Final M.Sc., Degree Examinations
September /October 2015
Directorate of Distance Education
PHYSICS
DPB510: Paper V : Electrodynamics, Optics and Molecular Spectroscopy

Time: 3 hrs]   *[Max.Marks: 75/85*

Instructions :   1. *Answer any FIVE questions from Parts A,B and C*
                        without omitting any Part.
                     2. *Part D is compulsory for those who appear for*
                        paper with maximum marks 85.

PART - A

1. a) Starting from Gauss law, obtain Poisson and Laplace equations.

   b) Arrive at the multipole expansion of electrostatic potential.   **(5+10)**

2. a) What are gauge transformations? Explain. Show that electric and magnetic fields
      are unaltered by gauge transformations.

   b) Discuss the propagation of plane electromagnetic waves in free space.   **(8+7)**

3. a) Derive Poynting's theorem by using Maxwell's equations and hence obtain
      expression for the energy and momentum of electromagnetic field,

   b) What are retarded Potentials? Explain.   **(10+5)**

PART- B

4. a) State the boundary conditions for electromagnetic field.

   b) Obtain Fresnel's formulae for reflection and refraction when the electric vector is
      polarized parallel to the plane of incidence.   **(4+11)**

5. a) Give the theory of light propagation in uniaxial and biaxial crystals.

   b) Distinguish between normal and abnormal dispersion.   **(10+5)**

6. a) Explain the phenomenon of second harmonic generation in nonlinear optical
      material.

   b) How an image can be recorded with Holographic technique?   **(7+ 5)**

PART- C

7. Give an account of electronic spectra of diatomic molecules.   **(15)**

8. a) Explain the principle of Nuclear Magnetic Resonance, with a neat diagram.

b) Explain the working of NMR spectrometer. **(8+7)**

9. a) Give the theory of rotational and vibrational Raman spectra of diatomic molecules,

b) Write a note on Laser Raman Spectroscopy. **(12+3)**

PART-D

10. Answer any TWO of the following: **(2X5=10)**

a) Biot-Savart law.

b) Principles of laser.

c) Electron spin resonance.

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PHYSICS
DPB520 Paper – VI : Nuclear Physics, Cosmic Rays and Elementary Particles

Time: 3 hrs.]   *[Max.Marks:75/85*

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

2. Part D is compulsory for those who appear for paper with maximum marks 85.

PART - A

1. a) How nuclear radius is determined from a) alpha decay method and b) mirror nuclei method? Explain. **(15)**

2. a) Obtain an expression for the energy loss due to ionization of proton like charged particles when they pass through matter.

b) Describe the principle and working of a gas filled counter. **(10+5)**

3. a) With a neat schematic representation, explain the principle and working of Microtron. Also, mention few applications.

b) Write a note on the relationship between cross section and mean free path. **(9+6)**

PART - B

4. a) Describe Fermi's theory of beta decay.

b) What do you mean by Mossbauer effect? Explain. **(10+5)**

5. a) Outline the general features of nuclear forces.

b) How do you account for the anomalous magnetic moment of neutron. **(9+6)**

6. a) How the Shell model explains the structure of nucleus? Explain.

b) Explain the fission process. **(10+5)**

PART - C

7. a) With a neat diagram, explain the working of a nuclear reactor. Also obtain an expression for four factor formula.

b) Explain the need of reflectors in a nuclear reactor. **(10+5)**

8. a) Give an account of cosmic ray showers through their experimental evidences.

   b) Describe the motion of charged particle in earth's magnetic field. **(8+7)**

9. a) How the elementary particles are classified? Explain.

   b) Write a note on eight-fold way and quarks. **(9+6)**

PART - D

10. **Write short notes on any TWO of the following :**

    a) Parity and isospin **5**

    b) Nuclear Isomerism **5**

    c) Moderators in reactor **5**

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PHYSICS
DPB 530: Paper VII : Solid State Physics - I

Time: 3 hrs]   *[Max.Marks: 75/85*

Instructions :   *1. Answer any FIVE questions from Parts A,B and C*
                          without omitting any Part.
                      2. Part D is compulsory for those who appear with maximum
                          marks 85.

PART - A

1. a) Arrive at dispersion relation for one-dimensional monoatomic lattice and discuss the properties of the one-dimensional dispersion relation.

   b) Give a qualitative discussion on three-dimensional lattice vibrations.   **8+7**

2. a) Arrive at Boltzmann transport equation under relaxation time approximation.

   b) Discuss Sommerfeld theory of electrical conductivity of metals.   **7+8**

3. a) Discuss temperature dependence of resistivity of metals.

   b) Explain normal and Umkalpp process of phonon collisions in solids. Why phonon contribution to thermal resistance is negligible at low temperatures?   **8+7**

PART - B

4. a) What is meant by polarization in dielectrics? Explain

   b) Explain the terms "dielectric constant" and "dielectric losses".

   c) What is meant by dipole relaxation? Derive Debye equation and discuss the condition for dielectric dispersion and resonance absorption.   **3+4+8**

5. a) What are ferroelectric materials? How they are classified? Mention few applications of ferroelectric crystals.

   b) Give the classical theory of electronic polarization in dielectric.   **8+7**

6. a) Give Landau theory of first order phase transition.

   b) Explain the processes of luminescence excitation and emission in solids.   **8+7**

PART-C

7. a) Discuss about first and second Fick's law of diffusion in solids.

   b) Explain the process of ionic conduction in pure alkali halides. **8+7**

8. a) Arrive at Nernst-Einstein relation of diffusion and apply the relation for ionic conductors

   b) Discuss the production of colour centers in solids by X-ray irradiation. **10+5**

9. a) Discuss about applications of diffusion, diffusion measurements and random-walk treatment of diffusion in solids.

   b) Explain about different types of colour centers found in solids. **10+5**

PART-D

10. Write a note on any TWO of the following: **2X5=10**

   a) Hall effect

   b) Gudden – Pohl effect

   c) The activation energy for the formation of defects in ionic solids.

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Final MSc., Degree Examinations

September /October 2015
Directorate of Distance Education
PHYSICS
DPB540 : Paper – VIII : Solid State Physics II

Time: 3 hrs.] [*Max.Marks:75/ 85*

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

         2. Part D is compulsory for those who appear for paper with maximum marks 85.

PART - A

1. a) Write the salient features of ferromagnetism? Describe the Weiss theory of ferromagnetism.

    b) Give the theory of magnetic domains in a ferromagnetic material. **(10+5)**

2. a) Describe the structure of ferrites. How is the magnetic moment of ferrite molecule calculated?

    b) Explain two sublattice model for antiferromagnetic materials. **(5+10)**

3. a) Describe Casimir and Dupre's thermodynamical theory of spin lattice relaxation.

    b) Explain the behavior of solutions of ^{3}He in liquid ^{4}He. **(7+8)**

PART - B

4. a) Obtain an expression for an electrical conductivity in impurity semiconductors and explain the variation of electrical conductivity with respect to band gap.

    b) Explain the term Fermi energy. How does Fermi energy vary with temperature and impurity density. **(10+5)**

5. a) Obtain an expression for the Hall coefficient of a semiconductor in terms of mobilities.

    b) Explain the effect of temperature, impurity concentration and magnetic field on Hall mobility. **(9+6)**

6. a) Explain the generation and recombination rates of excess carriers in semiconductors.

    b) Obtain continuity equation for excess carriers in semiconductors. **(7+8)**

PART – C

7. a) Deduce an expression for the space charge density under high field transport.

    b) Explain the theory of carrier transport in p-n junctions. **(8+7)**

8. a) Discuss the photo voltaic devices for radiation detection.

    b) Explain the laser action in p-n junction diodes. **(9+6)**

9. a) Explain Type I and Type II superconductors with examples.

    b) Write the applications of superconductors. Write a note on high temperature superconductors.

    c) How are Cooper pairs formed in superconductors? **(6+6+3)**

PART – D

10. **Answer any TWO of the following :**

    a) Write a note on Neel's temperature.

    b) Discuss impurity band conductivity.

    c) Write a note on photovoltaic devices. **(5 X2=10)**

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