PG/IIIS/PHS-303/12

M.Sc. 3rd Semester Examination, 2012

PHYSICS

PAPER – PHS- 303

Full Marks : 40

Time : 2 hours

The figures in the right hand margin indicate marks

Candidates are required to give their answers in their own words as far as practicable

Illustrate the answers wherever necessary

GROUP – A

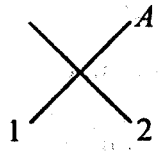
[*Marks* : 20]

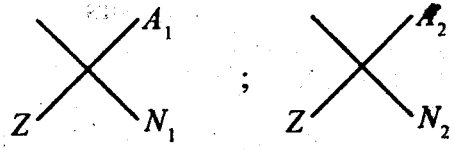
Answer **Q.No.1** and any **one** from the rest

1. Answer any *five* bits : 2 × 5

(*a*) Express the mathematical form of the parabolic mass relationship of a isobaric nuclei.

(*b*) Write the examples of the following nuclei :

(*i*) 

(*ii*) 

(*c*) Diagrammatically present charge-current distribution configuration of the nuclei 

(*d*) What is Fermi-Kurie plot ?

(*e*) Discuss the meaning of the systematics of α-decay energies.

(*f*) What do you mean by nuclear isomerism ?

(*g*) What is Mössbauer effect ?

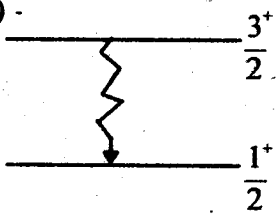
(*h*) What are the important uses of Mössbauer effect ?

2. What is mass spectrometer ? What do you mean by double focussing mass spectrometer ? Drawing a block diagram of the same mass spectrometer, explain the isotope separation techniques. $2 + 3 + 5$

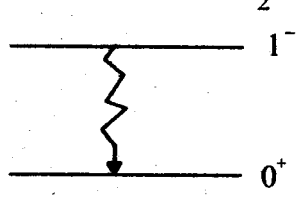
3. (*a*) What do you mean by multipole character of γ-radiation ? $2\frac{1}{2}$

(*b*) Find the multipole character of γ-radiations emitted in the following transitions with spin-parity values as shown below : $2\frac{1}{2} \times 3$

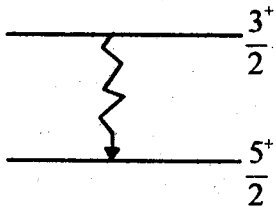
(*i*)



(*ii*)



(*iii*)



The numbers given in the above diagrams show the spin of the nuclear state and <+> or <–> indicates the parity.

GROUP – B

[*Marks* : 20]

Answer **Q.No.1** and any **one** from the rest

1. Justify any *five* of the following statements with reasoning and derivation wherever possible : 2 × 5

(*a*) For the scattering process $e^+ + e^- \rightarrow e^+ + e^-$ the sum of the Mandelstam variables is given by $s + t + u = 4Me^2C^4$ where each symbol has its usual meaning.

(*b*) The Gell-Mann Nishijima formula is extended to quarks to relate their baryon number, electric charge and flavour quantum numbers.

(*c*) The quark content of the $\pi^+ \Rightarrow$ resonant state $\Delta^{++}(1232)$ is (u, u, u).

(*d*) The annihilation of positronium in the $^3S_1$ state leads to the minimum number of three photons.

(*e*) The tau-theta puzzle has been resolved by proposing parity symmetry violation in weak interaction.

(*f*) The intrinsic parity of a fermion antifermion system is odd.

(*g*) The decay $\pi^{\circ} \rightarrow r + r$ implies that π° cannot have spin 1.

2. (*a*) State the CPT theorem. Show that the CPT invariance requires that the mass and lifetime of a particle are same as those of its antiparticle. 1 + 3

(*b*) Write down the CP eigenstates of the $K^{\circ} - \bar{K}^{\circ}$ system. Assuming CP conservation state which of the two states decaying into 2π and 3π is expected to live longer ? 2 + 2

(*c*) Show that short lived K°-meson can be regenerated from a pure beam of long lived K°-meson due to weak mixing. 2

3. (*a*) Prove that in SU(3)

$$3 \otimes 3 \otimes 3 = 10 \oplus 8 \oplus \overline{8} + 1.$$ 4

(*b*) $\pi^{+} + p \rightarrow p + \pi^{+}$

Calculate the threshold K. E. in the laboratory for production of $\Delta^{++}(1232)$ resonance in this reaction. 4

(*c*) $\pi^{o} \rightarrow \gamma + \gamma$

$K^{o} \rightarrow \pi^{o} + \pi^{o}$

explain the conservation of isospin (I) and I_3 in these reactions. 2