

STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI – 600 086.
(For candidates admitted during the academic year 2011-12 & thereafter)

SUBJECT CODE : 11PH/MC/NP64

B.Sc. DEGREE EXAMINATION APRIL 2016
BRANCH III - PHYSICS
SIXTH SEMESTER

REG. No. _____

COURSE : MAJOR – CORE
PAPER : NUCLEAR PHYSICS
TIME : 30 MINS.

MAX. MARKS : 30

SECTION – A
TO BE ANSWERED IN THE QUESTION PAPER ITSELF

ANSWER ALL QUESTIONS:

I. CHOOSE THE CORRECT ANSWER:

- The shape of yukawa potential is $V(r) = -V_0 \frac{e^{-r/r_0}}{r/r_0}$
a) $V_0 e^{-r/r_0}$ b) $-V_0 e^{-r^2/r_0^2}$ c) $\frac{V_0 r^{-r/r_0}}{r/r_0}$ d) $-V_0 \frac{e^{-r^2/r_0^2}}{r^2/r_0^2}$
- The nuclear energy levels were introduced by
a) liquid drop model b) shell model c) collective model d) radioactive model
- The Magic numbers one
a) 2,8,20,28,50,82,126 b) 2,4,8,18,32 c) 20,200,2000 d) 3,6,9,12
- Bi^{210} has a half life of 5 days. The time taken for seven eighths of a sample to decay is
a) 3.4 days b) 10 days c) 15 days d) 20 days
- Which of the following radioactive decay emits α - particles
a) ${}_{82}\text{Pb}^{214} \rightarrow {}_{83}\text{Bi}^{214} + \dots$ b) ${}_{92}\text{U}^{238} \rightarrow {}_{90}\text{Th}^{234} + \dots$
c) ${}_{90}\text{Th}^{234} \rightarrow {}_{91}\text{Pa}^{234} + \dots$ d) ${}_{91}\text{Pa}^{234} \rightarrow {}_{92}\text{U}^{234} + \dots$
- The decay constant of a radioactive sample is λ , the half life and mean life of the sample are respectively given by
a) $1/\lambda$ and $(\ln 2)/\lambda$ b) $(\ln 2/\lambda)$ and $1/\lambda$ c) $\lambda (\ln 2)$ and $1/\lambda$ d) $\lambda/(\ln 2/\lambda)$ and $1/\lambda$
- One dee is used in
a) cyclotron b) betatron c) frequency modulated cyclotron d) bevatron
- The substance used in solid state detector is
a) conductor b) semiconductor c) insulator d) any alloy
- The right energy limit in betatron is
a) 300 ev b) 300 kev c) 300 Mev d) 300 Bev

10. The fission of ${}_{92}\text{U}^{235}$ is caused by
 a) α - particle b) β -particles c) fast neutrons d) slow neutrons
11. The moderator used in nuclear reactor is
 a) cadmium b) U-235 c) coolant d) shield
12. The spontaneous fission is energetically feasible if the value of $\left(\frac{Z^2}{A}\right)$ is
 a) equal to 3 b) more than 49 c) less than or equal to 49 d) more than 15
13. Which of the following are fermions?
 a) neutrino b) μ - meson c) μ and Π - meson d) electron
14. A Π meson at rest can decay as $\Pi^0 = \mu^+ + \nu^-$ than energy of μ^-
 a) can be anything b) is a fixed quantity c) is zero d) is equal to mc^2
15. The carrier particle of strong interaction is
 a) photon b) quark c) graviton d) gluon

II. FILL IN THE BLANKS:

16. The quantum of energy of such time dependent vibrations is called _____.
17. When boron $({}^0_5\text{B})$ is bombarded by neutron, alpha-particles are emitted. The resulting nucleus is of the element _____ and has the mass number _____.
18. The high potential difference is produced by a _____.
19. Kinetic energy of fission neutrons _____.
20. The elementary particles sigma hyperons strangeness number is _____.

III. STATE WHETHER TRUE OR FALSE:

21. The nucleons are fermions, so they obey Pauli exclusion principle.
22. X rays are diffracted by crystals much in the same way as gamma rays.
23. The total relativistic energy of electron is given by $E = \sqrt{p^2c^2 + m_0^2c^4}$
24. The equation $4({}^1_1\text{H}) \rightarrow {}^4_2\text{He}^{++} + 2e + 26\text{mev}$ represents fission.
25. Photons obey fermi - Dirac statistics.

IV. ANSWER BRIEFLY:

26. Write Weizacker mass formula.

27. What do you mean by induced radioactivity?

28. Write the principle of cyclotron.

29. Define fission parameters α and μ .

30. What are baryons?



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SECTION – B

ANSWER ANY FIVE QUESTIONS: (5X 5 = 25)

1. Explain the Meson theory of nuclear force.
2. What are radioactive isotopes? Discuss some important uses.
3. The half life of radiocarbon C^{14} is 5700 years. In a sample the ratio of C^{14} to C^{12} has decreased to one-eighth of equilibrium value. Calculate the age of the sample.
4. A GM tube with a cathode 4.0 cm in diameter and a wire diameter of 0.016 cm is filled with argon and alcohol to a pressure such that mean free path is 4.6×10^{-3} cm calculated the maximum radius of which secondary ions will be formed when 1.2 KV is applied to cathode.
5. Calculated the energy released by the fission of 1kg of U^{235} in Kilowatt hour. Assuming that on the average energy released per fission is 200 Mev and Avogadro number $N = 6.023 \times 10^{26}$ per kg - atom.
6. Certain stars obtain part of their energy by the fusion of three α -particles to form a ${}^6_2C^{12}$ nuclear. How much energy does each such reaction evolve? The mass of helium atom is 4.00260 amu while the mass of an electron is 0.00055 amu. The mass of ${}^6_2C^{12}$ atom is 12.0000 amu by definition (1 amu = 931.5 Mev).
7. Give an account of symmetry and conservation laws.

SECTION C

ANSWER ANY THREE QUESTIONS: (3X15= 45)

8. On the basis of liquid drop model give a simple derivation of weizascker semi empirical mass formula giving arguments for each term. What important conclusions are from this formula.
9. Explain the (i) tunneling effect (ii) Geiger Nuttal law
10. Describe the construction and working of a cyclotron Discuss its energy limit and how it has been overcome in synchrocyclotron.

11. What is a plasma? Discuss possible thermonuclear reactions in a plasma What are the conditions for maintained fusion reactions in a plasma?
12. What do you understand by the classification of elementary particles? why such a classification is required?

