STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI – 600 086.
(For candidates admitted during the academic year 2004-05 & thereafter)

SUBJECT CODE : **PH/MC/AN64**

B.Sc. DEGREE EXAMINATION APRIL 2010

BRANCH III - PHYSICS

SIXTH SEMESTER

REG. No._____

COURSE : **MAJOR – CORE**

PAPER : **ATOMIC AND NUCLEAR PHYSICS**

TIME : **30 MINS.** **MAX. MARKS : 30**

SECTION – A

TO BE ANSWERED IN THE QUESTION PAPER ITSELF

ANSWER ALL QUESTIONS: (30 x 1 = 30)

I **CHOOSE THE CORRECT ANSWER:**

1. The frequency of the X-Ray spectral line is related to the atomic number of the emitting nucleus as
   a. Z b. Z^2 c. Z^3 d. $Z^{1/2}$

2. For a given material, the number of photoelectrons emitted is more with
   a. visible light b. infrared radiation
   c. ultra violet radiation d. microwave radiation

3. Bohr magneton is expressed as
   a. $e h /4\pi m_e$ b. $e h /4\pi m_p$ c. $e h /4\pi m_n$ d. None of the above.

4. Frank and Hertz experiment is highly useful in determination of
   a. excitation potential b. ionization potential
   c. both d. not any potential.

5. The Larmour precision frequency ω is given by
   a. $Be/2\pi m_e$ b. $Be/\pi m_e$ c. $Be/2m_e$ d. $Be/4\pi m_e$

6. In H_2 atom Paschen series transition produces spectral lines in
   a. UV- region b. Infrared region
   c. Visible region d. microwave region

7. When a parent nucleus emit a β-particle, the daughter nucleus is emitted with
   a. same atomic number, but different mass number.
   b. same atomic number, and same mass number
   c. same mass number, but different atomic number
   d. none of the above

8. The mean life of a radioactive nuclei is related to the decay constant as
   a. $1/\lambda$ b. $1/\lambda^2$ c. $0.6931/\lambda$ d. $0.6931/\lambda^2$

9. The frequency modulated cyclotron is known as
   a. betatron b. synchrotron c. bevatron d. synchrocyclotron

10. Geiger Nuttal law is given by
    a. $\log R = a + b \log \lambda$ b. $\log \lambda = a + b \log R$
    c. $\log \lambda + a = b \log R$ d. $\log R + a = b \log \lambda$

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11. The energy equivalent of 1 amu is
    a. 1 MeV b. 931 MeV c. 1840 MeV d. none of the above

12. The range of an α particle is related to its energy E as
a. E^2 b. E^3 c. $E^{1/2}$ d. $E^{3/2}$

13. The nuclear reactor is supposed to be at its super critical state when its multiplication factor of neutron is
a. equal to 1 b. less than 1 c. greater than 1 d. equal to 0

14. Positron is an antiparticle of
a. e^- b. n c. p d. ν.

15. The charge produced in ionization chamber
a. ne^2 b. n c. ne d. ne^3

II **FILL IN THE BLANKS:**

16. Positive rays are also known as _____ rays.
17. The path of the electron around the nucleus in an atom is in the form of a _____.
18. Stark effect is associated with splitting and spectral liner when an atom is kept in an external _____ field.
19. Breeder reactor converts _____ materials into _____material
20. Enriched uranium has _____ U^{235}.

III **STATE TRUE OR FALSE**:

21. For a given atom, there can be different ionization potential but only one excitation potential
22. Neutron is a Baryon
23. GM counter can only detect the presence of nuclear radiation but cannot identify the nature of incident radiation.
24. The reaction $Ra^{226} \rightarrow Rn^{222} + \alpha$ is an example of transient equilibrium.
25. The source of stellar energy is by nuclear fusion.

IV **ANSWER BRIEFLY:**

26. What is the main application of positive rays?

27. Differentiate between soft and hard X-rays.

28. Distinguish between Normal Zeeman effect and anomalous Zeeman Effect.

29. L – shell can accommodate a maximum of 8 electrons. Distribute the electrons in its sub shells.

30. Define half life period of a radioactive substance.

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BRANCH III - PHYSICS

SIXTH SEMESTER

COURSE : **MAJOR – CORE**

PAPER : **ATOMIC AND NUCLEAR PHYSICS**

TIME : **2 ½ HOURS** MAX. MARKS : 70

SECTION – B

ANSWER ANY FIVE QUESTIONS (5 x 5 = 25)

1. 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 700 nm.
2. The spacing between the atoms of NaCl crystal is 2.82 $^{\circ}$ A. Find the wavelength of x rays for 1st and 2nd order diffraction if the diffraction angles are 10 $^{\circ}$ and 21 $^{\circ}$ for 1st and 2nd order.
3. In Frank-Hertz experiment, Beryllium was bombarded by 10.21 eV and 12.01 eV electrons. It is observed that three spectral lines are emitted. Calculate their wavelengths.
4. Find the threshold energy in the following reaction, $_{7}N^{14}(n, \alpha)\ _{5}B^{11}$. The isotopic masses involved in the reaction are given as follows(in amu) 14.003074, 4.002604, 1.008665, 11.009305.
5. A reactor is developing energy at the rate of 3000 KW. How many atoms of U-235 undergo fission per second? How much of this material would be used in 1000 hours of operation assuming that on an average 200 MeV of energy is released per fission
6. If a radioactive element disintegrates for a period of time equal to its average life, what fraction of the original amount remains and what fraction would have disintegrated?
7. What are elementary particles? How are they classified into different groups? Explain.

SECTION – C

ANSWER ANY THREE QUESTIONS: (3x15=45)

8. Give the theory of Compton Effect and explain its experimental verification.
9. Give an account of Bohr- Sommerfeld relativistic atom model. How does it account for fine structure of hydrogen spectrum?
10. Describe the liquid drop model of the nucleus. How can the semi – empirical formula be derived from it?
11. Describe a G M counter and explain its working as a particle accelerator. A G M counter wire collects 108 electrons per discharge. Calculate the average value of the current in the circuit when the counting rate is 500 counts per minute.
12. Derive an expression for Lande's splitting factor and explain anomalous Zeeman Effect of sodium doublet lines D_1 and D_2 with its help.

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