22PHU516N

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

BSc DEGREE EXAMINATION DECEMBER 2025
(Fifth Semester)

Branch – **PHYSICS**

QUANTUM MECHANICS AND RELATIVITY

Time: Three Hours Maximum: 75 Marks

SECTION-A (10 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** marks (10 × 1 = 10)

Module No.	Question No.	Question	K Level	CO
1	1	The de Broglie wave is associated with: a) Charged particles/macroscopic objects moving b) Sub-atomic particles c) Electrically neutral particles d) None of these	K1	CO1
	2	Davisson–Germer experiment is related to the phenomenon of: a) Interference b) Diffraction c) Reflection d) Polarization	K2	CO1
2	3	If an atomic system remains in a particular state for a maximum interval of time, then the uncertainty in the measurement of energy is: a) Maximum b) Zero c) Minimum d) Infinite	K1	CO2
	4	Image formation in an electron microscope is based on: a) Column length b) Electron number c) Differential scattering d) Specimen size	K2	CO2
3	5	A linear harmonic oscillator is bound to its equilibrium position by a force F proportional to: a) x b) x^2 c) –x d) 1/x	K1	CO3
	6	The probability density of finding a particle in a one-dimensional potential box of length L in the ground state (n = 1) is maximum at: a) L/2 b) L/3 c) 3L/4 d) 4L/3	K2	CO3
4	7	A clock is moving with the speed of light relative to an observer. The observer feels that the stationary clock is: a) Fast b) Slow c) Completely stopped d) None of these	K1	CO4
	8	In relativistic mechanics, the contribution of G.F. FitzGerald is in the theory of: a) Length contraction b) Time dilation c) Michelson–Morley experiment d) Galilean transformation	K2	CO4
5	9	What happens to the wavelength of light when it passes through a strong gravitational field according to General Relativity? a) λ decreases b) λ increases c) λ remains constant d) λ = 0	K1	CO5
	10	Which celestial body's motion was used to confirm Einstein's General Relativity theory? a) The Moon b) Mercury c) Venus d) Mars	K2	CO5

Cont...

SECTION - B (35 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** Marks (5 × 7 = 35)

Module No.	Question No.	Question	K Level	CO
1	11.a.	Give the significance and conclusions of electromagnetic theory. Also Explain the properties of photons.	K5	CO1
		(OR)		
	11.b.	Explain the photoelectric effect and deduce Einstein's photoelectric equation.		
2	12.a.	State and prove Heisenberg's uncertainty principle. GIVE its physical importance.	K4	CO2
		(OR)		
	12.b.	Distinguish between the electron microscope and an ordinary optical microscope.		
3	13.a.	Derive the time-independent Schrödinger wave equation for a particle.	K5	CO3
		(OR)		
	13.b.	Explain the Schrödinger equation for a linear harmonic oscillator and obtain the eigenvalues of the energy of the oscillator.		
4	14.a.	Briefly discuss the Michelson–Morley experiment and mention its outcome.	K6	CO4
		(OR)		
	14.b.	State the fundamental postulates of the special theory of relativity. Deduce the Lorentz transformation equations, and discuss how these account for the phenomenon of length contraction.		
5	15.a.	List out the fundamental concepts and postulates of the general theory of relativity.	K4	CO5
		(OR)		
	15.b.	How does Einstein's equation predict the bending of light near a massive object?		

SECTION -C (30 Marks)

Answer **ANY THREE** questions

ALL questions carry **EQUAL** Marks (3 × 10 = 30)

Module No.	Question No.	Question	K Level	CO
1	16	Describe Davisson–Germer's experiment for the study of the diffraction of electrons.	K4	CO1
2	17	State Heisenberg's uncertainty principle and illustrate it by Bohr's idealized thought experiment.	K4	CO2
3	18	Explain the energy equation for a particle in a one-dimensional box.	K5	CO3
4	19	Deduce the relativistic velocity addition theorem. Show that it is consistent with Einstein's second postulate of the special theory of relativity.	K4	CO4
5	20	Explain Einstein's principle of equivalence. Give a detailed account of redshift of light. How has this been verified experimentally?	K5	CO5

Z-Z-Z END