(9)

**Exam.Code:0906**
**Sub. Code: 6668**

**1059**

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

x-x-x

Q1. Answer the following briefly:
(i) Explain the difference between Coriolis force and Centrifugal force.
(ii) What is a wave packet?
(iii) A body quadruples its momentum when its speed doubles. What was the initial speed in units of c, i.e., what was u/c?
(iv) What do you mean by the space-quantization of angular momentum L? What role does the magnetic quantum number $m_l$ play in this quantization?
(v) Explain the tunnel effect in reference to the tunnel diode. 5 x 2 = 10

**Section A**

Q2 (a) What is photoelectric effect? Give Einstein explanation of photoelectric effect on the basis of quantum theory. (5)
(b) Describe the Michelson-Morley experiment and briefly discuss its significance. How the negative results obtained from the experiment are interpreted? (5)

Q3(a) Prove that a free electron cannot completely absorb a photon and conserve both energy and momentum. (4)
(b) Discuss de Broglie hypothesis for matter waves. Describe the Davisson Germer experiment to establish the wave nature of the electrons. (6)

Q4(a) Obtain Schrodinger's time dependent wave equation for a particle in one dimension. (5)
(b) At what speed would a motorist in a very fast car have to go so that he or she would see a red traffic light as green? Assume that the light looks red when the motorist is at rest. Take wavelength of red light equal to 650 nm and 530 nm for green. (5)

**Section B**

Q5 (a) Explain the normal Zeeman effect. Explain why it is only possible to observe the normal Zeeman effect in an atom that has an even number of valence electrons. (5)
(b) Consider a particle of energy $E < V_0$ moving from left to right, towards a step potential function of height $V_0$ represented by the equations

$V = 0$ for $-\infty \leq x \leq 0$
$V = V_0$ for $0 \leq x \leq \infty$

Solve Schrodinger wave equation and write down the well behaved solutions in the above mentioned regions. (5)

Q6 (a) Discuss the Stern-Gerlach experiment. Mention its objectives and conclusions. (5)
(b) What is Fermi-Dirac statistics? Derive formula of Fermi-Dirac distribution law. (5)

Q7(a) State and derive the law of equipartiton of energy. What are the conditions for the law to be valid? (7)
(b) Consider a particle of mass m in an infinite well that runs from x = 0 to x = L. The normalized wavefunction is given by $(2/L)^{1/2} \sin(n\pi x/L)$. Calculate $\langle x \rangle$, $\langle p \rangle$ and $\langle p^2 \rangle$. (3)

x-x-x