M.Sc.—Phy-IIIS (CEC 304/ CEC 305)

2019

(January)

Time : 3 hours

Full Marks : 80

Answer all questions from any one Group according to your specialisation

The figures in the right-hand margin indicate marks

Candidates are required to answer in their own words as far as practicable

GROUP – I

(CONDENSED MATTER AND MATERIALS PHYSICS-I)

SECTION – A

1. **Answer any *four* of the following :** 4 × 4

   (*a*) **State and explain de Haas-von Alphen effect.**

(*b*) Obtain an expression for thermal conductivity.

(*c*) Explain Local density approximation in electron-electron interaction.

(*d*) Write a note on Type I and Type II superconductors.

(*e*) Explain Josephson effect.

(*f*) Give the elementary ideas of high Tc superconductors.

Or

2. Answer *all* questions from the following : 2 × 8

(*a*) What are phonens ? Explain.

(*b*) Define electrical conductivity.

(*c*) What are the advantages of Hartree-Fock approximation ?

(*d*) What do you mean by local density ?

(*e*) Explain energy gap in superconductivity.

(*f*) Define superconducting transition.

(*g*) What are Quasi electrons ? Explain.

(*h*) Define what is electron gas.

SECTION– B

Answer **all** questions : 16 × 4

3. (*a*) Describe the OPW and Pseudo-potential methods for the calculation of band energy.

Or

(*b*) Explain relaxation approximation method and obtain an expression for electrical conductivity.

4. (*a*) Distinguish between Hartree approximation and Hartree-Fock approximations in electron-electron interactions and explain Hartree approximation.

Or

(*b*) Describe in detail the density functional theory and explain its advantages.

5. (*a*) Discuss the occurrence of superconductivity and explain Meissner effect.

Or

(*b*) Obtain London equation and discuss the qualitative ideas of BCS theory.

6. (*a*) Explain Electron -Phonon interaction and discuss the significance of cooper pairs in superconductivity.

Or

(*b*) Explain the ground state of superconducting electron gas and write a note on high Tc superconductors.

GROUP– II

(NUCLEAR SCIENCE-I)

SECTION– A

1. Answer any *four* of the following : 4 × 4

(*a*) Explain the eigen functions of angular momentum operator.

(*b*) Write a note on irreducible spherical tensor.

(*c*) Give the salient features of optical model.

(*d*) Give briefly the vibrational modes of a spherical nucleus.

(*e*) Write a note on quadrupole deformation.

(*f*) Explain the electric quadrupole moment and magnetic dipolemoment.

Or

2. Answer *all* questions from the following : 2 × 8

(*a*) Define rotation matrices.

(*b*) Define the irreducible spherical tensor.

(*c*) Give the concept of optical model.

(*d*) What do you mean by complex potential ? Explain.

(*e*) Define moment of inertia.

(*f*) Define coupling of a particle.

(*g*) Define nuclear deformation.

(*h*) Define magnetic dipole moment for an even-even nuclei.

SECTION–B

Answer all questions : **16 × 4**

3. (*a*) Discuss the Rotational invariance in three dimensions and explain the explicit representation of the rotation matrices.

Or

(*b*) Explain the addition of angular momenta and obtain Clebsch-Gordon coefficients.

4. (*a*) Describe the optical model at low energies for nuclear reactions.

Or

(*b*) Discuss the theory of stripping and pick up reactions.

5. (*a*) Discuss in detail the collective vibrational modes of a spherical nucleus.

Or

(*b*) What are collective oscillation ? Describe the liquid drop model.

6. (*a*) Explain the rotational spectra of even-even nuclei.

Or

(*b*) Explain the coupling between modes of collective excitation and discuss the electric quadrupole moment.

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