M.Sc. 3rd Semester Examination, 2010

PHYSICS

PAPER—PH-2103 (A + B)

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

PAPER—PH-2103 A

[*Marks* : 20]

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

1. Answer any *five* bits : 2 x 5

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

(*b*) With energy level diagram show the isomeric transition schemes of $_{35}Br^{80}$ for γ, β particles and K-captures.

(*c*) Write the name with example of the following odd 'A' nuclei :

(*i*) $_{2}X_{1}^{A}$ and $_{1}Y_{2}^{A}$

(*ii*) $_{Z}X_{N}^{A}$ and $_{Z}X_{N_1}^{A_1}$

(*d*) Drawing a block diagram of double focussing mass spectrometer, discuss the separation of isotopes.

(*e*) Graphically show the continuous nature of β-ray spectrum and indicate the end point energy.

(*f*) In a nuclear beta-decay what is a Fermi-Kurie plot ?

(*g*) What are the mass-parabola for isobaric nuclei ?

(*Continued*)

(*h*) Explain non-conservation of parity in beta -decay with symbolic (by Spin and Linear momenta) presentation by products nucleus and particles of the following β-decay :

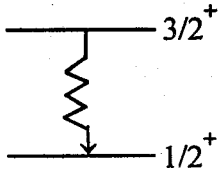
$$_{27}Co^{60}_{33} \rightarrow {}_{28}Ni^{60}_{32} + \beta^- + \bar{\nu}_e$$

2. Discuss the basic principle of the method (Rabi's) of determining the magnetic moment (μ_I) of a nucleus and describe the experimental arrangement. 5 + 5

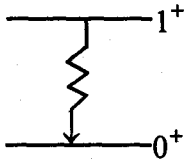
3. (*a*) What do you mean multiple character (E-l, M-l) of γ-radiation ? $2\frac{1}{2}$

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

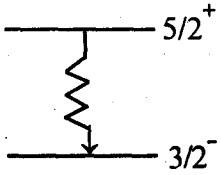
(*i*)



(*ii*)



(*iii*)



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

PAPER–PH-2103 B

(*Particle Physics*)

[*Marks* : 20]

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

1. Answer any *five* bits : 2 x 5

(*a*) Why is it necessary to introduce the colour degree of freedom for each quark flavour ?

(*b*) The CPT theorem predicts that an unstable particle and its anti-particle have same mass and life time. Explain.

(*c*) Define G-parity. Where it is conserved ?

(*d*) The eigenvalue of the charge conjugation operator of a system of fermion-antifermion is $(-1)^{l+s}$ where l is the relative orbital angular momentum and s is the total spin of the system.

(*e*) Define structure constant in Lie group. Write down the generators in SU (2) group.

(*f*) Define Mandelstam variables and write their relationship.

(*g*) Calculate the value of strength of coupling in weak force in natural unit.

(*h*) Explain spontaneous symmetry breaking in particle physics.

2. (*a*) Calculate the invariant mass for $(\pi^+ - p)$ system for $\Delta^{++}(1232)$ resonance. 5

(*b*) Prove that in SU (3) 5

$$3 \otimes 3 \otimes 3 = 10 \oplus 8 \oplus \bar{8} \oplus 1$$

3. (*a*) Write down GNN (Gellman-Nelman Nakano) formula for quarks. Calculate the charges for top and bottom quarks by this formula. 5

(*b*) How intrinsic parity of π^- meson is determined experimentally ? 5