B.Sc. DEGREE EXAMINATION APRIL 2024
BRANCH III - PHYSICS
SIXTH SEMESTER

COURSE   : MAJOR – CORE
PAPER   : ATOMIC AND NUCLEAR PHYSICS
SUBJECT CODE   : 19PH/MC/AN64
TIME   : 3 HOURS

                                                     MAX. MARKS :100

SECTION – A

ANSWER ALL QUESTIONS: **25 MARKS**
I   CHOOSE THE CORRECT ANSWER: **(10 X 1 = 10)**

1. The frequency of a spectral line in X-ray spectrum varies as

     (a) $v \propto Z^{1/2}$ (b) $v \propto Z^{3}$

     (c) $v \propto Z^{2}$ (d) $v \propto Z$

2. The photoelectric effect can be explained on the basis of

        (a) corpuscular theory of light   (b) wave theory of light

        (c) electromagnetic theory of light   (d) quantum theory of light

3. The Bragg law is

      (a) $2sin\theta = d\,\lambda$ (b) $2dsin\theta = n\,\lambda$

      (c) $dsin\theta = n\,\lambda$ (d) $sin\theta = d\,\lambda$

4. The Bohr magneton is equal to

     (a) e$\hbar$/2m   (b) 2m/$\hbar$e   (c) $\hbar$/2m   (d) 2m/e$\hbar$

5. Zeeman shift is directly proportional to

     (a) λ^{2} (b) λ (c) $1/\lambda$ (e) $1/\lambda^{2}$

6. The mean life of radioactive nuclei is related to the decay constant as

     (a) $1/\lambda$ (b) $1/\lambda^{2}$ (c) $0.6931/\lambda$ (e) $0.6931/\lambda^{2}$

7. In the following nuclear reaction X stands for $_{13}Al^{27} + {}_{2}He^{4} \rightarrow {}_{15}P^{30} + X$

     (a) $_{+1}e^{0}$ (b) $_{0}n^{1}$ (c) $_{-1}e^{0}$ (e) $_{1}p^{1}$

8. S.I. unit of radiation dosage is

     (a) Ray   (b) Gray   (c) Radian   (e) Poise

9. Magnetic bottles can be used to contain plasma to initiate

       (a) fission reaction   (b) fusion reaction

       (c) endo ergic reaction   (e) exo ergic reaction

10. Interaction between leptons is

       (a) strong   (b) weak

       (c) gravitational   (e) electromagnetic

FILL IN THE BLANKS   (5x1=5)

11. The empirical formula for nuclear radius is _____.
12. Four factor formula for a neutron cycle is _____.
13. Stark effect is associated with splitting and spectral lines when an atom is kept in an external _____ field.
14. Inner zone of Van Allen belts consists of _____ of high energy of the order of _____.
15. Moseley's law is _____.

ANSWER BRIEFLY   (5x2=10)

16. State Paschen back effect.
17. Distinguish between continuous and characteristic x-rays.
18. What is K electron capture?
19. What is meant by chain reaction?
20. What is Tunneling effect?

SECTION B
ANSWER ANY FIVE QUESTIONS   (5x6=30)

21. Compute the field gradient of a 0.4m long Stern-Gerlach experiment that would produce a 2mm separation at the end of the magnet between two components of beam of silver atoms emanating from an oven of 960° C.
22. The energy required to remove an electron from sodium is 2.3 eV. Does sodium show photoelectric effect when it is irradiated with the light of wavelength 700nm.
23. 1 gram of radium is reduced by 2.1 mg in 5 years by α – decay, calculate the life period and mean life period of the radium.
24. X-rays from a tube operated at 50 kV are analyzed with Bragg spectrometer using a calcite crystal cut along the cleavage plane. If grating space of calcite be given as 3.02945 Å. Calculate the smallest angle between the crystal plane and X-ray beam at which the shortest wavelength produced by the tube can be detected.
25. Calculate the threshold energy required to initiate the reaction Na^{23} (n,α) F^{20} (m_{Na}=22.9898 u, m_n=1.00866 u, m_α=4.0040 u, m_F=19.9999 u)
26. Explain how carbon-nitrogen cycle can account to produce stellar energy.
27. What are cosmic rays? Distinguish between primary and secondary cosmic rays.

SECTION – C
ANSWER ANY THREE QUESTIONS: (3x15=45)

28. Give the theory of Compton Effect and explain its experimental verification.
29. What is Zeeman effect? Describe the experimental arrangement for studying the Zeeman effect. Obtain an expression for Zeeman shift.
30. Discuss Fermi neutrino theory of beta decay and internal conversion.
31. Describe the construction and explain the working of a nuclear reactor. When is the reactor said to be critical?
32. Discuss the classification of elementary particles. Mention important elementary particle in each category and discuss their chief characteristics.

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