through out the P-N junction.

12. How can you determine the electron concentration of a metal-N type semiconductor junction using the data of C-V measurement.

13. What is the benefit of activation energy method over current-voltage measurement method to determine the barrier height of a metal-semiconductor junction ?

14. What do you mean by Normally 'ON' and Normally 'OFF' MESFET ? $1 + 1$

GROUP – B

Answer any **two** questions : 4×2

15. For a two sided abrupt P-N junction, derive the expression of depletion layer width. 4

16. Discuss various breakdown mechanisms present in a P-N junction diode. 4

17. With neat sketch discuss the operating principle of a photo diode ? Explain how its performance can be improved in P-I-N photo diode ? $3 + 1$

18. For a metal-semiconductor contact prove that $q\,\phi_{Bn} + q\,\phi_{Bp} = E_g$. 4

GROUP – C

Answer any **one** question : 8×1

19. Draw the Ebers-Moll model of a transistor

and calculate I_E, I_C and I_B. How do you differentiate depletion capacitance and diffusion capacitance in a P-N junction diode ? 6 + 2

20. For a metal semiconductor junction, having an uniform channel doping, prove that the drain conductance in linear region is equal with the transconductance in the saturation region. 8

[Internal Assessment — 5 Marks]
