Final Year B.Sc., Degree Examination

August / September 2009

Directorate of Correspondence Course

Physics

Paper - III : Modern Physics - I

Spectroscopy, Wave Mechanics, Statistical Mechanics, Relativity & Astrophysics

Time : 3 Hours Max. Marks : 75

Instructions:

(1) Answer Section - A in the first two pages of the main answer book.

(2) Answer ALL questions in Section - A, FIVE questions in Section - B, FIVE questions in Section - C & TWO questions in Section - D.

(3) Draw neat and labelled diagrams wherever necessary.

(4) Take the necessary data from the tables.

SECTION - A

I. Answer ALL the questions. 10x1=10 marks

1. What were the de-merits of Rutherford's atom model?
2. What is Stark effect?
3. State selection rules for spectral transitions.
4. What are characteristic x-rays?
5. State Rayleigh's law of scattering of light.
6. What is the average life time of metastable state?
7. The de Broglie wavelength of a moving cricket ball cannot be detected. Why?
8. Define astronomical unit.
9. State Hubble's law.
10. What is "Minkowski world"?

SECTION - B

II. Answer any FIVE questions. 5x3=15 marks

11. Find the ratio of mass of electron to that of proton. Given Rydberg constants. $R_{He} = 1.09677 \times 10^7 m^{-1}$ & $R_H = 1.09722 \times 10^7 m^{-1}$.
12. State & explain Pauli's exclusion principle.
13. Distinguish between Raman spectra & IR spectra.
14. State & explain Maxwell - Boltzmann's distribution law.
15. Explain the equivalence of "inertial mass" & "gravitational mass".

16. Explain the physical significance of the wave function Ψ.

17. The star Epsilon - Indi is at a distance of 11.82 light years & has a brightness 6.7045×10^{-10} Wm^{-2}. Calculate its Luminosity.

SECTION - C

III. Answer any FIVE questions. **5x6=30 marks**

18. With necessary theory, describe Thomson's experiment for the determination of $\frac{e}{m}$ of electron.

19. Describe Stern-Gerlach experiment & mention its results.

20. Derive Bragg's law of x-ray diffraction.

21. Describe the construction & working of a He-Ne Laser with the help of energy level diagram.

22. Solve the Schrodinger's wave equation for the allowed energy values of a particle in a one dimensional potential well.

23. Describe Michelson-Morley experiment & discuss its significance.

24. What is a HR diagram ? How it is used to account for the properties of stars?

SECTION - D

IV. Answer any TWO questions. **2x10=20 marks**

25. a) Give quantum mechanical explanation of normal Zeeman effect. **7 marks**

    b) An X-ray tube has an accelerating potential of 50kV. If the minimum wavelength present in its spectrum is 0.2487 Å, evaluate Planck's constant. **3 marks**

26. a) Give the theory of Compton effect. **7 marks**

    b) With the exciting radiation of wave length 435.8nm, a Raman line at a wavelength 462.4nm was observed. Find the corresponding anti-stokes line. **3 marks.**

27. a) Deduce Einstein's mass - energy relation. **6 marks**

    b) What is "Time Dilation" ? Explain it with an experimental evidence. **4 marks**

28. a) Write a note on stellar magnitudes and hence state mass - luminosity relation. **6 marks**

    b) Using uncertainty principle, show that electrons do not exist inside the nucleus. **4 marks**

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