Sanjay Ghodawat University, Kolhapur

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2020-21

EXM/P/09/00

Year and Program: F. Y. M. S.c	School of Science	Department: Physics
Course Code: PHS501	Course Title: Quantum Mechanics	Semester: I
Day and Date:	End Semester Examination	Time: 2 Hrs. Max Marks: 50

Instructions: 1) All Questions are compulsory.

Q.1		Answer/Solve the following.	Marks	Bloom's Level	CO
	a)	Deduce the expression for Energy of particle in a box.	8	L4	CO1
	b)	Explain Stern-Gerlach experiment and Sequential Stern-Gerlach experiment in details.	8	L3	CO1
		OR			
	c)	Write a note on i) Position operator ii) Momentum operator	8	L3	CO2
Q.2		**Answer/Solve the following.**			
	a)	Derive the expression for the time dependent Schrodinger wave equation.	8	L4	CO3
	b)	A 1.00 g marble is constrained to roll inside a tube of length L = 1:00 cm. The tube is capped at both ends. *i)* Modelling this as a one-dimensional infinite square well, determine the value of the quantum number n if the marble is initially given an energy of 1.00 mJ. ii) Calculate the exitation energy required to promote the marble to the next available energy state.	8	L4	CO3
		OR			
	c)	A free electron has wave function $\Psi(x, t) = \sin(kx - \omega t)$ *i)* Determine the electron's de Broglie wavelength, momentum, kinetic energy and speed when k = 50 nm-1. *ii)* Determine the electron's de Broglie wavelength, momentum, total energy, kinetic energy and speed when k = 50 pm^{-1}.	8	L4	CO3

Q.3		Answer/Solve the following.			
	a)	i) Explain angular momentum operator in details. Also write the expression for L_x, L_y, L_z and L^2. ii) Simulate Eigen values of L^2 and L_z.	9	L3	CO4
	b)	Calculate $<P>$, $<P^2>$ and Δp for a quantum oscillator in its ground state.	9	L2	CO4
		OR			
	c)	i) Write a note on the commutation relations for the orbital angular momentum. ii) Show that, $[Lx, Ly] = i\hbar Lz$.	9	L2	CO4

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