Exam.Code:0906
Sub. Code: 6668

1119

B.E. (Mechanical Engineering)
Second Semester
APH-203: Quantum and Statistical Physics
(Common with IT, ECE and EEE)

Time allowed: 3 Hours **Max. Marks: 50**

NOTE: *Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Unit.*

x-x-x

I. Answer the following briefly:-

a) Why does the moon create two high tides on opposite sides of the earth? Should'nt there only be one, on the side closest to the moon?

b) Explain the meaning of Eigenstate and Stationary state.

c) Distinguish between gravitational red shift and Doppler red shift.

d) Under what conditions do the Bose-Einstein and Fermi-Dirac distribution approach Maxwell Boltzmann distribution.

e) Explain the physical significance of quantum numbers n, 1 and m_l. (5x2)

UNIT – I

II. a) Using uncertainty principle, estimate the size of the hydrogen atom in the ground state.

b) Distinguish between group velocity and wave velocity. Prove that the de-Broglie wave packet associated with a moving body travels with the same velocity as the body. (4,6)

III. a) Discuss Doppler effect for light. Derive an expression of change in wavelength of light as seen by the moving observer moving away from the source of light.

b) Mention the important postulates of the quantum mechanics. (6,4)

IV. a) Derive the Schrodinger's time independent wave equation and prove that energy quantization is included in the equation.

b) Two rockets of rest length Lo are approaching the earth from opposite directions at velocities ± c/2. How long does one of them appear to the other? (5,5)

P.T.O.

UNIT – II

V. a) Explain the origin of spin-orbit coupling in atoms.

b) Discuss the tunnel effect for a particle approaching a potential barrier of finite width, with energy less than that of the barrier height. (3,7)

VI. a) In a hydrogen atom an electron is in a 3d state.

i) From the quantum mechanical model find the magnitude of the orbital angular momentum L of the electron in units of h.

ii) Find the energy of the electron in eV.

iii) What are the allowed transitions for this electron that result in the emission of a photon?

iv) Calculate the energy of the transition(s) in (iii) in eV.

b) What is Bose-Einstein statistics? Derive formula of Bose-Einstein distribution law. (4,6)

VII. Discuss how Rayleigh Jeans law failed to account for the spectral distribution of energy density in the black-body radiation. How did Planck's radiation law overcome the difficulty? (10)

x-x-x