End Semester Examination, 2021
Semester - V
Physics
PAPER - DSE-2T

Full Marks : 60

*Time : 3 Hours*

Group - A

Answer ten from 15 :–

1. a) What is meant by 'Packing – fraction' ? How does it vary with mass number of the nucleus ?   2

   b) The nucleus of $^{27}_{13}AL$ What will be number of U and d quark ?   2

   c) Give the difference between an ionisation Chamber, a proportional counter and a G.M. counter.   2

   d) What is the basic principle of a linear accelerator ?   2

   e) What is the condition for Synchronisation in linear accelerator ?   2

   f) A Cyclotron has a magnetic field of $1{\cdot}5wb/m^2$ the extraction radius is $0{\cdot}5$. Calculate the frequency of the rf-oscillator necessary for accelerating deuterons ?   2

   g) What is electric quadrupolemoment of a nucleus ?

   2

(Turn Over)

h) What are the basic similarities between a liquid drop model and an atomic nucleus ? 2

i) On the basis of shell model predict the spin and parity of $^{12}_{6}C$ –nuclens. 2

j) Write down the baisc difference between direct and compound nuclean reaction. 2

k) What is the Geiger Nuttal Law of radioactive decay ?

l) Write down the importance of nuclear shell model. 2

m) What is the main features of nuclear stability ? 2

n) What is strangeness quantam number ? Give examples of strange particles. 2

o) Give ratio of characteristics time of fundamental interactions. 2

Group - B

2.a) What is the Gamow's theory of Alpha-decay ? 2

b) Explain the angular momentum conservation problem in β decay phenomenon. How was it resolved ? 2+3=5

3.a) What is the threshold energy of endoergic reaction ?

b) Calculate the minimum energy to be given to neutron in order that the following nuclear reaction may occur.

$${}^{1}_{0}n + {}^{31}_{15}p \rightarrow {}^{31}_{14}si + {}^{1}_{1}H$$
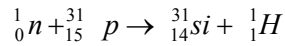
Give that the masses in amu of ${}^{1}n$, ${}^{31}p$, ${}^{31}si$, & ${}^{1}H$ are respectively 1·008665, 30·973766, 30·975349 and 1.007825

4.a) What is nuclear cross-section of nuclear reaction ?

b) The nuclear cross — section of ${}^{113}Cd$ for capturing thermal neutron is $2 \times 10^4 b$. and the number of ${}^{113}Cd$ per cubic meter is $5 \cdot 57 \times 10^{27}$ atoms m^{-3}. What fraction of incident beam of thermal neutron is obserbed by a cd-sheet of 0·1 mm thickness ?

(2+3)=5

5.a) The recently discovered Higg's Boson at LHC experiment has the decay mode into photon and a Z boson, if rest mass of Higg's Boson and Z boson are $125\dfrac{GeV}{C^2}$ and $90\dfrac{GeV}{C^2}$ respectively and decaying Higg's particle is at rest. then what will be energy of photon approximately ?

b) What is the modified Gell-Mann-Nishijima (G.M.N) formula ?

c) TRhe Charm quark C assigned quantam number C=1. How G.M.N. formula implemented for electric charge. (2+2+1)=5

6. Cheek type of interactions involved in the following reaction. **1x5=5**

a) $\sum^0 \rightarrow \Lambda^0 + \gamma$

b) $\Pi^- + P \rightarrow \Lambda^0 + K^0$

c) $\Pi^0 \rightarrow \gamma + \gamma$

d) $\Lambda^0 \rightarrow P + \Pi^-$

e) $\Lambda^0 \rightarrow P + e^- + \bar{\gamma}_e$

7.a) A GM Counter has a dead time $400\mu s$. What are the true counting rates when the observed rates are (i) 100 per minute (ii) 100 perminute ?

b) What is quenching of a GM Counter ? What is its necessity ? $2(2+1)=5$

8.a) Explain GUT

b) Cheek Bary on number Conservation :

a) $\sum^0 \rightarrow \Lambda^0 + \gamma$

b) $\Pi^- + P \rightarrow \Lambda^0 + K^0$

c) What is the Spin of Ω^- ?(omega) $(2+2+1)=5$

Group - C

Answer 2 from 4 : - **2x10=20**

9.a) Explain CPT theorem.

b) The quark contants of Λ^0 is (uds). What is its charge ?

c) What is meant by eight fold way on octet symmetry ?

d) Demonstrate the octet symmetry $(y - I_3)$ of baryons and measons in a weight diagram.

(2+1+2+5)=10

10.a) Identify the unknown particle in the following reaction,

$K^- + P \to K^+ + ?$

b) What is PMT ? Explain scintillation detector with PMT.

c) Explain principle of Ionization Chamber. And give the working principle. (2+5+3)=10

11.a) Derive the energy-10ss expression of heavy charged particle in matter, hence deduce the Bloch-Bethe reration.

b) A radioactive substance initially contains 5 mg of U-234

Calculate — (i) how much parent substance will remain after $4 \cdot 96 \times 10^4$ years.

(ii) its activity after $4 \cdot 96 \times 10^5$ years

Given, $\lambda = 8 \cdot 88 \times 10^{14} S^{-1}$ (decay constant)

half life = $2 \cdot 48 \times 10^5$ years.

and Avogadro number = $6 \cdot 02 \times 10^{23}$ (5+2)+3=10

12.a) Write down the binding energy of nucleus on the basis of semi-empirical mass formula of weizsacker. Explain each term.   5

b) Find the value of impact perameter and cross section for an α particle of energy 7·68 Mev scattered by a thin gold foil (Z=79)of thickness 6×10^{-10} cm for a scattering angle of 90^0.   3

12.c) Find the Q value of nuclear reaction :

$^7 Li \left(p,\ \alpha\right){}^4 He.$
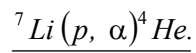
Given mass in amu.

$M \left({}^7 Li\right) = 7 \cdot 018222$

$M \left({}^4 He\right) = 4 \cdot 003879$

$M \left({}^1 H\right) = 1 \cdot 008145$