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6 SEM TDC DSE PHY (CBCS) 1 (H)

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(May)

PHYSICS

(Discipline Specific Elective)

(For Honours)

Paper : DSE–1

(Nuclear and Particle Physics)

$$\frac{Full\ Marks\ :\ 80}{Pass\ Marks\ :\ 32}$$

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

Choose the correct option from the following :

1×5=5

(a) The radii of two nuclei with mass numbers 1 and 8 are in the ratio

(i) 1 : 8

(ii) 8 : 1

(iii) 1 : 2

(iv) 2 : 1

(*Turn Over*)

(2)

(b) The average binding energy of a nucleus is of the order of

   (i) 8 eV

   (ii) 8 keV

   (iii) 8 MeV

   (iv) None of the above

(c) On emitting an α-particle and a β-particle, the mass number and atomic number of a nucleus $_nX^m$ change to

   (i) $m-4$, n

   (ii) $m-4$, $n-1$

   (iii) $m-3$, $n+1$

   (iv) $m-3$, $n-1$

(d) A kaon is a ___ and a proton is a ___.

   (i) fermion, boson

   (ii) fermion, fermion

   (iii) boson, fermion

   (iv) boson, boson

(e) Isospins for a proton and a neutron are

   (i) $\frac{1}{2}$ and $-\frac{1}{2}$ respectively

   (ii) $-\frac{1}{2}$ and $\frac{1}{2}$ respectively

   (iii) both $\frac{1}{2}$

   (iv) None of the above

(3)

2. (a) What is separation energy of a nucleon?   2

  (b) Derive an expression for nuclear magnetic dipole moment.   3

3. (a) What are 'independent particle model' and 'strong interaction model' in connection with a nucleus?   2

  (b) Discuss the evidences of a shell structure in a nucleus. Give a brief description of the shell model.   3+3=6

  (c) Write down the Bethe-Weizsacker semi-empirical mass formula. Describe briefly the significance of each term of the formula.   1+4=5

4. (a) Compare the energy spectra of alpha and beta rays.   4

Or

Give a qualitative description of the Gamow's theory of alpha decay. What is Gamow factor?   3+1=4

  (b) Why is gamma ray assumed to be emitted from inside the nucleus?   2

  (c) Explain the term 'internal conversion' in connection with gamma radiation.   3

(4)

5. (a) What are the conservation laws to be followed by a nuclear reaction? 3

(b) What is nuclear cross-section? Derive an expression for nuclear cross-section. What is its unit? 1+3+1=5

(c) What are resonance reactions? 1

6. Write short notes on any *two* of the following : 4×2=8

(a) Bethe-Bloch formula

(b) Gamma ray interaction through matter

(c) Compton effect

7. Describe the construction and working of a GM counter. What are dead time and recovery time? What is quenching? How is it achieved? 4+2+1+2=9

Or

What is a semiconductor detector? Name a few types of semiconductor detector. What are its advantages over a gas-filled detector? Describe any one type of semiconductor detector. 1+2+2+4=9

8. Give a brief description of the working of a linear accelerator. Derive a relation between frequency of the applied a.c. voltage and the length of a conducting cylinder. 3+2=5

(5)

9. (a) Classify elementary particles on the basis of standard model. 4

(b) Describe briefly the term 'strange particles'. What is strangeness quantum number S? What are the values of S for omega and lambda particles? 2+1+2=5

(c) What is CPT invariance? 2

(d) Check whether Baryon number and strangeness are conserved in the following reactions : 2×3=6

(i) $\pi^+ + n \rightarrow \Lambda^0 + K^+$

(ii) $\pi^+ + n \rightarrow K^0 + K^+$

(iii) $\pi^+ + n \rightarrow \pi^- + p$

Or

Describe the conservation laws to be followed specifically in a strong interaction. In which interaction is parity violated? 5+1=6

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