(D) What is Ruby Laser ? Explain the typical arrangement of a Ruby Laser System. 2½

(E) Explain the terms temporal coherence and spatial coherence. 2½

(F) The coherence time for sodium light is 10^{-10} sec. and wavelength is 5890 Å. Find the half width ($\Delta\lambda$) of the sodium spectral line. 2½

5. Attempt any **TEN** questions (**1** mark each) :

(i) Why is the melting point of crystalline solid fixed ? Explain.

(ii) Define Bravais Lattices.

(iii) For fcc crystal structure show that the cube edge is given by $a = \frac{4r}{\sqrt{2}}$, where r is the radius of each atom.

(iv) What are soft and hard X-rays ?

(v) Calculate the frequency of X-rays of wavelength 0.1 Å. Given C = 3×10^8 m/s.

(vi) Give the importance of Moseley's law.

(vii) What is reciprocal lattice ?

(viii) In terms of three Laue equation write the condition for constructive interference.

(ix) What is lattice spacing ? Write its general value.

(x) What is Laser ?

(xi) Define population inversion in Laser.

(xii) The coherence length of a red cadmium line of wavelength 6.438×10^{-7} m is 30 cm. Calculate the number of oscillations corresponding to the coherence length. 10×1=10

TKN/KS/16/5855

Bachelor of Science (B.Sc.) Semester–IV (C.B.S.) Examination

PHYSICS

(Solid State Physics, X-Ray and Laser)

Paper—I

Time—Three Hours] [Maximum Marks—50

N.B. :— (1) **ALL** questions are compulsory.

(2) Draw neat diagrams wherever necessary.

EITHER

1. (A) What do you mean by symmetry operations ? Explain briefly the various symmetry operations of a lattice. 5

(B) (i) What are Miller Indices ? State procedure to obtain Miller Indices. 3

(ii) Obtain the Miller Indices of planes having intercepts (a, b/2, 3c) in simple cubic structure. 2

OR

(C) What is meant by coordination numbers and packing fraction for a crystal. 2½

(D) If lattice parameter for an fcc cystal is 2.14 A.U. Find the radius of the atom. 2½

(E) Distinguish between crystalline solid and amorphous solid. 2½

(F) Show that the five-fold rotation symmetry is not consistent with translational periodicity of crystal. 2½

EITHER

2. (A) Explain the origin of continuous X-ray spectrum and give its significant features. State and explain Moseley's law. 5

(B) (i) Obtain an expression for minimum wavelength, λ_{min} of X-rays obtain from an X-ray tube. 3

(ii) What is the minimum wavelength of X-rays produced when the potential difference between cathode and target is 12.40 kV ? What is the corresponding maximum frequency ? 2

OR

(C) Discuss the characteristic absorption X-ray spectra. 2½

(D) Explain the energy level diagram of characteristic X-ray spectra with diagram. 2½

(E) Explain the production of X-rays in X-ray gas tube with diagram. 2½

(F) The P.D. applied between the cathode and the target of an X-ray tube is 150 kV and the current through it is 10 mA. Calculate the number of electrons striking the target per second and also find their maximum speed. 2½

EITHER

3. (A) Explain briefly the geometrical construction of reciprocal lattice. 5

(B) (i) Give the explanation of Bragg's X-ray spectrometer with diagram. 3

(ii) When X-rays wavelength 1.6 Å are incident on a crystal, the first order maxima is obtained at an angle of 14.2°. Find the distance between adjacent planes [sin 14.2° = 0.2453]. 2

OR

(C) Draw and explain Wigner Seitz cell. 2½

(D) Derive the Bragg's relation for the diffraction of X-rays. 2½

(E) The angles corresponding to first and second order of Bragg's reflections are 27.9° and 69.65°. Find the wavelength of X-ray in both cases if the interplanar spacing is 1.6 Å. 2½

(F) Explain the use of Bragg's spectrometer for the determination of X-ray wavelengths. 2½

EITHER

4. (A) Explain the spontaneous and stimulated emission of radiation with energy level diagram. 5

(B) (i) Explain the terms :

(a) Coherence length and

(b) Coherence time. 3

(ii) Coherence length of sodium D_2 line 2.5 cm and its wavelength is 5892 Å. Calculate the coherence time and purity of the spectral line. 2

OR

(C) Explain why the three levels are necessary for Laser action. 2½