M.Sc. Final (Physics) Examination, August/September 2008
Directorate of Correspondence Course
Paper – V : ELECTRODYNAMICS, OPTICS AND MOLECULAR SPECTROSCOPY

Time: 3 Hours Max. Marks: 75

*Note : 1) Answer **any FIVE** questions from Part A, B, and C without omitting any Part.*
*2) Part D is **compulsory**.*

PART – A

1. a) Derive the expression for the potential due to an arbitrary continuous distribution of charge.
   b) An electric dipole consists of two equal and opposite charges ($\pm q$) separated by a distance d. Find the approximate potential at points far from the dipole. **(8+4)**

2. a) State and explain Biot– Savart law.
   b) Obtain the expression for the magnetic dipole moment of a current loop. **(4+8)**

3. a) Discuss the propagation of electromagnetic waves in free space.
   b) Deduce the Poynting's theorem to give its physical significance. **(8+4)**

PART – B

4. Give the elementary theory of dispersion and explain the term anamolous dispersion. **12**

5. a) Explain optical classification of crystals.
   b) Give an account of interference figures in uniaxial crystals. **(5+7)**

6. a) Explain the properties of Laser light.

   b) Explain the construction and working of He-Ne laser. **(4+8)**

PART – C

7. a) Discuss the rotational fine structure of an electronic transition in diatomic molecules.

   b) What is dissociation energy ? **(9+3)**

8. a) Explain briefly the fine structure in ESR.

   b) Describe with neat diagram the principle and working of ESR spectrometer. **(3+9)**

9. a) Discuss vibrational Raman Spectra and its correlation with IR spectra.

   b) Explain briefly polarization of Raman lines. **(9+3)**

PART – D

10. Write short notes on the following :

    a) Brewster's law

    b) Electric dipole radiation

    c) Holography

    d) Mossbauer spectrometer

    e) NMR Spectroscopy. **(5×3=15)**

[redacted] **DPB – 520 PHY**

M.Sc. (Final) Examination, August/September 2008
Directorate of Correspondence Course
PHYSICS
Paper – VI : Nuclear Physics, Cosmic Rays and Elementary Particles

Time : 3 Hours | Max. Marks : 75

Note : *1) Answer **any FIVE** questions from Part **A**, Part **B** and Part **C** without omitting any **Part**.*

*2) Part **D** is **compulsory**.*

PART – A

1. a) How one can determine the nuclear radius by the method of electron scattering ? Explain with a neat diagram.
   b) Explain the term parity. **(10+2)**

2. a) Describe the mechanism of three important processes through which gamma rays interact with matter.
   b) Calculate the Compton wave length of the electron.
   (Given : $h = 6.626 \times 10^{-34}$ Js and $m_o c^2 = 511$ keV) **(9+3)**

3. a) Define the total and differential nuclear cross sections.
   b) Deduce the relation between the cross section and the mean free path. **(6+6)**

PART – B

4. a) Explain the continuous nature of the beta ray spectrum.
   b) Give the Fermi's theory of beta decay. **(3+9)**

5. a) By using the time dependent perturbation theory obtain an expression for the probability of K-electron capture.
   b) Explain with suitable examples, the meaning of double beta decay. **(6+6)**

P.T.O.

6. a) What are the assumptions of the liquid drop model of a nucleus ? Explain the stability of isobaric nuclei against beta decay.

   b) If the level density of the nucleus $^{100}_{44}Ru$ at excitation energy of 8 MeV is found to be 3×10^{8}, calculate its mean level spacing. **(10+2)**

PART – C

7. a) Explain the slowing down process of neutrons in matter and hence obtain an expression for the maximum possible energy loss of a neutron in a single collision.

   b) Calculate the maximum possible energy loss of a 2 MeV neutron when it under goes a single collision with the carbon nucleus. **(10+2)**

8. a) Explain the various types of cosmic ray showers.

   b) With a neat diagram, explain the production and detection of antiproton. **(6+6)**

9. a) What do you mean by the τ-θ puzzle ? How it was resolved ?

   b) Write and explain the Gell-Mann-Nishijima scheme. Using this calculate the strangeness quantum number of Ω^-, K^+ and K^0 particles. **(6+6)**

PART – D

10. Write short notes on the following :

    a) Scintillation counters

    b) Microtron

    c) Meson theory of nuclear forces **(5+5+5)**

M.Sc. Final (Physics) Examination, August/September 2008
Directorate of Correspondence Course
Paper – VII : SOLID STATE PHYSICS – I

Time : 3 Hours Max. Marks : 75

***Note** : Answer **any FIVE** from Parts **A, B** and **C** at least taking one from **each**. Part **D** is **compulsory**.*

PART – A

1. a) Explain the dynamics of the chain of identical atoms with specific examples.

   b) Experimentally how do you determine dispersion ? **(8+4)**

2. a) Give an account of Sommerfield theory of electrical conductivity of metals.

   b) Derive an expression for the electrical resistivity of metal. Explain how it varies over a wide range of temperature. **(4+8)**

3. a) Explain phonon-phonon interaction. Explain how thermal conductivity of insulators varies with temperature ? Also, explain the role of impurities and imperfections on thermal conductivity.

   b) Derive an expression for thermal conductivity of metal. **(8+4)**

PART – B

4. a) What are dielectrics ? Define dielectric constant and dielectric loss. Explain the importance of dielectric constant in electrical engineering.

   b) Explain how do you experimentally determine dielectric constant and relaxation time ? **(8+4)**

5. a) What are ferroelectric materials ? Explain different types of ferroelectrics and their properties.

   b) Explain the importance of Barium titanate ferroelectric. Give the theory of spontaneous polarization of Barium titanate. **(4+8)**

P.T.O.

6. a) Distinguish different types of luminescence phenomenon. Give the conditions to observe luminescence from substance.

   b) Explain how do you experimentally study the thermoluminescence in an ionic crystal. **(7+5)**

PART – C

7. a) Give an account of various types of lattice defects present in an ionic crystal.

   b) Explain the ionic conductivity of an alkali halide in its pure and with Ca^{2+} impurities. **(5+7)**

8. a) Define the first and second Fick's law and explain its importance.

   b) Give an account of diffusion in solids in general and alkali halide in particular. **(4+8)**

9. a) What are color centers ? Explain some importance types of colour centers.

   b) Explain the method of production of F-centers by additive coloration technique and the related mechanism. **(4+8)**

PART – D

10. Write notes on the following : **(5×3=15)**

    a) Umklapp process.

    b) Electroluminescence.

    c) Gudden-Pohl effect.

    d) Photoconductivity.

    e) Kirkendall effect.

[redacted] **DPB – 540 PHY**

M.Sc. Final (Physics) Examination, August/September 2008
Directorate of Correspondence Course
PHYSICS
Paper – VIII : Solid State Physics – II

Time : 3 Hours Max. Marks : 75

*Note : Answer **any FIVE** questions from Parts A, B and C without omitting **any** Part. Part **D** is **compulsory**.*

PART – A

1. a) Explain spin waves and magnons.
   b) Deduce the Bloch $T^{3/2}$ law and explain its validity. **(4+8)**

2. a) Give the basic theory of NMR.
   b) Draw a block of NMR spectrometer and explain the functioning of each part. Mention important applications of NMR. **(6+6)**

3. a) Explain the origin of superfluidity in liquid ^4He and liquid ^3He.
   b) With the help of suitable theory, explain the variation of specific heat, and susceptibility in liquid ^3He. **(4+8)**

PART – B

4. Obtain an expression for Fermi energy for an n-type semiconductor and explain the variation of E_f as function of temperature and carrier concentration. **12**

5. a) Obtain an expression for electrical conductivity for a p-type semiconductor. Explain how the conductivity and mobility vary as a function of temperature.
   b) Write a note on impurity band conduction. **(9+3)**

6. a) What is Hall effect ? Deduce an expression for Hall coefficient for an intrinsic semiconductor.
   b) Deduce the Einstein's relation. **(8+4)**

P.T.O.

PART – C

7. a) With suitable band diagram explain metal-insulator contacts.
   b) Explain the functioning of tunnel and Zener diode. **(6+6)**

8. a) Explain the construction and working of semiconducting laser.
   b) Write a note on photovoltaic devices. **(6+6)**

9. a) Give the salient features of BSC theory of superconductivity.
   b) Show that the magnetic flux through a superconducting ring is quantized. **(5+7)**

PART – D

10. Write short notes of the following :
    a) Structure of ferrites
    b) Diffusion of excess carriers in semiconductors
    c) Two sublattice model
    d) Gunn effect
    e) High Tc superconductors. **(5×3=15)**