



Applied Physics -I May 18

First Year (Semester 1)

Total marks: 80

Total time: 3 Hours

INSTRUCTIONS

(1) Question 1 is compulsory.

(2) Attempt any **three** from the remaining questions.

(3) Draw neat diagrams wherever necessary.

Q1) Attempt any five

(15 marks)

1(a) Why X- rays are used to study the crystal structure?

1(b) Calculate the frequency and wavelength of photon whose energy is 75 eV.

1(c) Draw the energy band diagram of p-n junction diode in forward and reverse bias condition.

1(d) "Superconductor is a perfect diamagnetic", Explain.

1(e) What is reverberation time? How it is important? Write the factors affecting reverberation time.

1(f) A quartz crystal of thickness 1.5 mm vibrating with resonance. Calculate it's fundamental frequency if the Young's modulus of quartz crystal is $7.9 \times 10^{10} \text{N/m}^2$ and density is 2650 kg/ m^3 .

1(g) Mobility's of electron and hole in a sample of Ge at room temperature are $0.36 \text{ m}^2/\text{V-sec}$ and $0.17 \text{ m}^2/\text{V-sec}$ respectively. If electron and hole densities are equal and it is $2.5 \times 10^{13}/\text{cm}^3$, calculate its conductivity.

2(a) Arrive at Heisenberg's uncertainty principle with single slit electron diffraction. (4 marks)

2(a) An electron has a speed of 300m/sec. with uncertainty of 0.01%. Find the accuracy in its position.

(4 marks)

2(b) Write the Fermi Dirac distribution function and terms in it. What is the probability of an electron being thermally excited to the conduction band in Si at 30 OC. The band gap energy is 1.12 eV. (7 marks)



3(a) With neat diagram of unit cell, explain the structure of NaCl crystal and calculate the no. of ions per unit cell, coordination no. and lattice constant. Calculate the packing factor of NaCl crystal assuming the packing factor of NaCl crystal assuming the radius of Na^+ is $0.98 A_0$ and radius of Cl^- is $1.81 A_0$. (8 marks)

3(b) State the Hall effect. Drive the expression for Hall voltage and Hall coefficient with neat diagram.

(7 marks)

4(a) What is working principle of SQUID? Explain how it is used to detect the magnetic field? (5 marks)

4(b) A hall of diameter $25 \times 18 \times 12 \text{ m}^3$ has an average absorption coefficient 0.2 Find the reverberation time. If a curtain cloth of area 150 m^2 is suspended at the Centre of Hall with coefficient of absorption 0.75, what will be the reverberation time? (5 marks)

4(c) State the piezoelectric effect. With neat circuit diagram explain the principle and working of piezoelectric oscillator. (5 marks)

5(a) With energy band diagram, explain the variation of Fermi energy level with impurity concentration in extrinsic semiconductor. (5 marks)

5(b) Explain with example how to determine crystal structure by Bragg's X-ray spectrometer. (5 marks)

5(c) Obtain one dimensional time dependent time independent Schrodinger equation. (5 marks)

6(a) Define ligancy and critical radius ratio. Calculate critical radius ratio for ligancy 8. (5 marks)

6(b) What is the significance of wave function? Derive the expression for energy Eigen values for the free particle in one dimensional potential well. (5 marks)

6(c) What is photovoltaic effect? Explain the principle and working of Solar cell. (5 marks)