

SIXTH SEMESTER B.Sc. DEGREE EXAMINATION, MARCH 2019

(CUCBCSS)

Physics

PHY 6B 11/APY 6B 12—SOLID STATE PHYSICS, SPECTROSCOPY AND LASER
PHYSICS

Time : Three Hours

Maximum : 80 Marks

Section A*Answer in word or phrase.**Answer all questions.**Each question carries 1 mark.*

1. The number of molecules present in the unit cell of sodium chloride is _____.
2. Raman spectrum appears due to the scattering of radiation by the _____ molecules.
3. The miller indices of the plane parallel to Y and Z axes are _____.
4. Soft superconductors observe _____ effect
5. Expand SQUID.
6. The expression for London penetration depth is _____.
7. The lines on the low frequency side of Raman spectra are called _____.
8. The expression for rotational constant B is _____.
9. Give an example for linear molecule.
10. Give an example for high temperature superconductor.

(10 × 1 = 10 marks)

Section B*Answer in a short paragraph-three or four sentences.**Answer all questions.**Each question carries 2 marks.*

11. What is co-ordination number ?
12. State vector form of Bragg's Law.
13. Sketch the magnetic phase diagram of a type II superconductor.

Turn over

14. Distinguish between symmetric top and spherical top molecules.
15. What are hot bands ?
16. Discuss population inversion associated with LASER.
17. Sketch the unit cell of a NaCl crystal.

(7 × 2 = 14 marks)

Section C

Answer in a paragraph of about half a page to one page.

Answer any five questions.

Each question carries 4 marks.

18. Discuss the applications of LASER.
19. Discuss breakdown of Born Oppenheimer approximation.
20. Compare Raman spectroscopy and Infrared spectroscopy.
21. Give an idea about optical pumping in Lasers.
22. Explain isotopic effect with suitable examples.
23. Explain interaction of radiation with rotating molecules.
24. Discuss vibrational energy of an anharmonic oscillator.

(5 × 4 = 20 marks)

Section D

Problems - write all relevant formulas.

All important steps carry separate marks.

Answer any four questions.

Each question carries 6 marks.

25. The lattice parameter and the atomic mass of a diamond crystal are 3.57 \AA and 12 respectively. Calculate the density of the same.
26. Show that the packing factor of fcc lattice is $\pi\sqrt{2}/6$.
27. What does the equation $dB/dt = 0$ tell us ? Is this equation adequate to explain superconductivity? If not, why ?
28. What is the frequency of the electromagnetic waves radiated by a Josephson junction having a voltage of $650 \mu\text{V}$ across its terminals ?
29. The London penetration depths for Pb at 3K and 7.1K are respectively 39.6 nm and 173 nm. Calculate its transition temperature as well as penetration depth at 0K.

30. Consider a He-Ne Laser with cavity life time $t_c = 5 \times 10^{-8}$ s. If $R_1 = 1.0$ and $R_2 = 0.98$, Calculate the cavity length d ; assume $n_0 = 1$.
31. In a material at 300K two energy levels have a wavelength separation of $1 \mu\text{m}$. Determine
- The ratio of upper to lower level occupation densities when the material is in thermal equilibrium.
 - The effective temperature when the levels are equally populated.

(4 × 4 = 16 marks)

Section E (Essays)

Answer in about two pages.

Answer any two questions.

Each question carries 10 marks.

32. Explain the spectrum of non-rigid Rotator in detail.
33. Explain the theory and working of Ruby Laser with suitable diagram.
34. Discuss Bragg's Law in detail. Discuss Bragg's X ray spectrometer.
35. Explain rotational Raman spectrum of symmetric top molecule with example.

(2 × 10 = 20 marks)