DSC – 210

III Year B.Sc. Examination, Sept./Oct. 2012
(Directorate of Distance Education)
PHYSICS
Paper – III : Spectroscopy, Wave Mechanics, Statistical Mechanics, Relativity and Astrophysics

Time : 3 Hours Max. Marks : 75/85

Instructions *: 1) Students who have attended **25** marks **IA** Scheme will have to answer for total of **75** marks.*
*2) Students who have attended **15** marks **IA** Scheme will have to answer for total of **85** marks.*
*3) Section **E** is **compulsory** for **85** marks Scheme only.*

SECTION – A

I. Answer **all** questions. **(10×1=10)**

1) What is the effect of nuclear mass on wavelength of a spectral line ?
2) Mention any one use of Pauli's exclusion principle.
3) Why production of continuous X-rays is considered as an inverse process of photo electric effect ?
4) Why non-polar molecules do not show rotational spectra ?
5) What do you mean by light amplification in case of laser ?
6) What is the physical significance of square of magnitude of a wave function ?
7) Define thermodynamic probability in statistical mechanics.
8) Define absolute magnitude of a star.
9) Why Lorentz transformation equations are preferred to Galilean transformation equations ?
10) Why material particles cannot have velocity equal to or greater than the velocity of light ?

P.T.O.

SECTION – B

II. Answer **any FIVE** questions. **(5×3=15)**

11) What are the factors that lead to the concept of electron spin ?

12) What is anomalous Zeeman effect ? Explain why normal Zeeman effect occurs only in atoms with even number of electrons.

13) What is population inversion ? Explain why three levels are required for laser action.

14) What is Raman effect ? Explain why stokes lines are more intense than antistokes lines.

15) State Mosley's law. What is its importance ?

16) State de Broglie hypothesis. Why electrons are used in electron microscope ?

17) Obtain the relativistic energy-momentum relation.

SECTION – C

III. Answer **any FIVE** questions. **(5×6=30)**

18) Describe Thomson's method of determining e/m of electron

19) Give the quantum theory of normal Zeeman effect.

20) State and derive Bragg's law. Mention any one of its applications.

21) What are distinguishable and indistinguishable particles ? Derive Planck's Law from Bose-Einstein statistics.

22) Derive Schrodinger's time-dependent wave equation.

23) State Postulates of general theory of relativity. Give Einstein's theory of gravitation.

24) What is Chandrashekar's limit ? Explain how a main sequence star becomes a neutron star.

SECTION – D

IV. Answer **any TWO** questions. **(2×10=20)**

25) a) Obtain an expression for magnetic moment due to orbital motion of the electron and hence define Bohr magneton.

b) Determine the maximum separation of a beam of hydrogen atoms that moves a distance of 20 cm with a speed of 2×10^5m/s perpendicular to a magnetic field, whose gradient is 2×10^{-24} T/m and $M_H = 1.67 \times 10^{-27}$ kg. **(6+4)**

26) a) Derive the expression for compton shift.

b) In the Raman experiment using mercury green of wavelength 546.1 nm, a stokes line of wavelength 554.3 nm was observed. Find the Raman shift and frequency corresponding to the anti-stokes line. **(7+3)**

27) a) With a neat diagram, explain the construction and working of He-Ne laser.

b) What are the characteristics of a laser beam ? **(7+3)**

28) a) Set up Schrodinger wave equation for a particle in one dimensional potential box and solve it to obtain expressions for energy eigen values and eigen functions.

b) The position and momentum of 1KeV electron are simultaneously determined. If its position is located within 0.4 nm, what is the percentage uncertainty in its momentum ? **(6+4)**

SECTION – E

V. Answer **any ONE** of the following questions.
(**Compulsory** question for **85** marks Scheme only) **(1×10=10)**

29. a) State Postulates of special theory of relativity. Derive velocity addition theorem and hence show that maximum attainable velocity is velocity of light.

b) A clock keeps correct time. With what speed should it be moved relative to an observer so that it may seem to lose one minute in one-day ? **(7+3)**

30) a) State Hubble's law. Write short notes on white dwarfs and black holes.

b) The apparent magnitude of the star Sirius A is –1.44 and that of star Regulus is +1.36. Calculate the relative brightness of the star Sirius A with respect to Regulus. **(6+4)**