NAME OF PROGRAMME: BSC (PCM/PSM)

SIX SEMESTER / YEAR: THIRD

SUBJECT NAME: SOLID STATE & NUCLEAR PHYSICS, SUBJECT CODE: BSPH 361

Some Important Guidelines for the Question Bank Setter:

1. **Question bank must cover: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyse) details in this regard are attached with the mail.**
2. **The question bank should be prepared in the given format would also be attached.**
3. Each question and parts of the questions should be written in clear language. Also break the questions relatively in shorter sentences if they contain brief information.
4. **Repetition of a question is not allowed.**
5. The file should be sent in MS-Word format.
6. The font size of the content should be Arial (font size 12) for English & Kruti Dev 010 (font size 14) for Hindi.
7. **Wherever the question papers have been prepared in both Hindi and English languages, the Hindi version of the question should be written immediately after English version of each question.**
8. **In case of MBA Course, Section-C must contain Case studies (one case study per unit or numerical type questions as per the format).**
9. If the syllabus contains more than 5 units or less than 5 units then update the format accordingly.
10. **A question bank moderation committee will be formed by the Dean of the concerned college under the supervision of the concerned department HOD. Committee will check & ensure that the question bank is prepared according to the guidelines. After that they will make a folder according to the Program, Branch & semester/year wise, and would ensure that all question banks are available according to the evaluation scheme. Hods will submit all folders to the CoE Office.**

SECTION-A (Very Short Answer Type Questions)

UNIT-I

S.No.	Question	CO	Bloom's Taxonomy
a)	What is the crystalline state of matter?	CO1	L1
b)	What is space lattice?		L1
c)	What is meant by unit cell and lattice constant?	CO1	L2
d)	Explain the Bravais space lattice.	CO2	L2
e)	Explain the concept of unit cell.	CO2	L3
f)	Explain the Miller Indices	CO3	L3
g)	Explain the crystal structure.	CO3	L4
h)	Explain the Translation vector	CO4	L4
i)	What do you mean by coordination number.	CO4	L5
j)	Explain the primitive cell and Basis.	CO5	L5

UNIT-II

S.No.	Question	CO	Bloom's Taxonomy
a)	What is X-ray diffraction and how does it relate to Bragg's law.		L1
b)	Explain the experimental methods of X-ray diffraction: Laue, Rotating crystal, and Powder methods.	CO1	L1

c)	What are reciprocal lattice vectors.	**CO2**	**L2**
d)	Explain the relationship between direct and reciprocal lattices.	**CO2**	**L2**
e)	What is the procedure for converting reciprocal lattice to face-centered cubic (FCC) lattice?	**CO3**	**L3**
f)	What are the main advantages of using the Laue method in X-ray diffraction?	**CO3**	**L3**
g)	What practical applications utilize X-ray diffraction techniques?	**CO4**	**L4**
h)	Explain the concept of reciprocal lattice and its significance in crystallography.	**CO4**	**L4**
i)	How do you convert reciprocal lattice to a simple cubic (SC) lattice?	**CO5**	**L5**
j)	Outline the process of converting reciprocal lattice to body-centered cubic (BCC) lattice.	**CO5**	**L5**

UNIT-III

S.No.	Question	CO	Bloom's Taxonomy
a)	What are the main types of crystals based on bonding, and how do they differ from each other?	**CO1**	**L1**
b)	Explain the significance of repulsive interactions in crystal structures.	**CO1**	**L1**
c)	Define cohesive energy in the context of crystal structures.	**CO2**	**L2**
d)	Describe the key characteristics of ionic crystals.	**CO2**	**L2**
e)	How is the equilibrium lattice constant of a crystal determined experimentally?	**CO3**	**L3**
f)	What are van der Waals-London forces.	**CO3**	**L3**
g)	Explain the significance of repulsive interactions in crystal structures.	**CO4**	**L4**
h)	What is the bulk modulus of a material, and how is it related to compressibility?	**CO4**	**L4**

UNIT-IV

S.No.	Question	CO	Bloom's Taxonomy
a)	What are lattice vibrations.	**CO1**	**L1**
b)	Describe the characteristics of lattice vibrations in linear diatomic.	**CO1**	**L1**

c)	What is the qualitative description of phonons in solids?	**CO2**	**L2**
d)	Explain Fermi energy and its significance.	**CO2**	**L2**
e)	What is paramagnetic susceptibility.	**CO3**	**L3**
f)	What is the Hall Effect, and how is it observed in metals?	**CO3**	**L3**
g)	What is the origin of band theory in solids?	**CO4**	**L4**
h)	Explain the concept of holes in band theory.	**CO4**	**L4**
i)	What factors influence the density of states in a solid?	**CO5**	**L5**

UNIT-V

S.No.	Question	CO	Bloom's Taxonomy
a)	What are nuclear constituents?	**CO1**	**L1**
b)	Write down the formula for representing size of nucleus.	**CO1**	**L1**
c)	Define the magnetic dipole moment.	**CO2**	**L2**
d)	Define the electric dipole moment.	**CO2**	**L2**
e)	Calculate the binding energy of Hydrogen atom.	**CO3**	**L3**
f)	Define the binding energy of nucleus.	**CO3**	**L3**
g)	What is mass defect?	**CO4**	**L4**
h)	Define the packing fraction of nucleus.	**CO4**	**L4**
i)	Define the nuclear stability.	**CO5**	**L5**
j)	Give the nuclear properties.	**CO5**	**L5**

UNIT-VI

S.No.	Question	CO	Bloom's Taxonomy
a)	Give the main assumptions of liquid drop model of nucleus.	**CO1**	**L1**
b)	What are magic number?	**CO1**	**L1**
c)	Explain the nuclear forces.	**CO2**	**L2**
d)	What type of nuclear forces is arises?	**CO2**	**L2**
e)	Give the characteristics of nuclear forces.	**CO3**	**L3**
f)	What is a nuclear reaction?	**CO3**	**L3**
g)	Classify major categories of nuclear reaction.	**CO4**	**L4**
h)	Explain nuclear fission.	**CO4**	**L4**
i)	Explain the nuclear fusion	**CO5**	**L5**
j)	Define chain reaction.	**CO5**	**L5**

UNIT-VII

S.No.	Question	CO	Bloom's Taxonomy
a)	Define the linear accelerator.	**CO1**	**L1**
b)	Give the name of proton synchrotron parts.	**CO1**	**L1**
c)	Name four areas of science using the nuclear accelerators.	**CO2**	**L2**
d)	On which basic principle the electron cyclotron resource source works	**CO2**	**L2**

e)	Why do you call the Van de Graaff accelerator at nuclear science centre?	**CO3**	**L3**

UNIT-VIII

S.No.	Question	CO	Bloom's Taxonomy
a)	Define the Baryon number.	**CO1**	**L1**
b)	Explain Lepton number.	**CO1**	**L1**
c)	Define the linear momentum.	**CO2**	**L2**
d)	Define the angular momentum.	**CO2**	**L2**
e)	Define the Terms: boson, fermion,	**CO3**	**L3**
f)	Define the terms : hadron, baryon	**CO3**	**L3**
g)	The electrostatic force between the earth and moon can be ignored because explain	**CO4**	**L4**

SECTION-B (Short Answer Type Questions)

UNIT-I

S.No.	Question	CO	Bloom's Taxonomy
a)	Explain the crystalline state of matter. Give seven system of crystal.	**CO1**	**L1**
b)	What is meant by lattice constant? Find the number of atoms per unit cell in FCC lattice.	**CO1**	**L1**
c)	Calculate the coordination number, number of lattice points per unit cell in FCC type of cubic lattice.	**CO2**	**L2**
d)	Explain the different lattices of a cubic crystal and determine the number of atoms per unit cell in each case.	**CO2**	**L2**
e)	Explain how lattice constant in a cubic crystal can be calculated.	**CO3**	**L3**

UNIT-II

S.No.	Question	CO	Bloom's Taxonomy
a)	What are some practical applications of X-ray diffraction techniques and Bragg's law in various scientific fields?	**CO1**	**L1**
b)	What are some recent advancements or developments in X-ray diffraction technology and methodology?	**CO1**	**L1**
c)	Describe the process of converting the reciprocal lattice to a face-centered cubic (FCC) lattice.	**CO2**	**L2**
d)	Derive Bragg,s Law for diffraction by a crystals. Describe Laue method in a detail and mentions its applications.	**CO2**	**L2**
e)	What are the characteristic of X-rays? How is their production accounted for ?	**CO3**	**L3**
f)	How does the understanding of reciprocal lattice contribute to the determination of crystal structures using X-ray diffraction data?	**CO3**	**L3**

UNIT-III

S.No.	Question	CO	Bloom's Taxonomy

a)	Describe the key characteristics of ionic crystals, including their cohesive energy and Madelung energy.	**CO1**	**L1**
b)	Explain the cohesive energy and compressibility of bulk modulus.	**CO1**	**L1**
c)	Define the Ionic and covalent bond with suitable examples.	**CO2**	**L2**
d)	Define the Equilibrium lattice constant.	**CO2**	**L2**
e)	How is the Madelung constant used to calculate the Madelung energy of an ionic crystal?	**CO3**	**L3**
f)	What does compressibility indicate about the physical properties of a crystal?	**CO3**	**L3**

UNIT-IV

S.No.	Question	CO	Bloom's Taxonomy
a)	What are lattice vibrations, and how are they represented in linear monoatomic chains?	**CO1**	**L1**
b)	Explain Fermi energy and its significance in the Free Electron Theory.	**CO1**	**L1**
c)	How is the heat capacity of conduction electrons determined in metals?	**CO2**	**L2**
d)	What is paramagnetic susceptibility of conduction electrons, and how does it relate to the Free Electron Theory?	**CO2**	**L2**
e)	How are solids classified based on band theory principles?	**CO3**	**L3**
f)	Discuss the relationship between paramagnetic susceptibility and the behavior of conduction electrons.	**CO3**	**L3**
g)	What distinguishes different types of solids based on band theory considerations?	**CO4**	**L4**

UNIT-V

S.No.	Question	CO	Bloom's Taxonomy
a)	Discuss essential properties of a nucleus.	**CO1**	**L1**
b)	Write down the formula for representing size of nucleus.	**CO1**	**L1**
c)	Show how the concept of binding energy is related to the stability of atomic nucleus	**CO2**	**L2**

d)	Explain the following terms: (i) Magnetic dipole moment (ii) Angular moment.	**CO2**	**L2**
e)	Explain the following terms: (iii) Spin (iv) Parity (v) Electric Moments.	**CO3**	**L3**
f)	Explain the nuclear forces responsible for holding the nucleons together. Discuss the nature of these forces.	**CO3**	**L3**

UNIT-VI

S.No.	Question	CO	Bloom's Taxonomy
a)	Describe liquid drop model of nucleus. What experimental results does it predict correct and what are its failure?	**CO1**	**L1**
b)	What are magic numbers? Explain spin-orbit interaction.	**CO1**	**L1**
c)	*Describe laws of conservation. Give the name of the quantities generally conserved in nuclear reaction.*	**CO2**	**L2**
d)	Explain the mechanism of nuclear reaction.	**CO2**	**L2**
e)	What are necessary conditions to be filled in nuclear reaction? Give two major types of nuclear reactions. Discuss major difference between them.	**CO3**	**L3**

UNIT-VII

S.No.	Question	CO	Bloom's Taxonomy
a)	Give the working principle of Van-de Graaff accelerator.		**L1**
b)	Give the working principle of Cyclotron accelerator	**CO1**	**L1**
c)	Give the working principle of Synchrotron accelerator	**CO2**	**L2**
d)	Give the advantages and disadvantages of Cyclotron	**CO2**	**L2**
e)	Give the advantages and disadvantages of Synchrotron	**CO3**	**L3**

UNIT-VIII

S.No.	Question	CO	Bloom's Taxonomy
a)	Give the classification of fundamental elementary particle.	**CO1**	**L1**

b)	Give the concept of quark model.	**CO1**	**L1**
c)	Give the concept of Baryons.	**CO2**	**L2**
d)	Give the families of leptons	**CO2**	**L2**
e)	Explain the mediating quanta.	**CO3**	**L3**

SECTION-C [Descriptive Answer Type Questions / Case Study (for MBA COURSES only)]

UNIT-I

S.No.	Question	CO	Bloom's Taxonomy
a)	What are differences between amorphous and crystalline solids.	**CO1**	**L1**
b)	What are lattice planes? How are they represented in term of Miller Indices.	**CO1**	**L1**
c)	Show that the distance between successive planes of Miller indices (h,k,l) is given by: $d_{hkl} = [h^2/a^2 + k^2/b^2 + l^2/c^2]^{-1/2}$ where abc are the primitive vectors of the lattice.	**CO2**	**L2**
d)	What are Miller indices and how are they obtained for a given plane in a crystal? Discuss the procedure step by step.	**CO2**	**L2**
e)	Derive expression for interplanar spacing between two successive lattice planes in cubic lattice.	**CO3**	**L3**

UNIT-II

S.No.	Question	CO	Bloom's Taxonomy
a)	How is the scattered wave amplitude derived in X-ray diffraction experiments?	**CO1**	**L1**
b)	Discuss the action of a crystal as a three-dimensional grating and deduce Bragg's Law for X-ray diffraction.	**CO1**	**L1**
c)	Describe the experimental setup of powder method for crystal structure analysis.	**CO2**	**L2**
d)	Describe powder method for obtaining X-rays diffraction. What are the various applications of powder method?	**CO2**	**L2**
e)	How does the Laue method work in X-ray diffraction experiments, and what are its advantages and limitations?	**CO3**	**L3**
f)	Describe the process of converting the reciprocal lattice to a face-centered cubic (FCC) lattice.	**CO3**	**L3**

UNIT-III

S.No.	Question	CO	Bloom's Taxonomy
a)	How are crystals classified based on their bonding, and what are the distinguishing characteristics of ionic, covalent, metallic, van der Waals molecular, and hydrogen-bonded crystals?	**CO1**	**L1**
b)	What is the nature of attractive interactions, particularly van der Waals-London forces, within crystals, and how do they influence the crystal structure?	**CO1**	**L1**

c)	Explain the concept of cohesive energy in crystals and its significance in understanding the stability and bonding within a crystal lattice.	**CO2**	**L2**
d)	Could you elaborate on the characteristics of ionic crystals, including their cohesive energy, Madelung energy, and the process of evaluating the Madelung constant?	**CO2**	**L2**
e)	Discuss the relationship between the structure and properties of ionic crystals, with specific reference to their cohesive energy and stability.	**CO3**	L3
f)	Discuss the concept of repulsive interactions within crystals and their impact on the stability and structure of the crystal lattice.	**CO3**	L3

UNIT-IV

S.No.	Question	CO	Bloom's Taxonomy
a)	Explore the Free Electron Theory, including its foundational principles, assumptions, and implications for the behavior of electrons in metals.	**CO1**	**L1**
b)	Describe Fermi energy in detail, explaining its significance in determining the electronic properties of materials.	**CO1**	**L1**
c)	Elaborate on the paramagnetic susceptibility of conduction electrons, including its relationship to the density of states and Fermi energy.	**CO2**	**L2**
d)	Provide a detailed explanation of the Hall Effect in metals, including the underlying principles and experimental observations.	**CO2**	**L2**
e)	Explain the qualitative idea of the Bloch theorem, illustrating how it accounts for the periodicity of electron wave functions in a crystalline solid.	**CO3**	**L3**
f)	Discuss the Kronig-Penney model in band theory, including its assumptions, mathematical formulation, and implications for electronic band structure.	**CO3**	**L3**

UNIT-V

S.No.	Question	CO	Bloom's Taxonomy
a)	Describe basic structure of Nucleus. Discuss essential properties of a nucleus?	**CO1**	**L1**

b)	What do you mean by energy of nucleons? Show how the concept of binding energy is related to the stability of atomic nucleus.	**CO1**	**L1**
c)	What is mass defect ? Explain nuclear binding energy in terms of mass defect	**CO2**	**L2**
d)	Discuss the principle of various methods employed to study nuclear size.	**CO2**	**L2**
e)	Atomic weight of oxygen is 16.00 amu. If its nucleus contain 8 protons and 8 neutrons, evaluated binding energy of the nucleus. Given masses of proton= 1.00759 amu, neutron=1.00848 amu and electron 0.00063 amu.	**CO3**	**L3**

UNIT-VI

S.No.	Question	CO	Bloom's Taxonomy
a)	Describe major features of nuclear forces. Explain the role of neutron only	**CO1**	**L1**
b)	What do you mean by nuclear forces? What are their characteristics?	**CO1**	**L1**
c)	Describe liquid drop model of nucleus. What experimental results does it predict correct and what are its failure?	**CO2**	**L2**
d)	*Describe laws of conservation. Give the name of the quantities generally conserved in nuclear reaction.*	**CO2**	**L2**
e)	Explain the construction and working of Nuclear reactors	**CO3**	**L3**
f)	Explain the nuclear fission and fusion with suitable examples.	**CO3**	**L3**

UNIT-VII

S.No.	Question	CO	Bloom's Taxonomy
a)	Give the construction and working of a Van-de Graaf generator.	**CO1**	**L1**
b)	Calculate the magnetic field in which the cyclotron dees should be placed to accelerate protons, the frequency applied being $8x10^6$ c/s e=$4.8x10^{-10}$ esu mass of proton = 1.67 $x10^{-24}$ gm	**CO1**	**L1**
c)	Show that the cyclotron frequency of given kind of ions is independent of energy**.**	**CO2**	**L2**
d)	Describe the construction and working of a Synchrotron accelerator.	**CO2**	**L2**

UNIT-VIII

S.No.	Question	CO	Bloom's Taxonomy
a)	Explain the conservation law of fundamental elementary particles.	**CO1**	**L1**
b)	Explain the elementary particles and its interaction with matter.	**CO1**	**L1**

c)	Explain the theory of : (i) Neutrons and antineutrons (ii) Mesons and Pions	**CO2**	**L2**
d)	Explain the K-Mesons and its decay modes	**CO2**	**L2**
e)	Explain the fundamental interaction with mediating quanta.	**CO3**	**L3**