Final Year M.Sc., (Physics) Examination

August / September 2009

Directorate of Distance Education

(Freshers)

Paper - V : Electrodynamics, optics and molecular spectroscopy

Time : 3 Hours Max. Marks : 85

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

PART- A

1. a. What are conservative fields? Show that electrostatic field is a conservative field.

   b. Derive Poison and Laplace equations satisfied by the electrostatic potential. **(8+5)**

2. a. Write brief notes on (i) Biot - Savart law (ii) Lorentz force experienced by a charged particle moving in electric and magnetic fields.

   b. Discuss Maxwell's contribution to electrodynamics and arrive at the wave equations satisfied by the electric, magnetic field vectors in vacuum. **(4+9)**

3. a. Discuss the propagation of plane waves in a conducting medium.

   b. What are retarded potentails ? Explain

   c. What are gauge transformations ? Explain. **(6+4+3)**

PART- B

4. a. Explain the concept of polarization by reflection.

   b. Derive Fresnel's formulae for reflection and refraction when the electric vector is polarized perpendicular to the plane of incidence. **(4+9)**

5. a. Give the general theory of interference of two monochromatic waves.

   b. Write a note on Fabry - perot interferometer and derive expression for resolving power of Fabry - perot interferometer. **(5+8)**

6. a. Illustrate the theory of interference figures in uniaxial crystals.

   b. Explain the construction and working of Ruby laser. **(6+7)**

PART- C

7. a. Explain the Frank - Condon principle for diatomic molecules.
   b. Describe the principle and working of the photoelectron spectrometer. **(5+8)**
8. a. Describe the principle and working of Mossbauer spectrometer.
   b. Discuss one simple application of the Mossbauer spectroscopy. **(9+4)**
9. a. Give the principle of Nuclear Magnetic Resonance.
   b. Explain briefly a typical NMR spectrometer and discuss how structural information can be obtained from the knowledge of the NMR spectrum. **(5+8)**

PART- D

10. **Write short notes on the following.** **(4x5=20)**
    a) Poynting theorem
    b) Coulomb Gauge and Lorentz Gauge
    c) Sellmeir's equation
    d) Fresnel diffraction at a circular aperture
    e) ESR spectrometer

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Paper - VI : Nuclear Physics, Cosmic Rays and Elementary Particles

Time : 3 Hours Max. Marks : 85

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

PART- A

1. a. What do you mean by the magnetic moment of a nucleus?

   b. Establish the relationship between I and μ of a nucleus on the basis of single particle model. **(3+10)**

2. a. Discuss in detail the energy loss of heavy charged particles while passing through matter.

   b. Write a note on Cerenkov counter. **(8+5)**

3. a. What is a nuclear reaction? Deduce an expression for the Q-value of a nuclear reaction and discuss its solutions.

   b. Deduce the relation between Nuclear cross section and mean free path. **(8+5)**

PART- B

4. a. Give Gamow's theory of alpha decay.

   b. Explain briefly Pauli's neutrino hypothesis **(9+4)**

5. a. With relevant experimental evidences argue that Nuclear forces are charge independent and spin dependent.

   b. The magnetic moments of nucleons are called anamolous. Explain. **(9+4)**

6. a. What are the basic assumptions of liquid drop model? Write down the semi-empirical mass formula for a nucleus and discuss the contribution of each term in it.

   b. Write briefly on nuclear evaporation. **(9+4)**

PART- C

7. a. Obtain the critical size of a homogeneous bare spherical reactor. Mention the uses of reflectors in a reactor

   b. Write breifly on moderators in nuclear reactors. **(9+4)**

8. a. Outline briefly Fermi's mechanism of acceleration.

   b. Discuss the motion of a charged particle in earth's magnetic field. **(7+6)**

9. a. Describe an experiment to measure the life time of charged pions.

   b. Write a note on the Eight fold way symmetry of baryons. **(8+5)**

PART- D

10. **Write short notes on the following.** **(4x5=20)**

    a) Gell - Mann and Nishijima scheme

    b) Microtron.

    c) Parity and isospin

    d) Stormer's cone

    e) Superiority of scintillation counter over gas filled counter.

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Final Year M.Sc., (Physics) Degree Examination

August / September 2009

Directorate of Distance Education

(Freshers)

Paper - VII : Solid State Physics - I

Time : 3 Hours Max. Marks : 85

Note : Answer any FIVE questions from Part A , B and C without omitting any part. Part D is compulsory. Each question carries 13 marks. Part D carries 20 marks.

PART- A

1. a. Explain the dynamics of identical atoms in three dimensions.
   b. Explain the terms ' anharmonicity' and 'thermal expansion'. **(7+6)**
2. a. Obtain the semiclassical boltzmann transport equation in the relaxation time approximation.
   b. Explain the electronic specific hert of metals. **(8+5)**
3. a. Distinguish between normal and Umklapp processes.
   b. Compare the thermal conductivity of metals and dielectrics. **(6+7)**

PART- B

4. a. Explain 'electronic' ' ionic' and 'orientation polarisations in dielectrics.
   b. Explain dielectric relaxation in solids. **(8+5)**
5. a. Discuss dipole theory of ferroelectricity. What are the objections against this theory?
   b. What are ferroelectric domains ? Explain. **(9+4)**
6. a. Discuss the different decay mechanisms.
   b. Explain i) Gudden - Pohl ii) Destrain effects **(7+6)**

PART- C

7. a. Derive an expression for the activation energy for the formation of defects in ionic crystals.
   b. Explain how ionic conductivity takes place in case of divalent impurity alkali halides. **(8+5)**

8. a. Obtain the Nernst - Einstein relation for atomic diffusion in solids.
   b. Explain kirkendall effect. **(8+5)**

9. a. Discuss the photoconductivity in crystals containing excess metal ion.
   b. Explain how the transformation takes place between F and F' color centres. **(7+6)**

PART- D

10. **Write short notes on the following.** **(4x5=20)**
    a) Hall effect in metals.
    b) Phonon- phonon interactions
    c) Polarisation catastrophe
    d) thermolumino cence
    e) Photovoltaic effect.

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Final Year M.Sc., (Physics) Degree Examination

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Paper - VIII : Solid State Physics - II

Time : 3 Hours Max. Marks : 85

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

PART- A

1. a. Discuss the domain structure in ferromagnetic materials.
   b. Give an account of Heisenberg's theory of the origin of the Weiss magnetic field. Establish the criteria for ferromagnetism. **(5+8)**
2. a. Describe the structure of ferrites.
   b. Give an account of Neel's theory of antiferromagnetism and show how the ferromagnetic behaviour of ferrites can be explained from Neel's theory. **(5+8)**
3. a. Give the basic theory of ESR
   b. Explain the variation of specific heat, susceptibility and transport co-efficient in liquid ^3He. **(5+8)**

PART- B

4. a. Distinguish between intrinsic and impurity semiconductors. Give an example for each class of semiconductors.
   b. Obtain an expression for the carrier concentration for an intrinsic semiconductor. **(6+7)**
5. a. Indicate on an energy level diagram the conduction and valence bands, donor and acceptor states. What are the positions of Fermi levels for
      a. intrinsic semiconductor
      b. n - type semiconductor
      c. p - type semiconductor
   b. Discuss the effect of impurity density on Fermi energy at low temperature. **(8+5)**
6. a. Derive Hall co- efficient in terms of mobility and carrier densities.
   b. Discuss the effect of temperature and magnetic field on Hall mobility. **(6+7)**

PART- C

7. a. What is the effect on the space charge width at a p - n junction when the junction is (i) forward - biased (ii) reverse biased.

   b. Explain the terms barrier energy, barrier potential and depletion region as applied to a p-n junction **(6+7)**

8. a. What is photoconductivity ? How does it arise ? Mention a few applications of the phenomenon.

   b. What is luminescence? Explain the laser action in p -n junction diodes. **(6+7)**

9. a. What are superconductors? Explain Type I and Type - II superconductors.

   b. Discuss DC and AC Josephson's effects and explain their importance. **(7+6)**

PART- D

10. **Write short notes on the following.** **(4x5=20)**

    a. Liquid ^3He as a Fermi gas

    b. Generation and recombination in semiconductors

    c. Magneto-resistance phenomenon

    d. Metal-semiconductor contacts

    e. Light emitting diodes.

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