

College of Engineering, Pune

F.Y. B.Tech.

(AS-106) Physics-II

Spring Semester

Date: 29/04/2009

Academic Year: 2008- 09

Timing : 3 hrs

Max. Marks: 50

Instructions:

1. All questions are compulsory
2. Figures to the right indicate full marks
3. Do not keep mobile phones with you; the handset will be retained permanently by exam cell.

Q.1 A) Explain the general properties of Maxwell Boltzmann and Bose Einstein statistics by sketching proper distribution curves. [4]

B) Solve any two [6]

- i) Derive an expression for Fermi level in intrinsic semiconductors.
- ii) If for some superconductor sample at 12°K , critical field is 15Torr and at 10°K it is 18Torr, calculate critical temperature.
- iii) In a betatron, the maximum magnetic field traversing in an electron orbit is 0.8 Wb/m^2 . The operating frequency of it is 50 Hz and the stable orbit diameter is 0.8 m. Calculate the number of revolutions and the final energy of the electron assuming maximum possible time for acceleration.

Q.2. A) Discuss in detail the free electron theory of solids. [4]

B) Solve any two [6]

- i) The susceptibility of paramagnetic FeCl_3 is 3.7×10^{-3} at 27°C . What will be the value of its relative permeability μ_r at 200°K and 500°K ?
- ii) Describe in brief about nanoparticles and their properties.
- iii) With neat labelled diagram explain the working of Scanning Electron Microscope

Q. 3. A) Why is a superconductor termed as a perfect diamagnet? [4]

B) Solve any two [6]

- i) In a Hall Effect experimental set up, a sample of n-type Ge has the donor density of $10^{21} / \text{m}^3$. Find the Hall voltage developed if the magnetic field used is 0.6 Tesla, given that current density is 500 Amp/m^2 and width of the sample is 5mm.
- ii) Derive expression for Q-value of a nuclear reaction.
- iii) Calculate the energy released by the fission of 2gm of ${}_{92}\text{U}^{235}$ in kWh, given that the energy released per fission is 200MeV.

Q.4. A) Describe Bragg's X-ray spectrometer and explain how it is used to study the structure of crystal. [4]

OR

State principle of G.M. Counter and explain its working with suitable diagram.

B) Choose the correct alternative by writing full sentence [6]

- i) Tandem accelerator belongs to the category.....
(a) Circular accelerator (b) linear accelerator (c) electrostatic accelerator
(d) Ion sources
- ii) To prevent continuous avalanching in G.M. tube, self quenching is achieved by adding.....
a) Argon b) Ethyl alcohol c) Helium d) Neon
- iii) The relative permeability can be expressed as.....
(a) $\mu_r = 1 + \mu_a$ (b) $\mu_r = 1 + \chi$ (c) $\mu_r = \chi / \mu_0$ (d) $\mu_r = \mu_0 + \mu_a$
- iv) For a stable nuclei packing fraction is
(a) positive (b) negative (c) zero (d) none of these
- v) When two particles are distributed in three energy states, the probability of finding two particles in the same state as per Bose-Einstein's distribution is....
(a) 2/3 (b) 1/2 (c) 0 (d) 1
- vi) In a p-type semiconductor sample Fermi level is situated at.....
a) mid way between conduction and valence band
b) close to conduction band
c) exactly at donor energy level
d) None of the above

Q.5. A) What is the primary function of electric and magnetic field in a cyclotron? Obtain an expression for maximum energy gained by charged particle. [4]

OR

Consider a free particle inside a one-dimensional box of length L , having an energy between E_1 and E_2 ($E_2 > E_1$). With the help of a diagram, show the allowed regions in the phase space of the system. Also calculate the number of microstates.

B) Solve any two [6]

- i) Write a short note on scintillation counter.
- ii) A G.M counter wire collects 10^8 electrons per discharge when the counting rate is 500 counts per min. What will be the average current in the circuit?
- iii) Distinguish between nuclear fission and fusion.