

2. (a) Derive the energy dispersion relation of electron in solid according to the tight-binding approximation (TBA). (8)
- (b) Find the bandwidth in a bcc crystal along [111] direction according to TBA. (2)
3. (a) Prove that dielectric loss is related to imaginary part of the dielectric constant. (3)
- (b) Describe the crystal structure of the BaTiO₃ and explain how spontaneous polarization appears in this material and how direction of polarization changes with temperatures. (5)
- (c) What is meant by polarization catastrophe? (2)
4. (a) Explain flux quantization and Landau levels in case of a metal placed in a magnetic field at low temperature. (5)
- (b) Describe, in details, De Haas-van Alphen effect. What is meant by ultra-quantum region? (4+1)
5. (a) Discuss *electrostatic screening* and derive the expression for *Thomas-Fermi dielectric function*. (2+5)
- (b) Calculate the density of energy states of 1 m^3 of *Na* at the Fermi level for $T = 0\text{ K}$, if $\frac{m^*}{m} = 1.2$. Given: Fermi energy of *Na* is 3.1 eV . (3)
- 6.(a) Derive the *Kramer-Kronig relations*. (5)
- (b) Explain the mechanism of formation of F-centre & V_k centre in alkyl halides. (3)
- (c) Argon gas contains 2.6×10^{25} atoms/m³ at 0°C at 1 atmospheric pressure. Calculate the dielectric constant of argon gas at this temperature. Assume the diameter of an argon atom to be 0.384 nm . (2)

2018
M.Sc.
3rd Semester Examination
PHYSICS
PAPER – PHS-303

Full Marks : 50

Time : 2 Hours

(Solid State Physics-Spl-I – PHS 303)

Answer Q1 and any three from the rest

1. Answer any five bits: 5X2 = 10
- (a) Draw the first three bands in a simple cubic lattice in [110] direction on the basis of empty lattice approximation.
- (b) Metallic Sodium crystallites have bcc structure having the length of the cube 4.25×10^{-8} cm. Find the concentration of conduction electrons. Valence electron in Sodium atom is one.
- (c) Find the electron plasma frequency considering the motions of positive ions imbedded in an electron sea.
- (d) What is Mott's Metal to Insulator transition?
- (e) What are the essential conditions of material to be ferroelectric?
- (f) What are F-centres?
- (g) Differentiate *fluorescence* and *phosphorescence*.
- (h) What are *Frenkel excitons*?