FD-601

M.Sc. 3rd Semester
Examination, Dec.-Jan., 2021-22

PHYSICS

Paper - I

Quantum Mechanics - II

Time : Three Hours]   [*Maximum Marks* : 80

Note : Answer **all** questions. All questions carry equal marks.

Unit-I

1. State and prove variational principle for obtaining estimating the energy of lower state and hence calculate ground state energy of helium atom using this principle.

OR

Derive approximate solutions of WKB approximation. Find the energy level of a potential well.

(2)

Unit-II

2. Discuss the Born approximation and its validity.

OR

In partial wave analysis discuss the asymptotic behaviour of partial waves and explain phase shift.

Unit-III

3. Use first order time dependent perturbation theory to calculate probability of ionization of hydrogen atoms by a harmonically time varying electric field.

OR

Define the Fermi's Golden rule. Discuss symmetric and antisymmetric wave function.

Unit-IV

4. Discuss the problems faced during the formulation of relativistic quantum mechanics. Hence solve Dirac's equation for free particles using alpha and beta matrices.

OR

Give a simple derivation of Klein-Gordon equation and obtain expression for current and charge densities.

(**3**)

Unit-V

5. Define spin angular momentum and derive Dirac equation for central field.

OR

Explain the spin of the Dirac particle. Write the method to separate the radial and angular part of Dirac equation and hence obtain the asymptotic series solution of radial equations.

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Time : Three Hours]   [*Maximum Marks* : 80

Note : Answer **all** questions. The figures in the right-hand margin indicate marks.

Unit-I

1. (*a*) Describe the general features of alkali atoms spectra. 8

(*b*) Explain fine structure of alkali spectra. 8

OR

Explain the spin-orbit interaction energy for a single non-penetrating valence electron. How will you explain the separation of 2p and 2D terms of alkali spectra ? 16

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(2)

Unit-II

2. (*a*) State and explain Pauli's principle ? How does a knowledge of symmetric and antisymmetric wave functions lead to this principle ? 8

(*b*) Explain the difference between singlet and triplet states. Also discuss the physical significance of these states. 8

OR

Describe and explain J-J Coupling. Illustrate L-S and J-J coupling with the help of vector diagram. Give the selection rules of L, S and J. 16

Unit-III

3. (*a*) Explain the vector models of one electron and discuss about its features. 8

(*b*) Explain magnetic interaction energy. 8

OR

Write short notes on any **two** of the following : 16

(*a*) Paschen-Back effect

(*b*) Zeeman effect

(*c*) Selection rules

Unit-IV

4. (*a*) Explain symmetric, asymmetric and spherical top molecules. 8

(*b*) Explain microwave spectrometer.   8

OR

Explain energy levels in a molecule in terms of electronic, rotational and vibrational energy levels and calculate the rotational energy of a diatomic molecule in the ground state.   16

Unit-V

5. (*a*) Discuss the main features of vibrational rotational Raman spectra of diatomic molecules.   8

(*b*) Explain pure rotational spectrum of a diatomic molecule. Derive an expression for intensities of the rotational lines.   8

OR

Write short notes on any **two** of the following :   16

(*a*) Anharmonic Oscillator

(*b*) Electronic States

(*c*) IR Spectrometer

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FD-603

M.Sc. 3rd Semester
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PHYSICS

Paper - III

Solid State Physics - I

Time : Three Hours]   [*Maximum Marks* : 80

Note : Answer **all** questions. All questions carry equal marks.

Unit-I

1. Explain the behaviour of electron in a periodic potential on the basis of Kronig-Penney model.

OR

Explain empty lattice approximation. Find out approximate solution near a zone boundary.

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(2)

Unit-II

2. Explain the construction of Fermi surface. Describe the De Haas-Van Alphen effect to study Fermi surface.

OR

Explain the tight binding method for energy bands. Describe the cohesive energy for metal.

Unit-III

3. Define optical and acoustic modes of diatomic lattice having two atoms per primitive basis in detail.

OR

Explain the phonon momentum and inelastic scattering by phonons. Write anharmonic crystal interaction.

Unit-IV

4. Explain the Meissner effect for superconductors. Discuss the London equation for it.

OR

What are type II superconductors ? Discuss their characteristics and obtain AC Josephson effect expression for it.

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(3)

Unit-V

5. Discuss the effective mass for electron. Give physical significance of effective mass of charge carriers. Obtain effective mass of electrons and holes in Si.

OR

What are donor and acceptor state ? Explain thermal ionization of donor and acceptors.

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FD-605

M.Sc. 3rd Semester
Examination, Dec.-Jan., 2021-22

PHYSICS

Paper - IV (B)

Electronics - I
(Communication)

Time : Three Hours]   [*Maximum Marks* : 80

Note : Answer **all** questions. The figures in the right-
hand margin indicate marks.

Unit-I

1. Discuss the working principle and analysis of
two cavity klystron. What are the requirements
of maximum output and maximum
frequency ?   16

OR

Explain construction and basic principle of operation of magnetron. What do you understand by velocity modulation and bunching process ?   16

Unit-II

2. Derive the wave equation for TE wave and obtain all the field components in a rectangular wave guide.   16

OR

Derive the wave equation for TM modes in circular wave guides and explain the excitation of modes in circular wave guide.   16

Unit-III

3. Explain the construction and working principle of the following :

(*a*) Read diode   6

(*b*) IMPATT diode   5

(*c*) TRAPATT diode   5

OR

Explain the following :

(*a*) Q-factor of a cavity resonator   8

(*b*) Components of antennas used in MW communication system   8

(3)

Unit-IV

4. Draw a block diagram of Radar and explain its operation. Find expressions for its frequency and Radar range equation.   16

OR

(*a*) Explain the following terms :

   (*i*) Signal to noise ratio   4

   (*ii*) RADAR cross-section   4

(*b*) What do you understand by antenna ? Explain different antenna parameters.   8

Unit-V

5. Write notes on the following:

(*a*) Orbital satellite   8

(*b*) Link modules   8

OR

(*a*) What are look angles ? Explain how they are determined. What do you mean by orbital spacing ?   8

(*b*) Explain about geostationary satellite. Write the advantages of geostationary orbit.   8

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