INFORMATION:

Mass of electron= 9.11e-31 kg

Mass of Proton= 1.67e-27 kg

Plank's constant=6.62e-34 Js

Boltzmann constant=1.38e-23 J/K

Question 1:   Answer All: Mark: 2x10

(a) A linear accelerator has 64 number of accelerating tubes. What is the length of the shortest tube if the length of the longest tube is 16 m ?

(b) The magnetic flux applied to the betatron is given as $\Phi=2\sin100\pi t$. Calculate how long the electrons are accelerated in it?

(c) Distinguish between crystal lattice and solid crystal?

(d) In certain x-ray diffraction experiment using Bragg's law .The first order diffraction maximum occurs at glancing angle of 33.37°. Calculate wavelength of the x-ray if interplanar spacing in the crystal is 2.8Å.

(e) Derive London's second equation from London's first equation in superconductivity .

(f) Differentiate between spontaneous emission and stimulated emission.

(g) Name and write down the theorem used in solution of Schrodinger equation in Kronig-Penney model.

(h) Find out the coherence length in a laser beam for which the coherence time is 0.5ns in vacuum.

(i) The silicon crystal is doped with arsenic atoms with doping concentration of 1 in 10e7. If the intrinsic atom concentration for silicon is 5.5e28 m-3, calculate the concentration of order atoms.

(j) Show graphically the variation of electronic specific heat with respect to temperature in normal and superconducting states of a material.

Answer any Five :

2.

(a) What are the characteristics of optical source used in FOCL ?   4

(b) Derive an expression for the cyclotron resonance condition.   4

(c) The lattice constant of a cubic lattice is 5Å. Calculate the spacing between{120} planes.   2

3.

(a) The electrons are ideally bound to the atoms as modeled by infinitely deep potential well in quantum physics. In this case use the Kronig-Penney model to derive an expression for energy of an electron.   4

(b) Find the critical current density of an indium wire of radius 5 mm at 5K. The data given for indium are Tc = 3.4K and Bc =29.3e-3 T at 0K.

    3

(c) How optical fibers are helpful to doctors in medical fields?   3

4.

(a) What are the advantages and disadvantages of Van de Graaff accelerator?   4

(b) In a cubic crystal ,a given plane intercepts the crystallographics axes at 2a,3b,3c respectively. Here a,b and c are the axial lengths respectively. Determine the Miller indices of the plane.   3

(c) Distinguish between extrinsic semiconductor and intrinsic semiconductor.   3

5.

(a) Mention at least ten applications of superconductivity in science and engineering .   5

(b) Enumerate different mechanisms employed to achieve population inversion in laser systems.   3

(c) In a cyclotron the diameter of dees is 70 cm and a magnetic field of induction 1.5T is applied to accelerate positively charged hydrogen ion. What is the maximum energy attainable by the ion?   2

6.

(a) Prove mathematically that every reciprocal lattice vector is normal to certain crystal plane in the direct lattice.   5

(b) Explain the origin of energy bands quantum mechanically.   3

(c) A step index optical fiber having the refractive indices of core and cladding as 1.55 and 1.53 respectively is immersed in water medium having refractive indeed 1.33. Calculate the acceptance angle of the fiber.   2

7.

(a) What are the principle of light emitting diode ? Write few applications of LED.   2+3

(b) In certain betatron the radius of stable electron orbit is 40 inches and operates at the maximum magnetic induction 4000 gauss and 50 Hz . Calculate the final energy of the electrons.   2

(c) Calculate the geometrical structure factor of a BCC unit cell containing same types of atoms.   3

8.

(a) Explain how BCS theory accounts for the phenomenon of superconductivity ?   4

(b) Write down the Law conditions of x-ray diffraction in vector form and scalar form.   4

(c) Give the band diagrams of conductor, semiconductor and insulators.   2