C 21079 (Pages : 3) Name.....

Reg. No.....

SIXTH SEMESTER B.Sc. DEGREE EXAMINATION, MARCH 2017

(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 word **or** *a phrase each.)*

Answer **all** *questions ; each question carries* 1 *mark.*

1. The Miller indices of the plane parallel to x and y axes are ———.
2. The co-ordination number in the case of simple cubic crystal structure is ———.
3. The transition temperature of mercury is ———.
4. Expand LASER.
5. The general pumping mechanism in semiconductor laser is ———.

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

6. For a linear molecule, all the three principal moment of inertia are equal.
7. The symmetric stretching vibration in CO_2 molecule is IR active.
8. The intensities of Stokes lines are greater than anti-Stokes lines.
9. Laser light is highly monochromatic.
10. Soft superconductors show Meissner effect.

(10 × 1 = 10 marks)

Section B

(Answer in two **or** *three sentences each.)*

Answer **all** *questions ; each question carries* 2 *marks.*

11. What are Miller indices ?
12. What is Meissner effect ?
13. Distinguish between symmetric top and spherical top molecules.

Turn over

14. What are hot bands in vibrating diatomic molecule ?
15. What is Raman effect ?
16. What are Einstein's coefficients ?
17. Mention two industrial applications of laser.

(7 × 2 = 14 marks

Section C

(Answer in a paragraph of about **half a page** *to* **one page** *each.)*
Answer any **five** *questions; each question carries 4 marks.*

18. Discuss sodium chloride crystal structure.
19. Discuss type I and type II superconductors.
20. Discuss various regions of electromagnetic spectrum.
21. Discuss rotational spectrum of rigid diatomic molecule.
22. Discuss vibrating diatomic molecule by considering the system as anharmonic.
23. Discuss rotational Raman spectra for linear molecules.
24. Discuss population inversion and metastable state associated with 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. Find the interplanar spacing for the lattice planes of Miller indices (3, 2, 1), (2, 1, 0) and (1, 1, 1) for a cubic lattice with $a = 5.62$ Å.
26. The interplanar spacing of (110) planes is 2Å for a cubic crystal with fcc structure. Find out the atomic radius.
27. The lattice parameter and the atomic weight of a diamond crystal are 3.57Å and 12 amu respectively. Calculate the density of the same. Given $N_A = 6.023 \times 10^{23}$ /mol.
28. The first line in the rotation spectrum of carbonmonoxide has a frequency of 3.8424 cm^{-1}. Calculate the rotational constant and hence the C—O bond length in carbon monoxide. Avogadro number is 6.023×10^{23} /mol.
29. The normal modes of vibration of CO_2 molecule are $\bar{\nu}_1 = 1330\ cm^{-1}$, $\bar{\nu}_2 = 667\ cm^{-1}$, $\bar{\nu}_3 = 2349\ cm^{-1}$. Evaluate the zero point energy of CO_2 molecule.

30. 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 4358Å. Calculate the wavelength of the corresponding infrared band.

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 6328Å.

(4 × 4 = 16 marks)

Section E

(Essays-answer in about **two pages** *each.)*

Answer any **two** *questions ; each question carries* 10 *marks.*

32. Derive Bragg's law for X-ray diffraction in crystals. How is it verified ? Describe and explain X-ray spectrometer method of determining λ of X-rays.

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

34. Explain rotational fine structure of vibrational Raman spectrum. State mutual exclusion principle.

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

(2 × 10 = 20 marks)