PH 571.4 Reg No

St Aloysius College (Autonomous)
Mangaluru
Semester IV – P.G. Examination – M.Sc. Physics
May - 2024
ATOMIC AND MOLECULAR PHYSICS

Time : 3 Hours **Max. Marks : 70**

PART A

Answer all questions choosing ONE from each unit. **(4 x 15 =60)**

Unit I

1 a. Detail the Stern-Gerlach experiment, emphasizing its contribution to the understanding of angular momentum and spin quantization. **(9)**

b. Distinguish between Zeeman effect and Paschen-Back effect with the suitable example for two electron system. **(6)**

OR

2. a. Discuss the Bohr model for hydrogen in detail, including its postulates and how it explains atomic spectra. Evaluate the strengths and limitations of the Bohr model. **(9)**

b. Explain Moseley's law and its importance in understanding the periodic table. **(6)**

Unit II

3. a. Describe the interaction of hydrogenic atoms with an electromagnetic field. Discuss the key principles of the interaction and how it influences the behavior of electrons in these atoms. **(6)**

b. Derive the Schrödinger equation for one-electron atoms and discuss its applications. Explain how this equation accounts for the energy levels and wave functions of electrons in a hydrogenic environment. **(9)**

OR

4. a. Discuss the central field approximation in detail, in the context of many-electron atoms. Evaluate its strengths and limitations, and illustrate its application in understanding the electronic structure of complex atoms. **(9)**

b. Explain the concepts of spontaneous absorption, stimulated emission, and spontaneous emission in the context of transition rates. Discuss the dipole approximation and its role in simplifying the calculation of transition probabilities. **(6)**

Contd..2

Unit III

5. a. Elaborate on the experimental techniques employed in microwave spectroscopy. Discuss the principles behind these techniques and their role in obtaining accurate data for the analysis of diatomic molecular structures. **(9)**

   b. State and explain Frank Condon principle. **(6)**

OR

6. a. Explain the rotational fine structure in electronic spectra. Discuss the formation of bands and the shading of bands in the electronic spectra of diatomic molecules. **(6)**

   b. Discuss the fine structure in electronic spectra and the formation of bands in diatomic molecules. Explain how the Frank-Condon principle influences electronic transitions, and discuss methods for determining molecular parameters such as I, r, and band origin. **(9)**

Unit IV

7. a. Compare the basic principles of Nuclear Magnetic Resonance (NMR) and Electron Spin Resonance (ESR) spectroscopy. Discuss the common features and differences in their applications. **(6)**

   b. Discuss the principles of Mossbauer spectroscopy and its applications. Explain how Mossbauer spectroscopy provides unique insights into the behavior of certain isotopes and its significan 6ce in various fields. **(9)**

OR

8. a. Discuss the effect of applied external fields on the behavior of nuclear and electron spins in NMR and ESR spectroscopy. Explain how these fields influence the energy levels and transitions in spin resonance. **(9)**

   b. Explain the classical theory of Raman effect **(7)**

PART - B

Answer any TWO questions. **(2x5=10)**

9. a. Explain how atomic states are represented in L-S and j-j coupling schemes.

   b. What are Einstein's coefficients? Deduce the relationship between them.

   c. Outline the effect of isotopic substitution on the rotational spectra of diatomic molecules.

   d. Explain the Nuclear Magnetic resonance experimental technique.

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St Aloysius College (Autonomous)

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Semester IV – P.G. Examination – M.Sc. Physics

May - 2024

NUCLEAR AND PARTICLE PHYSICS

Time : 3 Hours **Max. Marks : 70**

PART A

Answer all questions choosing ONE from each unit. **(4x15=60)**

Unit I

1 a. How is the mass spectrometer useful in the determination of nuclear mass? **(6)**

b. Give the Gamow's theory of alpha decay and explain it in detail. **(9)**

OR

2. a. Define the quadrupole momentum of a nucleus. Explain how the definition leads to the understanding of the shape of the atomic nuclei. **(6)**

b. What are the assumptions of the liquid drop model? Derive the expression for the semiempirical mass formula. **(9)**

Unit II

3. a. Explain energy loss when a charged particle passes through matter. Discuss Bethe-Bloch formula. **(9)**

b. Write a brief note of detection of neutrons. **(6)**

OR

4. a. Explain the principle of G.M Counter. **(6)**

b. Give the principle of a scintillation counter and compare its action with that of a GM counter. **(9)**

Unit III

5. a. Explain any four features of nuclear force. **(6)**

b. Explain Yukawa's theory of nuclear forces. **(9)**

OR

6. a. Explain the shell model of the nucleus. How does it explain the magic numbers and spins of the ground state of nuclei based on spin orbit interaction? **(9)**

b. Explain Q value of nuclear reactions. Obtain the expression for threshold energy for endoergic nuclear reaction. **(6)**

Unit IV

7. a. Distinguish between bosons and Fermions. **(6)**

b. Explain the conservation laws and symmetries. **(9)**

OR

8. a. Distinguish between electromagnetic force and nuclear force. **(6)**

b. Give the quark model of elementary particles. **(9)**

PART - B

Answer any TWO questions. **(2x5-10)**

9. a. Write a note on internal conversion.

b. A 1.332 MeV Y- photon is Compton scattered at angle of 140°. Calculate the energy acquired by the recoiled electron.

c. How you can explain deuteron is a loosely bound system.

d. Explain CP violation.

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St Aloysius College (Autonomous)

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Semester IV – P.G. Examination – M.Sc. Physics

May - 2024

Lasers, Vacuum Techniques and Nonlinear Optics

Time : 3 Hours **Max. Marks : 70**

PART A

Answer all questions choosing ONE from each unit. **(3 x 18 =54)**

Unit I

1 a. Discuss the phase matching criterion in SHG. **(10)**

b. Explain the properties of LASER and its applications. **(8)**

OR

2. a. Briefly discuss the construction and working of a Nd YAG laser with the energy level diagram. **(10)**

b. What is harmonic generation? Obtain the polarization expression for second harmonic generation? **(8)**

Unit II

3. a. With the help of neat diagram discuss the working of a turbo molecular pump. Compare its performance with an oil diffusion pump. **(10)**

b. Describe the construction and working of pirani gauge and mention its limitations. **(8)**

OR

4. a. Explain the working principles of Cryo pump. **(10)**

b. What is vacuum? Explain the classification of vacuum spectrum. Mention few application of vacuum in experimental physics. **(8)**

Unit III

5. a. With neat diagram explain principle of atomic force microscopy. **(8)**

b. Explain the principle of energy dispersion spectroscopy. Mention its applications. **(10)**

OR

6. a. How electron microscopes differ from optical microscope? Explain the nature of electron interaction with matter. **(8)**

b. Discuss in detail construction and working principle of SEM. **(10)**

PART B

Answer any FOUR questions. **(4 x 4 =16)**

7 a. What is self-focussing light? Explain.

b. What is pumping speed of a rotary vane pump? Write any two drawbacks of rotary vane pump.

c. Discuss low energy electron diffraction.

d. Write a note on population inversion and metastable state.

e. Discuss the applications of TEM.

f. Write a note on Reynold's and Knudsen's number.

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St Aloysius College (Autonomous)
Mangaluru
Semester IV – P.G. Examination – M.Sc. Physics
MAY - 2024
CONDENSED MATTER PHYSICS III

Time : 3 Hours **Max. Marks : 70**

PART A

Answer all questions choosing ONE from each unit **(3x18=54)**

Unit –I

1 a. With a schematic diagram explain DC Sputtering technique of film deposition. **(6)**

b. Explain the quartz crystal monitoring method for thin film thickness measurement. **(6)**

c. Explain different CVD techniques. **(6)**

OR

2 a. Explain the capillarity theory of homogeneous nucleation. Explain the various stages of thin film growth. **(6)**

b. Describe an optical method of determining the thickness of a thin film. **(6)**

c. Describe qualitatively conduction mechanism in metallic thin films. **(6)**

Unit-II

3 a. Arrive at London's equations and explain how they explain Meissner effect. **(10)**

b. Explain flux quantization in superconductivity. **(4)**

c. Write a note on cooper pair tunneling. **(4)**

OR

4 a. Explain with necessary theory DC Josephson effect. **(8)**

b. Enumerate the properties of type -II superconductors. **(5)**

c. Explain the BCS theory of superconductivity. **(5)**

Unit-III

5 a. What is piezoelectric effect? Explain how structure of PZT material is modified when stress is applied on it **(10)**

b. Explain giant magnetostrictive effect in Terfenol-D. **(4)**

c. What are dielectric elastomers? Explain. **(4)**

OR

6 a. Give the phenomenological description of phase transformation in shape memory alloys. **(8)**

b. What are ferrofiluids? Explain surfacted ferrofluids and ionic ferrofluids. **(5)**

c. Explain the properties of magnetic and semiconductor nanoparticles. **(5)**

PART-B

7 **Answer any FOUR Questions.** **(4x4=16)**

a. Explain Reflection and transmission of light in thin films.

b. Write a note on high temperature superconductors.

c. Describe the principle of SQUID.

d. What are photo chromatic materials?

e. Explain the synthesis of nanopartices by inert gas evaporation method.

f. Explain electrical conductivity in the case of nano and bulk materials.

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