## Bachelor of Science (T.Y.B.Sc.) Fifth Semester B.Sc.3534 : 5S-PHY501-Physics Paper-I (Statistical Physics And Relativity)

P. Pages : 3 Time : Three Hours			Iours $* 1 \circ 3 3 *$	GUG/W/18/1320 Max. Marks : 50				
	Not	es :	<ol> <li>All the questions are compulsory.</li> <li>Draw the neat labelled diagram wherever necessary.</li> </ol>					
	Eith	er:-						
1.	A)	i)	Explain the term microstate and macrostate with the help of an examp	ole.	4			
		ii)	What is meant by thermodynamic probability of a macrostate? How is probability of occurrence of that state? Distinguish between mathema and thermodynamic probability.	t is related to tical probability	4			
		iii)	Calculate the probability that in tossing a coin 10 times, We get 5 hea	ds and 5 tails.	2			
			OR					
	B)	i)	Derive Maxwell-Boltzmann's law of distribution of velocities of the rideal gas.	nolecules of	5			
		ii)	Assuming Maxwell's law of distribution of molecular speeds, derive a for the most probable speed.	in expression	3			
		iii)	At what temperature will the average speed of hydrogen molecules be that of nitrogen molecules at 35°C. Molecular weight of $N_2 = 28$ and t	the same as that of $H_2 = 2$ .	2			
	Eith	er:						
2.	A)	i)	What are Bose-Einstein's statistics? and give its basic postulates.		3			
		ii)	Derive an expression		5			
			$\eta_i = \frac{gi}{e^{\alpha + \beta Ei - 1}}$ for the most probable distribution of the particles of a	ı system				
			obeying B.E. statistics.					
		iii)	Find the number of ways in which three bosons may be distributed in	four cells.	2			
	OR							
	B)	i)	What are the postulates of special theory of relativity?		2			
		ii)	Derive the formula for the relativistic variation of mass with velocity. significance.	Explain its	6			
		iii)	What would be the speed of a particle if its mass is equal to four time mass?	s to its rest	2			

	Eith	Either:-					
3.	a)	Explain Bridge with macroscopic physics.	21/2				
	b)	Assuming MB distribution of molecular speeds, show that the mean speed for the molecules of an ideal gas is given by $\overline{V} = \sqrt{\frac{8KT}{\pi m}}$	21/2				
	c)	How does FD statistics differ from BE statistics?	21/2				
	d)	The length of a rocket ship is 100m on the earth. When it is moving with velocity $v$ , its length observed is 99m. Calculate its velocity.	21/2				
	OR						
	e)	Derive the condition of equilibrium between two systems in thermal contact.	21/2				
	f)	Find the most probable speed of nitrogen at 27°C. Molecular weight of	21/2				
		$M_2 = 28 \times 10^{-3} \text{ kg/mol}$ , the gas constant R = 8.314 J/mol $\mathring{k}$ .					
	g)	Distinguish between classical and quantum statistics.	21/2				
	h)	On the basis of Lorentz transformation discuss length contraction.	21/2				
	Eith	Either:-					
4.	a)	State and explain the principle of equal a priori probability.	21/2				
	b)	Assuming M.B. distribution of molecular speeds, show that the rms speed is given by $V_{rms} = \sqrt{\frac{3kT}{m}}$	21/2				
	c)	Define Fermi energy. Explain the significance of the Fermi energy.	21/2				
	d)	The length of a rod is found to be half its length when at rest. What is the speed of the rod relative to the observer?	21/2				
	OR						
	e)	In a system of 8 distinguishable particles distributed in two equal sized compartments, calculate the probability of the macrostate. (3,5) and (4,4).	21/2				
	f)	What are the limitations of Maxwell. Boltzmann statistics?	21/2				
	g)	Derive the expression for Fermi energy of electron in a metal at absolute temperature.	21/2				
	h)	Derive $E = mc^2$ , Einstein's mass-energy relation.	21/2				

	Attempt any ten of the followings.	
a)	What is $\mu$ -space?	1
b)	Distinguish between accessible and inaccessible states.	1
c)	Define probability.	1
d)	Draw the graph showing mean, r.m.s. and most probable velocity.	1
e)	What is partition function for system of gas?	1
f)	Define root mean square velocity of the gas molecules.	1
g)	What are Bosons? Give its examples.	1
h)	What are Fermions? Give its examples.	1
i)	Write Fermi-Dirac distribution law for assembly of fermions.	1
j)	Write Inverse Lorentz transformations equations.	1
k)	What is meant by time dilation?	1
1)	Define proper time?	1
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5.