SIXTH SEMESTER B.Sc. DEGREE EXAMINATION, APRIL 2025

(CBCSS-UG)

(Regular/Supplementary/Improvement)

CC19U PHY6 B11 / CC20U PHY6 B11 - STATISTICAL PHYSICS, SOLID STATE PHYSICS, SPECTROSCOPY AND PHOTONICS

(Physics - Core Course)

(2019 Admission onwards)

Time: 2 Hours   Maximum: 60 Marks

Credit: 3

Part A (Short answer questions)

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

1. What is statistical mechanics?

2. Write down Planck blackbody formula.

3. Distinguish between a primitive cell and a unit cell.

4. What is glide plane symmetry?

5. Calculate the distance between two atoms of a basis of the diamond structure. The lattice constant of the structure is 5 Å.

6. What is Spectroscopy?

7. Define Absorbance.

8. What is zero point energy? What is its significance?

9. Write down the selection rules for the vibrational transitions of an anharmonic oscillator and obtain an expression for the first overtone.

10. Explain with neat diagram, absorption, spontaneous emission and stimulated emission of radiation.

11. What are Einstein coefficients? Define them.

12. Distinguish between stokes lines and antistokes lines.

(Ceiling: 20 Marks)

Part B (Short essay questions - Paragraph)

Answer *all* questions. Each question carries 5 marks.

13. Explain Fermi energy. Discuss the distribution of particles around the Fermi energy at temperature T = 0 and T>0.

14. Discuss the fermi energy of a system at 0K and at a finite temperature.

15. Describe the scheme to determine the Miller indices of a plane. Show the following planes are in simple cubic lattice: (111), (120), (020)

16. How many revolutions per second does a CO molecule make when J=3. The CO bond length is 0.1131nm. Avogadro number 6.022×10^{23}.

17. Obtain the expression for total energy of a diatomic molecule as a vibrating rotator in terms of wave number and explain the symbols.

18. Explain the process of light amplification in laser.

19. Describe the working of semiconductor laser.

(Ceiling: 30 Marks)

Part C (Essay questions)

Answer any *one* question. The question carries 10 marks.

20. Discuss the distribution of molecular speeds. How can the Maxwell's Boltzmann distribution be obtained from it?

21. Derive Bragg's law of X-ray diffraction in crystals. Give an account of powder method of crystal structure analysis.

(1 × 10 = 10 Marks)

****