

B. Sc. DEGREE END SEMESTER EXAMINATION - MARCH 2025**SEMESTER 6 : PHYSICS****COURSE : 19U6CRPHY11 : NUCLEAR, PARTICLE PHYSICS AND ASTROPHYSICS***(For Regular 2022 Admission and Supplementary 2021/2020/2019 Admissions)*

Time : Three Hours

Max. Marks: 60

PART A**Answer any 8 (2 marks each)**

1. Nuclear radius is proportional to the number of nucleons, what does it say about the nucleus?
2. Comment on the nuclear capture cross-section using shell model.
3. What is a white dwarf?
4. Discuss the origin of energy released in nuclear fission.
5. Write the order of magnitude of nuclear radius. What is its unit?
6. Describe briefly neutrino theory of beta decay.
7. Plot the average binding energy per nucleon vs atomic mass number A .
8. Explain K-electron capture.
9. Write the difference between Baryons and mesons.
10. What are black holes?

(2 x 8 = 16)**PART B****Answer any 6 (4 marks each)**

11. There are two (A and B) stars under observation. Both stars have the same temperature but star A is 10000 times more luminous than star B. Which star is larger and by how much?
12. 1g of a radioactive substance (atomic weight = 226) disintegrates at a rate of 37 billion disintegrations per second. Calculate its mean life.
13. A smart student of UG third year at SH college, doing summer internship at IAA Bengaluru, observes two stars WR111 and WR150 with about the same temperature of 89100 K. If the luminosity were found to be $245000L_S$ and $724000L_S$ respectively, find the ratio of their radii as reported in his lab record book. Here L_S is the solar luminosity.
14. How much energy in eV does a mass of 1u (unified atomic mass units) correspond to? Prove your answer.
15. The diameter of a cyclotron is 1.8m and the strength of the magnetic field is $0.7\text{weber}/m^2$. Calculate the energy to which a proton can be accelerated. Given $m_p = 1.67 \times 10^{-27}kg$.
16. Calculate the weight in kg of 1 curie of Ra B (Pb^{214}) from the half life period of 26.8 minutes.
17. Star A and star B have the same luminosity , if the temperature of star B is 2 times the temperature of star A find the ratio of their radii R_A/R_B .
18. A bright star in Orion constellation, Betelgeuse, has a surface temperature of 3500K and is 10^5 times more luminous than the Sun. Calculate its radius in terms of solar radius R_S , the radius of the Sun. What kind of star could it be on the basis of the H-R diagram?

(4 x 6 = 24)

PART C

Answer any 2 (10 marks each)

19. Explain the evolution of stars. Find the final stage volume of a star more massive than the sun.
20. Derive the Q value equation of a nuclear reaction. Explain four types of nuclear reactions.
21. What are quarks? Mention the flavor of quarks, their charge and strangeness number . Also mention about quark color and quark confinement.
22. Explain the liquid drop model of the nucleus and its assumptions. Write the semi empirical mass formula and explain the terms.

(10 x 2 = 20)