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PGIIS-N 1040 A-18
M.Sc. IInd Semester Examination
PHYSICS
(Atomic and Molecular Physics)(CBCS)
Paper : SCT-2.1
(New)

Time : 3 Hours Maximum Marks : 80

Instructions to Candidates:

Answer all questions.

1. a) Obtain expressions for Einstein's A and B coefficients.

   b) Give an account of spin orbit coupling and calculate the energy level splitting for a 3p electron. **(9+6)**

OR

2. a) What is meant by fine structure of spectral lines? Give an account of the fine structure of the emission lines of hydrogen atom based on spin-orbit interaction.

   b) Give an account of Thomas Fermi potential. **(10+5)**

3. a) Calculate the term splitting due to the pd-configuration in LS-coupling case.

   b) Distinguish between zeeman Effect and Paschen-Back effects with a suitable example for a two electron system. **(9+6)**

OR

4. a) Explain LS and jj coupling for atoms with two valence electrons.

   b) With relevant assumptions, compute the spin-orbit interaction energy due to single valence electron. **(5+10)**

5. a) Discuss the energy levels, frequencies, selection rules and IR spectrum of a diatomic molecule as a vibrating rotator.

   b) Describe microwave spectroscopy and explain its usefulness in understanding the structure information. **(9+6)**

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OR

6. Considering diatomic molecule as rigid rotator, deduce the theory of rotational spectrum. **(15)**

7. Discuss the construction and working principle of a semiconductor laser. **(15)**

OR

8. a) Describe the recording and reconstruction processes in holography.

   b) Explain the working principle of dye laser. **(9+6)**

9. Describe microwave spectrometer with the help of a diagram. **(10)**

OR

10. Describe Zeeman effect of hyperfine structure and isotope shift with examples. **(10)**

11. State Franck-Condon principle. Describe it for different internuclear distances. **(10)**

OR

12. Explain any two important applications of lasers. **(10)**

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PGIIS-O 1045 A-18
M.Sc. IInd Semester Examination
PHYSICS
(Basic Nuclear Physics) (CBCS)
Paper : HCT 2.1
(Old)

Time : 3 Hours Maximum Marks : 80

Instructions to Candidates:

*Answer all questions of **15** marks and two questions of **10** marks.*

1. a) Estimate nuclear radius by Coulomb energy radius method.

b) What do you mean by isotones? Give example. **(12+3)**

OR

2. a) Prove that ground state of the deuteron is an admixture of P and D states.

b) Discuss a method of determining binding energy of deuteron. **(12+3)**

3. a) Obtain Q - value equation of a nuclear reaction.

b) Describe compound nuclear reaction. **(10+5)**

OR

4. a) What are magic numbers? Give any three evidences.

b) Obtain energy level scheme for nuclei with infinite square well potential. **(3+12)**

5. Give an account of Gamow theory of alpha decay. **(15)**

OR

6. a) Explain the term "Straggling in range".

b) Give the energy loss mechanism of heavy charged particles in matter. **(3+12)**

7. a) Compare and contrast fundamental interactions in nature.

b) Give examples for leptons and baryons. **(12+3)**

OR

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8. a) Discuss in detail nuclear chain reaction.

   b) Classify the reactors. **(12+3)**

9. Write a note on nucleon quantum numbers. **(10)**

OR

10. Write a note on reaction probability and cross section. **(10)**

11. Write a note on Compton scattering. **(10)**

OR

12. Discuss in brief four factor formula. **(10)**

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PGIIS-N 1044 A-18
M.Sc. IInd Semester Examination
PHYSICS
(Basic Nuclear Physics)(CBCS)
Paper : HCT-2.1
(New)

Time : 3 Hours Maximum Marks : 80

Instructions to Candidates:

Answer all questions.

1. Describe how the nuclear size can be estimated by the alpha scattering method. **(15)**

OR

2. Work out the quantum mechanical theory of the ground state of deuteron assuming a square well potential and account for the observed properties of deuteron in its ground state. **(15)**

3. Outline Bohr's compound nucleus theory of nuclear reaction and obtain expression for the decay of the compound nucleus through a particular channel. How does the theory compare with experiments?

OR

4. Give an account of extreme single particle shell model and obtain single particle states in an infinite square well potential. Compare predictions of this model with the observed nuclear structure and properties **(15)**

5. Explain the multipole character or gamma radiation and discuss the selection rules for nuclear transitions leading to emission of gamma rays. **(15)**

OR

6. Explain the various mechanisms through which the gamma rays interact with matter and discuss the factors that determine their relative contribution to the attenuation of gamma rays. **(15)**

7. a) State the classification of the elementary particles based on their masses and name at least two members in each class.

   b) Discuss the conservation laws holds good in fundamental interactions. **(7+8)**

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OR

8. a) What are thermonuclear reactions? State and explain the parameters of plasma which control the rate of these reactions.

   b) Describe the construction and working of a Tokomak? **(8+7)**

9. With the aid of uncertainty principle, calculate the average kinetic energy of the nucleons inside a nucleus. $[\hbar c = 197.327\,\text{MeV fm}]$. **(10)**

10. Calculate the threshold energy for the $^{14}N(\alpha,p)^{17}O$ reaction using the data given. mass of proton = 1.007825 amu, mass of alpha particle = 4.002603 amu, mass of $^{14}N = 14.003074$ amu, mass of $^{17}O = 16.999131$ amu **(10)**

11. Write a note on internal conversion. **(10)**

12. Write a note on Quark model of the elementary particles. **(10)**

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PGIIS-O 1043 A-18
M.Sc. IInd Semester Examination
PHYSICS
(Basic Solid State Physics) (CBCS)
Paper No : HCT-2.2
(Old)

Time : 3 Hours Maximum Marks : 80

Instructions to Candidates:

Answer all questions.

1. a) Explain notations of planes and directions.
   b) Explain the concept of reciprocal lattice and state the properties. **(7+8)**

OR

2. a) Draw the structures of diamond and ZnS
   b) Discuss the working of power XRD method. **(7+8)**
3. a) Explain Vander Waals-London Interaction.
   b) Write a note on modelling constant. **(7+8)**

OR

4. Discuss the Einstein theory of specific heat of solids. **(15)**
5. a) Discuss the forbidden energy bands in solids.
   b) Explain the temperate variation of F-D distribution function. **(7+8)**

OR

6. a) Explain Frank-Read mechanism for dislocation multiplication.
   b) Explain grain boundary and stacking faults. **(5+10)**
7. a) Explain the concept of majority and minority carrier in semiconductor.
   b) Derive the expression for electrical conductivity in intrinsic semiconductors. **(5+10)**

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OR

8. a) Explain Meissner effects in conventional superconductors.

b) Discuss the any two applications of super conductors. **(7+8)**

9. Discuss crystal classes. **(10)**

OR

10. Discuss hydrogen bonded crystals. **(10)**

11. Discuss concept of Fermi energy. **(10)**

OR

12. Discuss statistics of electrons and holes. **(10)**

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PGIIS-N 1042 A-18
M.Sc. IInd Semester Examination
PHYSICS
(Basic Solid State Physics) (CBCS)
Paper : HCT-2.2
(New)

Time : 3 Hours Maximum Marks : 80

Instructions to Candidates:

Answer all the questions.

1. a) Explain the terms lattice, basis and crystal structure.

   b) Give the classification of crystal systems. Explain the construction of Wigner-Seitz Cell. **(6+9)**

OR

2. a) What is reciprocal lattice? List out its properties.

   b) How and when X-ray diffraction occurs. Derive Bragg's condition for X-ray diffraction. **(6+9)**

3. a) What is madelung constant? Determine its value for CsCl structure.

   b) What are metallic and hydrogen bonded crystals? Explain. **(7+8)**

OR

4. What are phonons? Obtain dispersion relation for lattice vibrations of a one dimensional monoatomic lattice and explain. **(15)**

5. a) Explain the formation of energy bands in solids.

   b) Discuss free electron motion in a three dimensional potential well. **(5+10)**

OR

6. List out various point defects possible in a crystalline solid. Derive an expression for equilibrium concentration of Frenkel defects. **(15)**

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7. a) What are intrinsic and extrinsic semiconductors? Explain.

b) Obtain expressions for carrier concentrations in an intrinsic Semiconductor. Discuss the location of Fermi level in it. **(6+9)**

OR

8. a) Discuss Meissner effect in superconductors.

b) Discuss the properties of type I and type II superconductor. Give examples. **(5+10)**

9. Draw and explain the diamond crystal structure. Mention any two properties of diamond. **(10)**

OR

10. Discuss quantization of lattice vibrations. **(10)**

11. Discuss briefly the Hall effect in Semiconductors. **(10)**

OR

12. Write a note on grain boundaries and stacking faults. **(10)**

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PGIIS-O 1040 A-18
M.Sc. IInd Semester (CBCS) Examination
PHYSICS
(Atomic and Molecular Physics)
Paper : SCT-2.1
(Old)

Time : 3 Hours Maximum Marks : 80

Instructions to Candidates:

Answer all questions.

1. a) Discuss the vector model of spin and orbital angular momentum and deduce the expression for the spin-orbit interaction energy in case of hydrogen atom.

b) Explain Pauli exclusion principle. **(10+5)**

OR

2. a) Discuss LS coupling scheme in three valence electron atoms.

b) Explain what is meant by fine structure of energy levels in many electron atoms. **(10+5)**

3. a) Discuss the Zeeman effect in two electron atoms assuming LS-Coupling.

b) Calculate the Zeeman pattern arising from the transition $^3D_3 - {}^3P_2$. **(10+5)**

OR

4. a) Derive the interaction energy due to interaction of nuclear spin in case of two valence electron atoms.

b) Determine the hyperfine structure levels for ^3D terms for the case where I = 1/2. **(10+5)**

5. a) Discuss the rotational spectrum for the rigid rotator model of the diatomic molecule.

b) Explain with an example how the rotational spectrum can be used to determine the inter nuclear distance. **(10+5)**

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OR

6. a) What are progression and sequences in the vibrational band structure of an electronic transition? Explain.

   b) Describe the three types of intensity distribution in an electronic band absorption by using Franck-Condon principle. **(5+10)**

7. a) Explain the principle on which a typical laser works. Describe the various population inversion techniques.

   b) Write a note on the application of lasers **(10+5)**

OR

8. a) Explain the principle of holography.

   b) Describe the recording and reconstruction of the holograms. **(5+10)**

9. Explain the Lamb-Shift in the fine-structure of atoms. **(10)**

OR

10. Discuss the effect of isotope substitution on the spectrum of atoms. **(10)**

11. Give the schematic diagram of an UV-V is spectrometer. Explain its working. **(10)**

OR

12. Describe the working of nitrogen laser. **(10)**

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PGIIS-O 1043 A-18
M.Sc. IInd Semester Examination
PHYSICS
(Basic Solid State Physics) (CBCS)
Paper No : HCT-2.2
(Old)

Time : 3 Hours Maximum Marks : 80

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