16U608 (Pages: 2) Name……..……..……….

Reg. No…………..………

SIXTH SEMESTER B.Sc. DEGREE EXAMINATION, APRIL 2019

(Regular/Supplementary/Improvement)

(CUCBCSS-UG)

CC15U PH6 B12 - NUCLEAR PHYSICS, PARTICLE PHYSICS AND ASTROPHYSICS

Physics - Core Course

(2015 Admission onwards)

Time: Three Hours Maximum: 80 Marks

Section A

Answer in a word or a phrase.

Answer ***all*** questions. Each question carries 1 mark.

1. Radius of Aluminum nucleus of mass number 27 is ……………..
2. …………….. gives the measure of the likelihood of a particular interaction.
3. Ultra short lived particles that cannot be detected by recording their creation and subsequent decay are called ……………..
4. Distance at which the radius of earth's orbit(1a.u.) subtends an angle of one second of arc is ……………..
5. Stellar parallax is a measure of ……………..

Write True or False:

6. Fermi theory of β-decay explains the existence of neutrinos.
7. Energy and momentum of a charged particle can be found using a bubble chamber.
8. Balloon experiment is used to study the composition of cosmic rays entering the earth's atmosphere.
9. The lifespan of sun can be explained by its luminosity.
10. A Helium nucleus can be accelerated by a cyclotron.

(10 x 1 = 10 Marks)

Section B

Answer ***all*** questions. Each question carries 2 marks.

11. Explain the stability of nucleus using binding energy curve.
12. Only α-particles are emitted by radioactive nuclei while protons and neutrons are not emitted. Why?
13. What is meant by nuclear isomerism? Give an example.
14. Explain the working principle of scintillation counter.
15. Explain the electron-photon 'shower' produced by cosmic rays at sea level.
16. Define color and flavor of quarks.
17. Differentiate absolute and apparent magnitude.

(7 x 2 = 14 Marks)

Section C

Answer any ***five*** questions. Each question carries 4 marks.

18. Explain the semi-empirical formula of binding energy.
19. Explain how energy is produced in the sun.
20. Discuss how α-particles are qualitatively analyzed using cloud chamber.
21. Using Voltage –Current (pulse) characteristics explain the counting regions of gas filled counters.
22. With suitable examples explain the characteristics of Leptons and Hadrons.
23. Explain the effect of earth's magnetic field on the cosmic ray particles.
24. Explain the colour-index of a star.

(5 x 4 = 20 Marks)

Section D

Answer any ***four*** questions. Each question carries 4 marks.

25. Find the binding energy per nucleon of O^{16}. The masses are m_p=1.007825u, m_n=1.008665u and M(oxygen) =15.9949u.
26. A sample of C^{14} collected from an old monument shows 4.2 disintegrations per minute per gram. What is the age of the monument if the half life of C^{14} is 5568 years and activity of fresh C^{14} is 14.6 disintegrations per minute per gram?
27. A reactor is producing 8MW energy. How many atoms of U^{238} undergo fission per second? How many Kg. of U^{235} would be used for 30 days production? Energy released per fission = 200MeV.
28. Check which of the following processes are mediated by strong and electromagnetic interactions:

    a) $k^- + p \rightarrow \Omega^- + K^+ + K^0$ b) $\pi^- + p \rightarrow \Sigma^+ + K^-$ c) $p + p \rightarrow p + \bar{p}$
29. Identify the quark content and spin of the following particles :

    a) K^+ b) Ω^- c) n d) p
30. Determine the luminosity of a star of radius four times the radius of sun and effective temperature twice as that of sun if the luminosity of sun is $3.84 \mathbf{x} 10^{33}$erg/s.
31. In a cyclotron the magnetic field is 0.8T. What should be the frequency to accelerate deuterons of mass $3.34\ \mathbf{x}10^{27}$Kg.

(4 x 4 = 16 Marks)

Section E

Answer any ***two*** questions. Each question carries 10 marks.

32. Discuss the background of shell model and explain the energy levels of nucleons.
33. Explain the tunnel theory of α-decay and derive the expression for decay constant.
34. With suitable examples explain the basic symmetry and conservation laws of particle physics.
35. Explain the principle, construction, working and limitations of a linear accelerator.

(2 x 10 = 20 Marks)

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