22PHU309N

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

BSc DEGREE EXAMINATION DECEMBER 2025
(Third Semester)

Branch – **PHYSICS**

ATOMIC, MOLECULAR AND LASER PHYSICS

Time: Three Hours Maximum: 75 Marks

SECTION-A (10 Marks)
Answer **ALL** questions
ALL questions carry **EQUAL** marks (10 × 1 = 10)

Question No.	Question	K Level	CO
1	What is the ionization potential of hydrogen atom? a) 13.6 eV b)10.2 eV c) 12.9 eV d) 3.4 eV	K1	CO1
2	How many number of spectral lines splitting occur in the presence of magnetic field for the $l = 2$ state? a) 7 b) 3 c) 5 d) 4	K2	CO1
3	Identify the type of radiations which will be effective for the emission of electrons from a metallic surface. a) radio wave b) microwave c) infrared d) ultraviolet	K1	CO2
4	Which of the following explains the photoelectric emission of light? a) particle nature b) wave nature c) dual nature d) quantum nature	K2	CO2
5	According to Moselay's law frequency of a characteristic x ray line is proportional to a) z b) z^2 c) 1/z d) $1/z^2$	K1	CO3
6	Choose the correct one for Duane- Hunt law. a) $\lambda_{min} \propto \frac{1}{v}$ b) $\lambda_{min} \propto v$ c) $\lambda_{min} \propto \frac{1}{v^2}$ d) $\lambda_{min} \propto v^2$	K2	CO3
7	Which of the following does not show IR? a) HCl b)N_2 c) CCl_4 d) CO_2	K1	CO4
8	Identify the essential parameter that should change for a molecule to be Raman active. a) frequency b) intensity c) polarizability d) dipole moment	K2	CO4
9	Which of the following pumping mechanism is used in semiconductor laser? a) Atom atom collision b) optical pumping c) Direct pumping d) chemical pumping	K1	CO5
10	An atom in the ground state of energy absorbs a photon of energy and goes to the higher excited state. Identify the process. a) stimulated absorption b) stimulated emission c) spontaneous absorption d) stimulated absorption	K2	CO5

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SECTION - B (35 Marks)

Answer **ALL** questions

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

Question No.	Question	K Level	CO
11.a.	Analyse the inelastic collision of electron with atoms in the Franck and Hertz experiment. Sketch and interpret the I-V characteristic curve	K4	CO1
	(OR)		
11.b.	State Zeeman effect and Appraise the quantum mechanical treatment of normal Zeeman effect for multiple line splitting.		
12.a.	The cadmium line of wavelength λ = 4226.73Ä which exhibit normal Zeeman splitting when placed in a uniform magnetic field of 4 wbm^{-2}. Calculate the wavelength of three components exhibited in normal Zeeman pattern.	K3	CO2
	(OR)		
12.b.	When a light of wavelength 400 nm is incident on a metal surface with a work function of 2.0 eV. Calculate the following. a. The energy of incident Photons is eV. b. Maximum energy of emitted electrons is eV. c. Stopping potential required to stop the fastest electrons.		
13.a.	Apply Bragg's law in rotating crystal method to identify the dimension of the unit cell.	K3	CO3
	(OR)		
13.b.	Illustrate how the powder method of diffraction can be applied to identify unknown crystalline materials from its diffraction pattern.		
14.a.	Analyse Beer lambert's law for absorption spectroscopy.	K4	CO4
	(OR)		
14.b.	Examine the quantum theory of Raman effect and also give the characteristic of Raman lines as a result of your examination.		
15.a.	With a neat energy level diagram, explain the construction and working of He –Ne gas laser. Mention the advantages and limitations of this method.	K2	CO5
	(OR)		
15.b.	Discuss the concept of inertial confinement fusion to explain the laser induced fusion reactor.		

SECTION -C (30 Marks)

Answer **ANY THREE** questions

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

Question No.	Question	K Level	CO
16	Give the postulates of Bohr atom model. Derive the radius of the orbit and total energy of the electron. Also interpret hydrogen spectrum through this model	K4	CO1
17	Examine the terms in Einstein's photo electric equation. Analyse how Millikan's experimental verification of Einstein's equation supports the particle nature of light.	K4	CO2
18	Analyse how the conservation of energy and momentum principles are applied in deriving Compton wavelength shift by deriving the expression for $\Delta\lambda$.	K4	CO3
19	Break down the parts of IR spectrometer and discuss the contribution of each part in recording IR spectra.	K4	CO4
20	Compare the processes of spontaneous emission, stimulated emission and absorption in terms of Einstein's coefficients A and B. Interpret how Einstein's coefficients mathematically justify laser process.	K4	CO5

Z-Z-Z END