D 40050 (Pages : 3) Name.....

Reg. No.....

SIXTH SEMESTER B.Sc. DEGREE EXAMINATION, MARCH/APRIL 2018

(CUCBCSS—UG)

Physics/Applied Physics

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

Time : Three Hours Maximum : 80 Marks

Section A (Answer in a Word or a Phrase)

Answer **all** *questions.*
Each question carries 1 *mark.*

1. The number of lattice points in a primitive cell is ————.
2. Name the theory which explains the phenomenon of superconductivity.
3. Give the relation between atomic radius and lattice constant in fcc structure.
4. Expand LASER.
5. The transition temperature of mercury is ————.

Questions 6 *to* 10 *: write True* **or** *False*

6. For a spherical top molecule, all the three principal moment of inertia are equal.
7. The intensities of antistoke lines are greater than stokes lines.
8. The population inversion in Ruby laser is achieved by electrical pumping
9. The vibrational energy at the lowest vibrational level is zero
10. Super conductors are diamagnetic.

(10 × 1 = 10 marks)

Section B (Answer in two or three sentences)

Answer **all** *questions.*
Each question carries 2 *marks.*

11. What are Miller indices ?
12. What is meant by population inversion ?
13. How cooper pairs are formed in superconductors ?
14. What is co-ordination number ?
15. Give the advantage of using laser as a Raman source.

16. What are hot bands in vibrating diatomic molecule ?

17. State mutual exclusion principle.

(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 crystal structure of diamond.

19. Derive Bragg's law for X ray diffraction in crystals.

20. Discuss type I and type II superconductors.

21. Discuss normal vibrations of CO_2 and H_2O molecule.

22. Obtain Einstein's coefficients related to emission and absorption.

23. Discuss electromagnetic spectrum.

24. Briefly explain the working of semiconductor laser.

(5 × 4 = 20 marks)

Section D

Problems-write **all** *relevant formulas, all important steps carry separate marks.*
Answer any **four** *questions; each question carries* 4 *marks*

25. The Raman line associated with a vibrational mode which is both Raman and infrared active is found at 4600 Å when excited by a light of wavelength 4358 Å. Calculate the wavelength of the corresponding infrared band.

26. The critical temperature, T_c for mercury with isotopic mass 199.5 is 4.185 K. Calculate its critical temperature when its isotopic mass changes to 230.4.

27. The first three rotational Raman lines of a linear triatomic molecule are at 4.86, 8.14 and 11.36 cm^{-1} from the exciting Raman line. Estimate the rotational constant B and the moment of inertia of the molecule.

28. The lattice parameter and the atomic weight of a diamond crystal are 3.57 Å and 12 a.m.u. respectively. Calculate the density of the same. Given $N = 6.023 \times 10^{23}$ /mol.

29. A monochromatic X ray beam of $\lambda = 0.7$ Å undergoes first order Bragg reflection from the plane (3 0 2) of a cubic crystal at a glancing angle of 35°. Calculate the lattice constant.

30. Copper has fcc structure of atomic radius 0.1278 nm. Calculate the interplanar spacing for (3 2 1) plane.

31. A He-Ne laser is emitting a laser beam with an average power of 4.5 mW. Find the number of photons emitted per second by the laser. The wavelength of emitted radiation is 6328 Å

(4 × 4 = 16 marks)

Section E (Essays-answer in about two pages)

Answer any **two** *questions.*
Each question carries 10 *marks.*

32. Discuss Bravais lattice and crystal systems with the help of illustrations.

33. Explain with a schematic diagram the working of a He-Ne laser.

34. Explain diatomic vibrating rotator. Discuss the spectrum and relevant selection rules.

35. Discuss rotational Raman spectra of symmetric top molecule. Give example

(2 × 10 = 20 marks)