16U607 (Pages: 3) Name……………………...

Reg.No……………………

SIXTH SEMESTER B.Sc. DEGREE EXAMINATION, APRIL 2019

(Regular/Supplementary/Improvement)

(CUCBCSS-UG)

CC15U PH6 B11 - SOLID STATE PHYSICS, SPECTROSCOPY AND LASER PHYSICS

Physics – Core Course

(2015 Admission onwards)

Time: Three Hours Maximum: 80 Marks

Section A

(Answer in a word or a phrase)

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

1. In diatomic vibrating rotator spectral lines corresponds to $\Delta j = -1$ are called ………….
2. The transition temperature of mercury is ………….
3. The energy of a photon having frequency 3×10^{12} Hz is ………….
4. In ruby laser, population inversion is achieved by ………….
5. Expand MASER

For questions 6 to 10, write whether True or False.

6. All diatomic molecules shows microwave spectrum.
7. The selection rule of pure rotational Raman spectra of a linear molecule is $\Delta J=+2$.
8. As temperature of sample increases intensity of anti stokes lines decreases.
9. Stimulated emission is very essential for production of laser light.
10. The number of NaCl molecules in a unit cell of sodium chloride is four.

(10 x 1 = 10 Marks)

Section B

(Answer in two or three sentences each)

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

11. Distinguish between a prolate and oblate molecule.
12. Calculate the coordination number and packing fraction for bcc structure.
13. Draw the first four vibrational levels of a molecule, assuming its vibrations are harmonic in nature.
14. Mention the important properties of laser beam.
15. Explain the terms primitive cell and unit cell.
16. What is Meissner effect?
17. Explain the term coherence length in superconductivity. **(7 x 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. Explain the isotope effect on the rotational spectrum of a molecule.
19. Explain the factors on which the intensity of spectral lines depends.
20. Give the schematic representation of different regions of electromagnetic spectrum.
21. What is Raman effect? Distinguish between stokes and anti stokes lines.
22. With proper diagram discuss the working of semiconductor laser.
23. What are Miller indices? Explain.
24. Distinguish between Type I and Type II super conductors.

(5 x 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. What is the average period of rotation of HCl molecule if it is in the J=1 state? The inter nuclear distance of HCl is 0.1274 nm. Given mass of Hydrogen and Chlorine atoms are $1.673\text{x}10^{-27}$ kg and $58.06\text{x } 10^{-27}$ kg respectively.
26. The microwave spectrum of HI molecule consists of a series of equidistant spectral lines with spacing 1280 m^{-1}. Calculate the rotational constant and bond length of HI molecule. Given atomic mass of H=1 and Iodine =128.Avogardro number =6.624 x 10^{26} atoms /kg.
27. The rotational constant for a molecule is $192m^{-1}$.Find the energy in joules absorbed when the molecule is raised from J=1 to J=2 and J=3 states.
28. Calculate atomic packing factor of fcc structure.
29. The critical temperature of a superconductor when no magnetic field is present 12 K. Find the temperature at which the critical field becomes half its value at 0 K.
30. Calculate the angles for first order diffraction for the (100) and (110) planes of a simple cubic lattice of side $3.2A^0$,where the wave length of X-rays used is $1.02A^0$.
31. A substance shows Raman line at $4570A^0$ when exciting line is $4358A^0$.Find the Raman shift. Also find the frequencies of stokes and anti-stokes lines for the same substance if the wavelength of the exciting line is $4047A^0$.

(4 x 4 = 16 Marks)

Section E

(Essays; answer in about two pages each)

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

32. Discuss with necessary theory the vibration–rotation spectrum of a diatomic molecule.
33. Define Einstein Coefficients. Derive the relation between these Coefficients and its significance.
34. Explain Bragg's law and Bragg's X-ray Spectrometer.
35. What are symmetry elements? Discuss the symmetry elements of a cubic crystal.

(2 x 10 = 20 Marks)

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