

6/PHY-352 Syllabus-2023

2026

(May-June)

FYUP : 6th Semester Examination

PHYSICS

(Nuclear and Particle Physics)

(PHY-352)

Marks : 75

Time : 3 hours

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

Answer any ten questions

1. (a) What is nuclear size? Discuss the mirror method for determining the nuclear radius. 1+4=5
(b) Mass of ${}^{64}_{28}\text{Ni}$ is 63.92 atomic mass unit. Calculate the density of the nucleus. Given that $R_0 = 1.2 \times 10^{-15} \text{ m}$. 2½
2. (a) Explain nuclear spin. Calculate the nuclear spin of any two of the following nuclei : 1½+2=3½
(i) ${}^{12}\text{C}_6$, (ii) ${}^{16}\text{O}_8$ and (iii) ${}^{32}\text{S}_{16}$

- (b) What is nuclear magnetic moment?
Find the ratio of nuclear magneton to
Bohr magneton.

$$1+3=4$$

3. (a) Plot the binding energy per nucleon
curve and discuss its significance.

$$1\frac{1}{2}+3=4\frac{1}{2}$$

- (b) Calculate the binding energy per
nucleon of $^{16}\text{O}_8$ in MeV. Given the
mass of neutron = 1.0089 u, mass of
proton = 1.0073 u and mass of
 $^{16}\text{O}_8 = 16$ u.

$$3$$

4. Describe the nuclear shell model and
explain the existence of the magic numbers.

$$7\frac{1}{2}$$

5. (a) What do you understand by range of
an alpha particle? Give a qualitative
description of Gamow's theory of
 α -decay.

$$1+3\frac{1}{2}=4\frac{1}{2}$$

- (b) What is straggling of range of
 α -particles? What are the factors
causing straggling?

$$1+2=3$$

6. (a) What are the different forms of β -decay?
Give one example each.

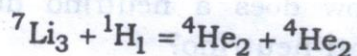
$$1\frac{1}{2}+1\frac{1}{2}=3$$

- (b) Show that β^- and β^+ decay are possible
only if the mass of the parent atom is
greater than that of the daughter atom.

$$2\frac{1}{2}+2=4\frac{1}{2}$$

7. (a) Outline the basic features of Fermi's theory of β -decay. 5
- (b) How does a neutrino differ from an anti-neutrino? $2\frac{1}{2}$
8. (a) Discuss the different processes in which γ -rays interact with matter. What is the order of energy of the γ -rays necessary to produce pair production? $3+\frac{1}{2}=3\frac{1}{2}$
- (b) An ionization chamber exposed to a beam of α -particles registers a current of 3.85×10^{-13} A. On the average, twenty α -particles enter the chamber per sec. If the production of ion pair requires 35 eV of energy, calculate the energy of the α -particle. 4
9. Describe a GM counter and explain its operation. What is meant by the 'dead time' of a GM counter? $6+1\frac{1}{2}=7\frac{1}{2}$
10. (a) What is nuclear reaction? List the different conservation laws in nuclear reaction. $1+2\frac{1}{2}=3\frac{1}{2}$
- (b) Explain what is Q-value of a nuclear reaction. What are exoergic and endoergic reactions? $3+1=4$

11. (a) Calculate the energy of the α -particles released in the following reaction in MeV :



Given mass of H-atom = 1.0086 u, mass of He-atom = 4.0039 u and mass of Li-atom = 7.0182 u.

3

- (b) What is nuclear fission? Give one example. Describe qualitatively Bohr-Wheeler theory of nuclear fission.

$$\frac{1}{2} + \frac{1}{2} + 3\frac{1}{2} = 4\frac{1}{2}$$

12. (a) Discuss nuclear chain reaction, and explain what is meant by critical size and critical mass.

$$2\frac{1}{2} + \frac{1}{2} + \frac{1}{2} = 3\frac{1}{2}$$

- (b) Explain the important components of a nuclear fission reactor.

4

13. (a) Explain fusion reaction and discuss the condition for maintaining fusion reaction.

4½

- (b) Explain tokamak experiment in nuclear fusion.

3

14. What are elementary particles? How are the elementary particles classified on the basis of their mass and interaction?

$$1 + 6\frac{1}{2} = 7\frac{1}{2}$$

15. (a) What are baryon and lepton numbers?
Show with example that in any nuclear
reaction they are conserved. $2+3=5$
- (b) What are quarks? How many possible
quarks are there? $1+1\frac{1}{2}=2\frac{1}{2}$
16. (a) Discuss the origin of cosmic rays.
Explain the latitude effect shown by
these rays. $3+2\frac{1}{2}=5\frac{1}{2}$
- (b) What are primary and secondary
cosmic rays? 2

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