17U608 (Pages: 3) Name: ……..…….

Reg. No…….……

SIXTH SEMESTER B.Sc. DEGREE EXAMINATION, APRIL 2020

(CUCBCSS - UG)

(Regular/Supplementary/Improvement)

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. Who proposed the Exchange Model for Nuclear Force?
2. To detect neutrons, the ionization chamber is filled with ……..
3. Give the quark structure of neutron.
4. β-decay is an example of …….. interaction
5. The total amount of energy radiated from a star from its surface per second is called ……..

Write True or False:

6. A Tokomak is employed for magnetic confinement of plasma.
7. The intensity of cosmic rays is maximum at an altitude of 8 Km.
8. When a charged particle moves through a magnetic field, it suffers a change in its energy.
9. The moderators in a nuclear fission reactor should have neutron capture cross-section.
10. Fermions are particles with anti-symmetric wave function.

(10 x 1 = 10 Marks)

Section B

(Answer in two or three sentences)

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

11. What are magic numbers?
12. Draw β spectrum and explain.
13. List the geomagnetic effects of cosmic rays.
14. What is “Bremsstrahlung”?
15. Distinguish between hadrons and leptons
16. Name two limitations of LINAC.
17. What is ecliptic?

(7 x 2 = 14 Marks)

Section C

(Answer in a paragraph of about half a page to one page)

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

18. Roughly estimate the mass of the pion using uncertainty principle.
19. Discuss the principle of radiocarbon dating. Mention its application
20. Write a note on cosmic ray showers.
21. Describe the working of semiconductor detectors.
22. Explain the three generations of fundamental particles.
23. Derive an expression for the kinetic energy attained by the particles in terms of cyclotron frequency.
24. Explain what you understand by the colour index of a star? Mention its significance.

(5 x 4 = 20 Marks)

Section D

(Problems- write all relevant formulas, all important steps carry separate marks)

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

25. Find the energy difference the spin up and spin down states of a proton in a magnetic field of B = 1 T (b) What is the Larmor frequency of a proton in this field? Given $\mu_{pz} = 2{,}793\mu_N$ where $\mu_N = 3.153 \times 10^{-8}$ eV / T. and h = 4.136×10^{-15} eV. s
26. If 200 MeV energy is released in the fission of a single nucleus of $_{72}U^{235}$. How many fissions must occur per second to produce a power of 1 kW.
27. Derive the relation $K_\alpha = \frac{A-4}{A} Q$, for the kinetic energy of the alpha particle released in the decay of a nucleus of mass number A.
28. A particles of energy 5 MeV pass through an ionization chamber at the rate of 10 per second. Assuming all the energy is used in producing ion pairs, calculate the current produced. (35 eV is required for producing an ion pair and e = 1.6×10^{-19}C.
29. Verify the Gell-Mann Nishijima formula for Kaon doublet (K^+, K^0) and singlet Ω^-.
30. In a linear accelerator, proton accelerated thrice by a potential of 40kV leaves a tube and enters an accelerating space of length 30cm before entering the next tube. Calculate the frequency of the r.f voltage?
31. Calculate the absolute magnitude of
    a) Sirius m = -1.45 and d = 2.69 parsecs. b) Sun m = -26.74 and d = 4.854×10^{-6}.

(4 x 4 = 16 Marks)

Section E

(Essays – Answer in about two pages)

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

32. Obtain the expression for the binding energy per nucleon of a nucleus using liquid drop model. Discuss the corrections to the expression from asymmetry energy and pairing energy and obtain the semi empirical binding energy formula.
33. Explain nuclear fusion. Discuss the different fusion cycles for the origin of stellar energy.
34. What are the important quantum numbers and conservation laws in elementary particle physics?
35. Describe the construction and working of a Betatron.

(2 x 10 = 20 Marks)

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