KU2DSCPHY121:Physics of Atoms, Molecules and Nuclei

Semester	Course Type	Course Level	Course Code	Credit	Total Hours
II	DSC	100	KU2DSCPHY121	4	75

Learning Approach (Hours/ Week)		Marks Distribution			Duration of ESE (Hours)
Lecture+ Tutorial	Practical	CE	ESE	Total	
3	2	35	65	100	2

Course Description:

This course will provide the student an understanding of atom models, wave properties of particles and their applications. The student will learn to apply Schrodinger equation for simple problems. An elementary understanding of bonding in solids and molecular spectroscopy is included.

Course Prerequisite: Higher secondary level Physics Chemistry and Mathematics

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Understand the structure of atom and different atom models	U
2	Understand wave properties of particles	U
3	Understand quantum physics and Apply Schrodinger equation for simple one-dimensional problems.	U & A
4	Understand Bonding in solids and Analyse spectral properties of diatomic molecules	U & An

**Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)*

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	3	2	1	3	2	2	0
CO 2	3	2	0	3	2	2	1
CO 3	3	3	1	3	2	2	1
CO 4	3	2	1	3	2	2	1

**Correlation level 0-None, 1-Slight, 2-Medium, 3-High*

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	UNIT	DESCRIPTION	HOURS
1	**Particle properties of waves and wave properties of particle**		**12**
		Blackbody spectrum- Wein's displacement law, Planck's hypothesis, Planck's radiation formula (Derivation not required)	**4**
		Photoelectric Effect - experimental results - Quantum theory-Einstein photoelectric equation	**4**
		De Broglie hypothesis, De Broglie wavelength, Experimental study of matter waves-Davisson and Germer Experiment, Heisenberg Uncertainty principle- statement and expression	**4**
		Sections 8.1, 8.4, 8.5, chapter 9, 11.1,11.3	
2	**Structure of the atom**		**9**
	1	Introduction, Rutherford's experiments on scattering of α particles Rutherford atom model- Drawbacks of Rutherford atom model.	4

	2	Bohr atom model – Basics postulates and explanations, Bohr formula, Calculation of total energy, Bohr's interpretation of the hydrogen spectrum, Spectral series of hydrogen atoms, drawbacks of Bohr atom model.	5
		Sections 6.1, 6.2, 6.4	
3	**Lasers, Molecular spectra and Raman effect**		**12**
	1	Induced absorption, spontaneous emission, stimulated emission, Ruby laser, He- Ne laser, Semiconductor laser, properties of laser beam	4
	2	Origin, nature of molecular spectra, different modes of molecular excitations, factors affecting linewidth, intensity of molecular spectra.	4
	3	Rayleigh scattering, Raman effect-discovery, experimental study, Quantum theory, Applications	4
		Sections 19.1- 19.5, 23.1-23.5, 19.10-19.14	
4	**Introduction To Nucleus & Nuclear Structure**		**12**
	1	Introduction, Classification of Nuclei, General properties of Nucleus	3
	2	Binding Energy, Nuclear Stability,	3
	3	Discovery of radioactivity, natural radioactivity, Alpha, beta gamma rays, Law of Radioactive Disintegration, mean life, Radiometric Dating,	3
5	4	Nuclear Fission, Energy released in fission, Nuclear Reactor, Nuclear Fusion, sources of stellar energy	**3**
		Book 1- Sec 27.1-27.5, 31.1-31.3, 31.30, 31.31,31.35, 35.2, 35.3, 35.6. 35.7. 35.8	
	Practical Module		**30**
	Directions: **At least 4** experiments from the following + 2 Activities (can be selected from the list or can be designed by course faculty.)		
	1. Liquid lens - Refractive index of a liquid and material of the lens using another liquid of known refractive index. 2. Compound pendulum radius of gyration 3. Spectrometer – refractive index of a prism 4. CF Bridge -Resistance and resistivity		

	5. Potentiometer calibration of low range voltmeter 6. Deflection Magnetometer –Tan A and Tan B 7. Construction of Logic gates – AND , OR verification of truth table 8. Simulations-Structural elucidation of simple molecules by analysing IR spectrum, Spectral analysis of UV-Vis spectrum	

Essential Readings:

1. Modern Physics by R Murugeshan, Kiruthiga Sivaprasath, S Chand Publishing, 17th Edition, .

Suggested Readings:

1. Concepts of Modern Physics by Arthur Beiser, 6th Edn, Mc Grew Hill, 2020.
2. Modern Physics by Kenneth S Krane, 4th Edn, Wiley India, 2020.
3. Fundamentals of molecular spectroscopy by Banwell, Elaine M McCash, Mc Grew Hill, 1994.
4. University Physics with Modern Physics - Young and Freedman-14th Edn, 2016.

Assessment Rubrics:

Evaluation Type			**Marks**	**Evaluation Type**			**Marks**	**Total**
Lecture			**75**	**Practical**			**25**	**100**
a)	**ESE**		**50**	a)	**ESE**		**15**	
b)	**CCA**		**25**	b)	**CCA**		**10**	
	i	*Test Paper	10		i	Punctuality	3	
	ii	**Assignment/ Book-Article review	10		ii	Skill	4	
	iii	Seminar/ Viva-Voce	5		iii	Record	3	

*Best out of two test papers

** or any other activities like quiz, open book exam, group activity