SECTION—C

4. Explain the two-well problem. How it helps us in understanding the CP-violation ? Discuss the CPT theorem. 20

5. Describe the SU(3) model and hence establish an eight-fold way diagram for the baryon octet. Identify the quark content of each baryon in this octet. Hence, write down the wave-function for proton with spin-up component. 20

SECTION—D

6. (a) What type of symmetry is obeyed by parity quantum number ? How does it get violated in Λ^0-decay ? 10

   (b) What are the selection rules for Fermi-transition and Gamow-Teller transitions ? Justify your answer with at least one example in each case. 10

7. With the help of Dirac spinors, establish the vector axial-vector interactions prevailing in weak-decay. 20

SECTION—E

8. Firstly state with explicit notations and diagrams the Feynman rules and hence establish the cross-section for

   $e^- + e^+ \rightarrow e^- + e^+$. 20

9. Establish the Euler-Lagrange equation for the fields and hence construct the Proca-Lagrangian for a massive spin-1$\hbar$ field. 20

Exam. Code : 209004
Subject Code : 4794

M.Sc. Physics 4th Semester

PARTICLE PHYSICS

Paper—Phy-551

Time Allowed—Three Hours] [Maximum Marks—100

Note :— Section-A is compulsory. Attempt at least ***one*** question each from Sections B, C, D and E.

SECTION—A

1. (a) A positive kaon (K^+) has a rest mass of 494 MeV/c^2, whereas a proton has a rest mass of 938 MeV/c^2. If a kaon has a total energy that is equal to the proton rest mass energy, then find the speed of kaon.

   (b) A π^0 meson (rest mass energy 135 MeV) is moving with velocity 0.8 c $\hat{e}_z$ in the laboratory rest frame when it decays into two photons γ_1 and γ_2. In the π^0 rest frame, γ_1 is emitted forward and γ_2 is emitted backward relative to the π^0 direction of flight. What would be the velocity of γ_2 in the laboratory rest frame ?

   (c) Does the following reaction occur ?

   $\gamma \rightarrow \gamma + \gamma$

   If yes give reason, if not then why not ?

(d) What is the parity of muon (μ^+) ? How would you determine it ?

(e) Suppose that π^- has spin o$\hbar$ and negative intrinsic parity. If it is captured by the deuterium nucleus from a p-shell in the reaction

$$\pi^- + d \rightarrow n + n$$

what would be the resultant state of di-neutron system ?

(f) Identify the missing particle from the following reactions (i) $\Omega^- \rightarrow k^- + ?$ (ii) $\pi^o \rightarrow e^- + e^+ + ?$

(g) Identify the dominant interaction underlying the following processes :

(i) $k^- + p \rightarrow \Sigma^- + \pi^+$

(ii) $\mu^- + \mu^- \rightarrow k^- + k^+$

(iii) $\Sigma^+ \rightarrow p + \pi^o$

(h) On the basis of spin-parity, identify the nature of following particles :

(i) γ (ii) ρ-resonance (iii) ω^o-resonance

Here, nature stands for are they scalar, vector or ...

(i) What is the length L of the longest drift tube in a LINAC, which operating at a frequency f = 50 MHz, is capable of accelerating protons to a maximum energy E = 300 MeV ? It is given that for a constant acceleration, the proton must travel the length in half a cycle.

(j) What minimum incident energy must an electron have in order to produce an electron-positron pair upon striking a second electron, which is at rest, i.e.

$$e^- + e^- \rightarrow e^- + e^- + e^- + e^+ ?$$ 20

SECTION—B

2. (a) Define Helicity of a particle. Determine the helicity of neutrino and antineutrino using Goldhaber experiment. 15

(b) Cosmic ray muons are produced high in the atmosphere, say at 10 km, and have an energy of about 2 GeV. What is the speed of such a muon ? How far will the muon travel on average before it decays ? Given : The mass of muon = 106 MeV/c^2 and its life-time = 2.2 μs. 5

3. Consider the reactions :

(a) $\pi^+ + p \rightarrow \Delta^{++} \rightarrow \pi^+ + p$

(b) $\pi^- + p \rightarrow \Delta^o \rightarrow \pi^- + p$

(c) $\pi^- + p \rightarrow \Delta^o \rightarrow \pi^o + n$

These reactions, which conserve isospin, can occur with isospin $I = \frac{3}{2}\hbar$ or $I = \frac{1}{2}\hbar$. Calculate the ratio of their cross-section i.e. $\sigma_a : \sigma_b : \sigma_c$. 20

Exam. Code : 209004
Subject Code : 4795

M.Sc. Physics Semester—IV

CONDENSED MATTER PHYSICS–II

Paper–PHY –552

Time Allowed—3 Hours] [Maximum Marks—100

SECTION—A

Note:— Attempt **ALL** questions from Section-A and attempt one question each from Sections B, C, D and E.

1. (i) Can diamagnetic materials show hysteresis loop ? Give appropriate explanation of your answer.

(ii) Why paramagnetic materials are used to attain low temperature using adiabatic demagnetisation phenomenon ?

(iii) Give the origin of spin wave.

(iv) Can the domain structure in a ferromagnetic substance be detected by neutron diffraction ? Give appropriate evidence of your answer.

(v) What are the consequences of anisotropic energy on the structure of ferromagnetic materials ?

(vi) What is Curi's law of paramagnetism ?

(vii) Discuss the application of superconductors in producing high magnetic field.

(viii) How the presence of impurities in materials affects the absorption process ?

(ix) Distinguish between direct and indirect band gap.

(x) What type of information can be made from interaction of light with solids ? 2×10=20

SECTION—B

2. (i) Describe Langevin theory of diamagnetism. 14

(ii) Discuss the practical applications of paramagnetic materials. 6

3. (i) Describe the Quincke's method to measure magnetic susceptibility. 10

(ii) Compare the results of classical and quantum theory of paramagnetism. 10

SECTION—C

4. (i) Describe the thermal excitations of magnons. 10

(ii) Explain the significance of variation of exchange integral with interatomic distance for transition elements. 10

5. (i) Explain the susceptibility below Neel's temperature. 12

(ii) Distinguish between exchange and superexchange interactions. 8

SECTION—D

6. Discuss the Josephson tunneling current, when in addition to the static bias, an alternating voltage is also impressed across the junction. 20

7. (i) Explain the electrodynamics of superconductors in comparison to normal conductors. 15

(ii) Prove that the magnetic flux linking a superconducting ring is quantized. 5

SECTION—E

8. (i) Write short notes on the following :

(a) Free carrier absorption

(b) Photoconductivity. 10

(ii) Explain atomic and electronic interactions. 10

9. (i) Compare optical properties of metals and non-metals. 10

(ii) Explain the process of exciton absorption. 10

Sr.No.7079

Exam.Code: 209004
Subject Code : 4797

M.Sc. Physics - 4th Sem.

(2517)

Paper-PHY-562: Radiation Physics

Time allowed: 3 hrs. **Max. Marks: 100**

Note : Section A is compulsory. Attempt one question from each of the Sections B, C, D and E. All questions carry equal marks.

SECTION A

1. a. State Bragg-Gray principle.
   b. Name different kind of radiations.
   c. List different units of radiations.
   d. Give some applications of dosimeters.
   e. What is the principle of pocket dosimeter?
   f. What is Linear Energy Transformation (LET)?
   g. What are the stochastic biological effects of radiations?
   h. Name different radiation shielding materials.
   i. What is plane source?
   j. What is buildup factor?

SECTION B

2. What is exposure dose? Discuss its measurement in air wall chamber.
3. Discuss different sources of radiations.

SECTION C

4. What do you mean by dosimeter? Discuss SSNTD dosimeter in detail.
5. Discuss neutron detectors in detail.

SECTION D

6. Discuss acute and delayed biological effects of radiations in detail.
7. What is ALARA concept? Discuss single target theory.

SECTION E

8. Discuss shielding requirements for medical and industrial facilities.
9. Discuss point kernel technique for calculations of radiation attenuations.

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Exam. Code : 209004
Subject Code : 4798

M.Sc. Physics Semester—IV

PHY-563 : REACTOR PHYSICS

Time Allowed—3 Hours] [Maximum Marks—100

Note :— Section A is compulsory. Attempt **ONE** question from each of the Sections B, C, D and E. All questions carry equal marks.

SECTION–A

1. (a) What are the orders of energies of thermal and fast neutrons ?
   (b) What do you mean by mean free path ?
   (c) How is diffusion different from drift ?
   (d) In nuclear reactors what is the need of moderation of neutrons ?
   (e) How is the interaction of neutrons different from charged particles ?
   (f) Name the factors of four factor formula.
   (g) Name different fuels used in nuclear reactors.
   (h) What do you mean by super critical size of a nuclear reactor ?
   (i) Name any five nuclear reactors in India.
   (j) In fission which are the prompt neutrons ?

SECTION–B

2. Discuss thermal neutron diffusion and then derive steady state equation.

3. In diffusion process of neutrons obtain the solution of diffusion equation for an infinite plane source in a finite medium.

SECTION–C

4. Discuss slowing down density and slowing down time of neutrons.

5. What is fast neutron diffusion ? Derive Fermi age equation ?

SECTION–D

6. What do you mean by neutron cycle ? On the basis of this cycle derive four factor formula.

7. What is the difference between material and geometrical buckling ? Discuss geometrical buckling taking the case of any type of geometry.

SECTION–E

8. What do you mean by delayed neutron ? Discuss the role of delayed neutrons in nuclear reactors.

9. Discuss the use of coolants and control rods.