WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 2nd Semester Examination, 2022

ELSACOR04T-Electronics (CC4)

Time Allotted: 2 Hours   Full Marks: 40

The figures in the margin indicate full marks.
Candidates should answer in their own words and adhere to the word limit as practicable.
All symbols are of usual significance.

GROUP-A

Answer any *five* questions from the following   2×5 = 10

1. Explain why Compton effect is considered as an example of quantum nature of radiation.

2. What is orthonormal wave function?

3. Prove that the eigenvalues of a Hermitian operator are real.

4. What is de Broglie hypothesis?

5. What is Bose condensation?

6. Obtain relation between pressure and volume of ideal fermion at $T = 0$ K.

7. Define microcanonical and canonical ensemble.

8. How does magnetic materials are classified based on magnetic moment?

GROUP-B

Answer any *six* questions from the following   5×6 = 30

9. (a) Show that $[\hat{L}_+, \hat{L}_-] = 2\hbar\hat{L}_z$. $2\frac{1}{2}$

   (b) Evaluate: $[\hat{L}_z, \hat{L}_x]$ $2\frac{1}{2}$

10. (a) What are the observations of Einstein's photoelectric effect? $1\frac{1}{2}$

    (b) Why classical theory fails to explain these observations? $1\frac{1}{2}$

    (c) How did Einstein explain the observations of photoelectric effect?   2

11. A particle of charge Q and mass m is accelerated to a non-relativistic velocity through a potential V. Considering the mass initially at rest, calculate the de Broglie's wavelength.   5

12.(a) What are the basic postulates of quantum mechanics? 2

(b) The wavefunction of a particle moving along x-axis is given by 3

$$\psi(x) = Ax \text{ for } 0 < x < L$$

Show that the expectation value in position x is $\langle x \rangle = \dfrac{A^2 L^4}{4}$.

13. Starting from basic assumptions, derive Fermi-Dirac distribution function. 5

14. Assume that the Tungsten (At. Wt. = 183.8, Density = 19.3 gm/cc), there are two free electrons per atom. Calculate Fermi energy and electron density. 5

15.(a) Deduce Planck's radiation law from the concept of BE distribution function. 3

(b) Hence derive Wien's law and Rayleigh Jeans law. 2

16. Prove that for a perfect gas, $C_P - C_V = R$ (symbols carrying usual meaning). 5

17. M gm of water at temperature T_1 is isobarically and adiabatically mixed with an equal mass of water of at T_2. Show that the entropy change of the universe is 5

$$2MC_P \ln \frac{(T_1 + T_2)/2}{\sqrt{T_1 T_2}}.$$

18.(a) What do you mean by permeability and susceptibility of a magnetic substance? 2

(b) Distinguish among dia, para and ferromagnetic substances. 3

N.B. : *Students have to complete submission of their Answer Scripts through E-mail / Whatsapp to their own respective colleges on the same day / date of examination within* 1 *hour after end of exam. University / College authorities will not be held responsible for wrong submission (at in proper address). Students are strongly advised not to submit multiple copies of the same answer script.*

——×——

WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 2nd Semester Examination, 2022

ELSACOR03T- ELECTRONICS (CC3)

Time Allotted: 2 Hours   Full Marks: 40

The figures in the margin indicate full marks.
Candidates should answer in their own words and adhere to the word limit as practicable.
All symbols are of usual significance.

GROUP-A

1.   Answer any *five* questions from the following: 2×5 = 10

   (a) What is a primitive cell?

   (b) Write the significance of "Law of mass action".

   (c) Why crystalline solids are isotropic in nature while amorphous ones are not?

   (d) What are the effects of the depletion capacitance at a *p-n* junction?

   (e) What is the base transport factor of a transistor?

   (f) Distinguish between Enhancement type and Depletion type MOSFETs.

   (g) Why MOSFETs are also called IGFET and MISFET?

   (h) How power electronic devices differ from their non-power application devices structurally?

GROUP-B

Answer any *six* questions from the following   5×6 = 30

2. (a) Copper (Cu) has FCC lattice structure having atomic radius 1.278Å. Find its density.   3+2

   (b) What is the utility of Miller indices?

3.   What is 'Hall effect'? Explain the phenomenon.   5

4. (a) What is space-charge region in a *p-n* junction? Draw the energy level diagram and point out the space charge region at the thermal equilibrium.   (1+2)+2

   (b) Explain Avalanche breakdown mechanism in a *p-n* junction.

5.   What is potential barrier? Find the expression of potential barrier for a *p-n* junction at equilibrium condition.   1+4

6. (a) What do you mean by 'Base-width Modulation' and 'Punch-through' effect in bipolar junction transistor? $(1\frac{1}{2}+1\frac{1}{2})$ $+2$

   (b) A silicon n-p-n transistor with $\alpha = 0.995$ and $I_{CO} = 15$ nA, operates in the CE configuration. What is the collector current for a base current of 20 μA?

7. Sketch a neat diagram of a n-channel depletion type MOSFET structure, and explain its operation. 5

8. Draw the Emitter follower circuit with a n-p-n transistor. Explain the working of the circuit. 5

9. Explain the structure of an Unijunction Transistor with a neat diagram. Write two applications of UJT. 4+1

10.(a) What are the differences between Ohmic and Rectifying contacts? 3+2

   (b) What is a linearly graded junction?

11.(a) What are the basic differences between JFET and MOSFET? 2+2+1

   (b) What is meant by 'pinch-off' of a JFET?

   (c) Why complete 'pinch-off' is not possible?

   N.B. : *Students have to complete submission of their Answer Scripts through E-mail / Whatsapp to their own respective colleges on the same day / date of examination within 1 hour after end of exam. University / College authorities will not be held responsible for wrong submission (at in proper address). Students are strongly advised not to submit multiple copies of the same answer script.*

——×——