## M.Sc. (Physics) Third Semester (Old) MSc23101-Paper-I (Compulsory) - Quantum Mechanics-II

P. Pa Time	ages : e : Thr	2 ree Hours $* 1794 *$	<b>GUG/W/18/2300</b> Max. Marks : 80
1.		Either	
	a)	Give first order perturbation theory of non degenerate system and find the energy and wavefunction.	expressions of 8
	b)	Calculate the first order energy correction for anharmonic oscillator.	8
		OR	
	e)	Define Stark effect. Explain first order stark effect in the ground and first Hydrogen atom.	excited state of 8
	f)	Explain the applications of perturbation theory to ground state energy.	8
2.		Either	
	a)	Discuss time dependent perturbation theory and derive the expression of F rule of probability transition.	Fermi-Golden 12
	b)	Distinguish between stimulated emission and spontaneous emission of rad basis of time dependent perturbation theory.	iation on the 4
		OR	
	e)	What is WKB approximation ? Discuss the conditions of applicability of t approximation.	he WKB 8
	f)	Outline the steps involved in solving a problem using the vibrational princ	iple. 8
3.		Either	
	a)	Explain Heitler - London theory of the hydrogen molecule.	8
	b)	Using spin matrices, $S_x$ , $S_y$ and $S_z$ construct spin product function of the spelectrons.	ystem of two 8
		OR	
	e)	Explain scattering theory of quantum particles using partial wave analysis	. 8
	f)	Define particle exchange operator and show that if commutes with Hamilt eigen values and consequences on the wave function.	onian. Find its <b>8</b>

## 4. Either

a) Define dirac Hamiltonian for the relativistic particle. What are the properties of  $\alpha$  and  $\beta$ ? **8** 

b) Solve K.G. equation for a free particle and discuss its limitations.

## OR

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e)	Explain spin-orbit interaction for Dirac's particles.		8
f)	Show that the spin of electron is an automatic consequence of Dirac equation, using the law of conservation of momentum.		
	Answer <b>all</b> the following :		
	a)	Explain second order stark effect in hydrogen atom.	4
	b)	What are Einstein's A and B coefficients ? Give their relation.	4
	c)	Explain 'Ortho' and 'Para' stales of the helium atom.	4
	d)	Give the physical significance of negative energy state.	4

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