



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 $\langle x \rangle = \frac{A^2 L^4}{4}$.
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.

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