B.Sc.-III (Physics)
Semester – VI

Physics – PH-601

Paper – XI : Solid State and Nano Physics

Max. Marks: 40
Internal Assessment: 10
Time: 3 hours

Note:-

1. Nine Questions will be set in total.
2. Question number 1 will be compulsory and will be based on the conceptual aspects of entire syllabus. This question may have five parts and the answer should be in brief but not in Yes/ No.
3. For more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit I: Crystal Structure I

Crystalline and glassy forms, liquid crystals, crystal structure, periodicity, lattice and basis, crystal translational vectors and axes. Unit cell and Primitive Cell, Winger Seitz primitive Cell, symmetry operations for a two dimensional crystal, Bravais lattices in twoand three dimensions. Crystal planes and Miller indices, Interplaner spacing, Crystal structures of Zinc Sulphide, Sodium Chloride and Diamond.

Unit II: Crystal Structure II

X-ray diffraction, Bragg's Law and experimental X-ray diffraction methods. K-space and reciprocal lattice and its physical significance, reciprocal lattice vectors, reciprocal lattice to a simple cubic lattice, b.c.c. and f.c.c.

Unit III: Super conductivity

Historical introduction, Survey of superconductivity, Super conducting systems, High Tc Super conductors, Isotopic Effect, Critical Magnetic Field, Meissner Effect, London Theory and Pippards' equation, Classification of Superconductors (type I and Type II), BCS Theory of Superconductivity, Flux quantization, Josephson Effect (AC and DC), Practical Applications of superconductivity and their limitations, power application of superconductors.

Unit IV: Introduction to Nano Physics

Definition, Length scale, Importance of Nano-scale and technology, History of Nan-technology, Benefits and challenges in molecular manufacturing. Molecular assembler concept, Understanding advanced capabilities. Vision and objective of Nano-technology, Nanotechnology in different field, Automobile, Electronics, Nano-biotechnology, Materials, Medicine.

References:

1 C. Kittel, *Introduction to Solid State Physics*, 7th Ed (1996) John Wiley & Sons, New Delhi.

2 H. Ibach and H. Lüth, *Solid State Physics, An Introduction to Theory and Experiment*, Springer-Verlag, Berlin, 1991

3 Pillai O S, *Solid State Physics*, New Age International Publishers (2007) New Delhi4 Mark R and Denial R, *Nano-tecnology* – A Gentle Introduction to the Next Big Idea (2002)

5 M. Tinkham, *Introduction to Superconductivity*, McGraw-Hill, New York, 1975

6 Dekkar A J, Solid State Physics (2000), Mc Millan India Ltd New Delhi

7 Ascroft N W and Mermin N D, Solid State Physics (2003) Harcourt Asia, Singapore

8 Keer H V, Solid State Physics (1993), Wiley Eastern Ltd, New Delhi

9 Kachhava C M, Solid State Physics (1990) Tata Mc Graw Hill Co Ltd, New Delhi

10 Gupta, Solid State Physics (1995) Vikas Publishing House Pvt Ltd, New Delhi

B.Sc.-III (Physics)

Semester – VI

Physics – PH-602

Paper – XII: Atomic and Molecular Spectroscopy

Max. Marks: 40

Internal Assessment: 10

Time: 3 hours

Note:-

1. Nine Questions will be set in total
2. Question number 1 will be compulsory and will be based on the conceptual aspects of entire syllabus. This question may have five parts and the answer should be in brief but not in Yes/ No.
3. For more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks.
4. 20% numerical problems are to be set.
5. Use of scientific (non-programmable) calculator is allowed.

Unit – I: Historical background of atomic spectroscopy

Introduction of early observations, emission and absorption spectra, atomic spectra, wave number, spectrum of Hydrogen atom in Balmer series, Bohr atomic model(Bohr's postulates) , spectra of Hydrogen atom , explanation of spectral series in Hydrogen atom, un-quantized states and continuous spectra, spectral series in absorption spectra, effect of nuclear motion on line spectra (correction of finite nuclear mass), variation in Rydberg constant due to finite mass, short comings of Bohr's theory, Wilson sommerfeld quantization rule, de-Broglie interpretation of Bohr quantization law, Bohr's corresponding principle, Sommerfeld's extension of Bohr's model, Sommerfeld relativistic correction, Short comings of Bohr-Sommerfeld theory, Vector atom model**;** space quantization, electron spin, coupling of orbital and spin angular momentum, spectroscopic terms and their notation, quantum numbers associated with vector atom model, transition probability and selection rules.

Unit –II: Vector Atom Model (single valance electron)

Orbital magnetic dipole moment (Bohr megnaton), behavior of magnetic dipole in external magnetic filed; Larmors' precession and theorem.

Penetrating and Non-penetrating orbits, Penetrating orbits on the classical model**;** Quantum defect, spin orbit interaction energy of the single valance electron, spin orbit interaction for penetrating and non-penetrating orbits. quantum mechanical relativity correction, Hydrogen fine spectra, Main features of Alkali Spectra and their theoretical interpretation, term series and limits, Rydeburg-Ritze combination principle, Absorption spectra of Alkali atoms. observed doublet fine structure in the spectra of alkali metals and its Interpretation, Intensity rules for doublets, comparison of Alkali spectra and Hydrogen spectrum .

UNIT-III: Vector Atom model (two valance electrons)

Essential features of spectra of Alkaline-earth elements, Vector model for two valance electron atom: application of spectra.

Coupling Schemes;LS or Russell – Saunders Coupling Scheme and JJ coupling scheme, Interaction energy in L-S coupling (sp, pd configuration), Lande interval rule, Pauli principal and periodic classification of the elements. Interaction energy in JJ Coupling (sp, pd configuration), equivalent and non-equivalent electrons, Two valance electron system-spectral terms of non-equivalent and equivalent electrons, comparison of spectral terms in L-S And J-J coupling. Hyperfine structure of spectral lines and its origin; isotopeeffect, nuclear spin.

Unit –IV: Atom in External Field

Zeeman Effect (normal and Anomalous),Experimental set-up for studying Zeeman effect, Explanation of normal Zeeman effect(classical and quantum mechanical), Explanation of anomalous Zeeman effect(Lande g-factor), Zeeman pattern of D1 and D2 lines of Na-atom, Paschen-Back effect of a single valence electron system. Weak field Stark effect of Hydrogen atom.

Molecular Physics

General Considerations, Electronic States of Diatomic Molecules, Rotational Spectra (FarIR and Microwave Region), Vibrational Spectra (IR Region), Rotator Model of Diatomic Molecule, Raman Effect, Electronic Spectra.

References

1 Beiser A, Concept of Modern Physics (1987), Mc Graw Hill Co Ltd, New Delhi2 Rajab J B, Atomic Physics (2007), S Chand & Co, New Delhi
3 Fewkes J H and Yarwood J Atomic Physics Vol II (1991) Oxford University Press4 Bransden B H and Joachain C J, Physics of Atoms and Molecules 2nd Ed (2009), Pearson Education, New Delhi.
5 Banwell, Molecular Spectroscopy
6 Ghoshal S N, Atomic and Nuclear Physics Vol I (1996) S Chand & Co, New Delhi7 Gopalkrishnan K, Atomic and Nuclear Physics (1982), Mc Millan India New Delhi8 Raj Kumar, Atomic and Moleculer Spectra:Laser , Kedarnath Ram nathpub.
9 S.L.Gupta, V.Kumar,R.C.Sharma, Elements of Spectroscopy,Pragati Prakashan.