19P307 (Pages: 2) Name……..

Reg. No…….…….

THIRD SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2020

(CUCSS-PG)

CC19P PHY3 C10 - NUCLEAR AND PARTICLE PHYSICS

(Physics)

(2019 Admission - Regular)

Time: Three Hours Maximum: 30 Weightage

Section A

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

1. Explain the meson field and show how Yukawa arrived at the concept of a meson.
2. Why Fermi Kurie plot is known as a classical test of Fermis theory of beta decay?
3. Suggest the mode of gamma transition allowed for $0^+ \rightarrow 0^+$ transitions. Explain the process.
4. Thermal neutron absorption for ^{235}**U** in nuclear fission is very large compared to ^{238}**U.** Why?
5. What are the characteristics of nuclear fusion?
6. How can we determine gamma ray energies using a scintillation counter?
7. Explain the theory of Quantum Chromodynamics.
8. What is Gellmann Okubo Mass Formula from eightfold way model?

(8 x 1 = 8 Weightage)

Section B

Answer any ***two*** questions. Each question carries 5 weightage.

9. Solve Schrödinger equation for the ground state of the deuteron under square well potential. Discuss the nature of the wave function an depth of the well. Is singlet bound state for deuteron possible?
10. Describe briefly how shell model was successful in predicting the magic numbers. Assuming the shell model to be correct, what should be the spin and parity of the ground state of $^{15}_{7}N$.
11. Explain the principle and working of a Geiger Muller counter. Discuss the importance of quenching in the counter
12. Discuss the classification of elementary particles based on spin and interaction. List the quantum number conservations in particle interactions.

(2 x 5 = 10 Weightage)

Section C

Answer any ***four*** questions. Each question carries 3 weightage.

13. Find the energy required to remove a neutron from $^{40}_{20}Ca$ .Given masses of $^{40}_{20}Ca$ =39.962589 u , $^{39}_{20}Ca$= 38.97069 u and neutron mass =1.008665 u.
14. Polonium 212 emits an alpha particle whose kinetic energy is 10.54 MeV. Determine the disintegration energy and energy of the recoil nucleus.
15. What are the expected types of gamma ray transitions between the following γ types of odd-A nuclei; $f_{\frac{5}{2}} \rightarrow p_{\frac{3}{2}}$, $h_{\frac{11}{2}} \rightarrow d_{\frac{5}{2}}$ and $g_{\frac{9}{2}} \rightarrow p_{\frac{1}{2}}$.
16. The first excited state of ^{180}W is 2+ and is 0.1 MeV above the ground state. Find the next two excited states of the nucleus. Also find the moment of inertia of the nucleus in $\hbar^2$/ keV.
17. Determine the element for which stable isobar exist for A=97. Given $a_c = 0.71\ MeV$, $a_{sym} = 22.7\ MeV$, $M_H = 1.00784u$ and $M_n = 1.00864u$
18. Calculate the electric field at the surface of the wire of a proportional counter with a radius $1 \times 10^{-4}\ m$ and a cylinder of radius $10^{-2}\ m$, when 1500 volts is applied between the two.
19. State whether the reactions are possible or not and classify the type of interaction.
    (a) $\pi^- + p \rightarrow \Lambda^0 + K^0$
    (b) $K^0 \rightarrow \pi^+ + \pi^-$
    (c) $\pi^0 \rightarrow \gamma + \gamma$
    (d) $\Omega^- \rightarrow \Xi^0 + \pi^-$

(4 x 3 = 12 Weightage)

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