C 1265 (Pages : 3) Name.....

Reg. No.....

SIXTH SEMESTER (CUCBCSS—UG) DEGREE EXAMINATION MARCH 2021

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 **all** *questions.*

Each question carries 1 *mark.*

Answer in word *or* a phrase :

1. The two dimensional lattice with highest rotational symmetry is _____.
2. In Raman scattering, if the scattered photon have energy $h(\upsilon_0 - \upsilon_m)$ that corresponds to _____ line.
3. In electromagnetic spectrum, the region corresponding to the wavelength 100μm–1μm _____.
4. The volume of a primitive unit cell of a fcc structure with lattice constant "a" is _____.
5. A hot band will increase in intensity as temperature of the sample _____.

Write True *or* False :

6. Amorphous solids are isotropic.
7. In superconductivity critical field depends on temperature.
8. In a symmetric top two of the principal moment of inertia is equal and all the three are non-zero.
9. Unit cell is the building block of a crystal lattice.
10. Molecular absorption takes place at a single frequency.

(10 × 1 = 10 marks)

Turn over

Section B

Answer at least **six** *questions.*
Each question carries 2 *marks.*
All questions can be attended.
Overall Ceiling 12.

11. What is pumping ? Name two different methods of pumping.
12. What is superconductivity ?
13. Vibrational spectra are observable only in the case of heteronuclear diatomic molecule. Why ?
14. What is Type II superconductor ?
15. Explain Raman effect.
16. What is Doppler broadening ?
17. What are hot bands ? Why are they called so ?

(6 × 2 = 12 marks)

Section C

Answer at least **four** *questions.*
Each question carries 5 *marks.*
All questions can be attended.
Overall Ceiling 20.

18. Make drawing of the unit cells and the primitive unit cells for the rutile(TiO_2) and cuprite(Cu_2O) structure.
19. Write a note on BCS theory.
20. Name the different regions of electromagnetic spectra in the order of their increasing frequency.
21. Write a note on the vibrational Raman spectra.
22. Draw the block diagram of a laser system and explain the components .
23. Explain the effect of anharmonicity on the vibrational spectra of diatomic molecule.
24. Explain rotational Raman spectra of symmetric top molecule.

(4 × 5 = 20 marks)

Section D

Answer at least **three** *questions.*
Each question carries 6 *marks.*
All questions can be attended.
Overall Ceiling 18.

25. Find the relative population of the two states in a ruby laser that produces a beam of wavelength 6943A° at 300 K. Boltzmann's constant = 1.38×10^{-23}J/K.

26. Electrons are accelerated to 728 Volts and are reflected from a crystal. The first reflection maximum occurs when glancing angle is 8°. Determine the interplanar spacing of the crystal.

27. Irradiation of carbon tetra chloride by 4358A° radiation gives Raman lines at 4400, 4419 and 4447A°. Calculate the Raman shift for each of these lines.

28. Find the radius of the interstitial sphere that can just fit into the void at the body centre of the fcc structure co-ordinated by the facial atoms.

29. The frequency of OH stretching vibration in CH_3OH is 3300 cm^{-1}. Estimate the frequency of OD stretching vibration in CH_3OD.

30. The first rotational line of ^{12}C ^{16}O is observed at 3.84235 cm^{-1} and that of ^{13}C ^{16}O at 3.67337 cm^{-1}. Calculate the atomic weight of ^{13}C , assuming the mass of ^{16}O to be 15.9949.

31. An atom has two atomic levels spaced by 3eV in energy. Calculate the ratio of population in higher energy and lower energy at 50°C. Boltzmann's constant = 1.38×10^{-23}J/K.

(3 × 6 = 18 marks)

Section E (Essays)

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

32. Write notes on crystal structures of sodium chloride, diamond and zinc sulphide.

33. State and explain Bragg's law. Explain the working of Bragg's spectrometer.

34. Explain the information derived from rotational spectra about molecular structure.

35. Explain the working of He-Ne laser.

(2 × 10 = 20 marks)