(FOR THE CANDIDATES ADMITTED DURING THE ACADEMIC YEAR 2023-24 ONLY)

SUBJECT CODE 23UPS614

REG.NO.:

N.G.M.COLLEGE (AUTONOMOUS) : POLLACHI

END-OF-SEMESTER EXAMINATIONS : MAY– 2026

B.Sc. – PHYSICS **MAXIMUM MARKS: 75**

VI SEMESTER **TIME : 3 HOURS**

PART – III
ATOMIC AND NUCLEAR PHYSICS

SECTION – A (10 X 1 = 10 MARKS)

ANSWER THE FOLLOWING QUESTIONS. (K1)

1. Rutherford's atomic model failed to explain

(a) Presence of nucleus b) Scattering of α-particles

(b) Stability of the atom d) Positive charge of nucleus

2. Bragg's law is expressed as

(a) nλ=dsinθ b) 2dsinθ=nλ

(b) λ=2ndsinθ d) d=nλsinθ

3. The law of Radioactive decay

(a) $N = N_0 e^{-i\lambda t}$ (b) $N = N_0 e^{i\lambda t}$ (c) $N = N_0 e^{-\lambda t}$ (d) $N = N_0 e^{\lambda t}$

4. The analytical relationship between the kinetic energy of the projectile and outgoing particle and nuclear disintegration energy Q is called as the Q equation. The solution of $Q > O$

(a) Endoergic reactions b) Exoergic reactions

(b) Stripping reactions d) Compound nuclear reactions

5. The properties of strange(d) Quark

(a) Charge +1/3, Spin 1/2, Baryon number 1/3, Strangeness 0

(b) Charge -1/3, Spin 1/2, Baryon number 1/3, Strangeness -1

(c) Charge -1/3, Spin 1/2, Baryon number 1/3, Strangeness 0

(a) Charge +2/3, Spin 1/2, Baryon number 1/3, Strangeness 0

ANSWER THE FOLLOWING IN ONE (OR) TWO SENTENCES (K2)

6. The Fine structure Doubling of spectral line arises from a magnetic interaction between the spin and angular momenta of an atomic electron is called ----------

7. The splitting of spectral lines in the presence of a magnetic field is called the _____ effect

8. In nuclear fission reaction to reach stability: neutron (N) increases by 2 units and proton (Z) number decreases by 2 units, which is…

9. Find out the unknown (x) particles in the nuclear reaction given below

$$Te_{52}^{122} + x_2^4 \rightarrow d_1^2 + I_{53}^{124}$$

10. The binding energy per nucleon is constant due to ……

(CONTD …. 2)

SECTION – B (5 X 5 = 25 MARKS)

ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS. (K3)

11. a) State Larmor's theorem and explain the physical significance of Larmor precession of an electron orbit in the presence of a uniform magnetic field.

(OR)

b) What are coupling schemes in atomic physics? Explain the L-S coupling schemes.

12. a) Using the concept of photon–electron collision derive the expression for Compton shift using explain how the change in wavelength depends on the angle of scattering.

(OR)

b) Apply Moseley's law to determine the atomic number of an unknown element from its characteristic X-ray spectrum. Discuss it's significance of Moseley's work in establishing the concept of atomic number.

13. a) Describe how the nuclear properties such as radius, mass, charge, and binding energy, can be determined experimentally.

(OR)

b) Explain the concepts of nuclear binding energy and packing fraction. How are they relate to the stability of a nucleus.

14. a) Explain the construction & working of cyclotron .

(OR)

b) Describe how energy is released during the fission of a U^{235} nucleus.

15. a) Explain the fundamental conservation laws: Strange particle and Strangeness.

(OR)

b) Apply quark model to classify given hadrons and predict their properties, such as charge, baryon number, and strangeness.

SECTION – C (5 X 8 = 40 MARKS)

ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS. (K4 (Or) K5)

16. a) Using Sommerfeld's relativistic atom model, explain how the inclusion of relativistic mass variation of electrons leads to the fine structure of hydrogen spectral lines

(OR)

b) Using quantum mechanical principles, explain the origin of the Normal Zeeman Effect

17. a) Analyze how the powder X-ray diffraction method is used to determine the crystal structure of a material.

(OR)

b) Derive Einstein's photoelectric equation and explain how it accounts for the experimental observations of the photoelectric effect.

18. a) Using semi-empirical mass formula, evaluate the contributions of volume, surface, Coulomb, asymmetry, and pairing terms to the binding energy of a nucleus, and discuss how it helps in predicting nuclear stability and the occurrence of nuclear fission.

(OR)

b) Analyze the law of radioactive decay and derive the relationship between decay rate, half life, and mean life of a radioactive substance.

19. a) Describe the concept of a nuclear chain reaction and explain how one fission event can initiate a self-sustaining sequence of reactions.

(OR)

b) Explain the working principle of a Geiger-Müller counter and how it detects ionizing radiation.

20. a) Explain how elementary particles are categorized according on the fundamental interactions they participate in (strong, weak, electromagnetic, and gravitational).

(OR)

b) Describe the distinction between primary and secondary cosmic rays. Explain the function of secondary cosmic rays in the earths atmosphere

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