Semester Lecture Plan

Name of the college: Government College of Arts, Science & Commerce, Sanquelim-Goa

Name of Faculty: Mahendra R. Pednekar	**Subject:** Physics Core	
Paper code: PYC- 108 Atomic and Molecular Physics	**Program/Course: T.Y. B.Sc.**	**Division: A**
Academic year: 2024- 2025	**Semester: VI**	**Total Lectures: 60**

Course Objectives: 1. To study atomic spectra of one and two valence electron atoms and change in behaviour in the presence of external weak magnetic field and strong magnetic field.
2. To Study X ray spectra and its characteristics.
3. To study spectra of diatomic molecules.
4. To

Course Learning Outcome: The students will be able to

1. **Understand the concept spectra of one and two valence electrons.**
2. **Understand the fine structure of spectra of atoms in presence and absence of external magnetic field.**
3. **Explain X ray spectra, the concept of Auger effect and fluorescence yield.**
4. **Understand the spectra of diatomic molecules.**
5. **Understand the concept of of Raman effect and Raman spectra.**

Month	Lectures From:	To:	No. of lectures allotted	Topic, Subtopic to be covered	Learning outcome	ICT Tools	Reference books
December	09/12/24	17/12/24	06	Hydrogen Atom Schrodinger's equation for the H-atom separation of variables Quantum numbers- n, l, ml, spin,	Students will be able to: 1.Apply spherical polar coordinates to H atom . 2. Formulate Schrodinger's equation and solve it		Arthur Beiser, Perspectives of Modern Physics. McGraw-Hill International Editions., Singapore.

				magnetic moment, J and mJ, Angular momentum	using separation of variables method. 3.Understand the significance of quantum numbers 4. Explain the angular momentum and magnetic moment due to orbital and spin motion.		Namjoshi A.V., Rao Jyoti A., (1997) Atomic and Molecular Physics And Electrodynamics. Sheth Publishers pvt. Ltd. Bombay.
January	2/1/25	11/1/25	06	Magnetic moment and Bohr magneton. Many Electron Atoms Pauli exclusion principle classification of elements in periodic table.	Students will be able to: 1.Explain the concept of magnetic moment and Bohr magneton. 2. Understand and apply Pauli exclusion principle. 3.Classify elements in periodic table		Arthur Beiser, (1999) Concepts Of Modern Physics. Tata McGraw-Hill Publishing Company Limited New Delhi. Namjoshi A.V., Rao Jyoti A., (1997) Atomic and Molecular Physics And Electrodynamics. Sheth Publishers pvt. Ltd. Bombay.
January	13/01/25	18/01/25	04	Symmetric and Antisymmetric wave functions Electron configuration, Hund's rule	Students will be able to:1.Define symmetric and antisymmetric wave function. 2.Write electron		Arthur Beiser, (1999) Concepts Of Modern Physics. Tata McGraw-Hill

				Spin orbit interaction, Vector atom model,	configuration of elements. 3.State and apply Hund's rule. 4.Understand the concept of spin orbit interaction. 5.Apply vector atom model.		Publishing Company Limited New Delhi. Namjoshi A.V., Rao Jyoti A., (1997) Atomic and Molecular Physics And Electrodynamics. Sheth Publishers pvt. Ltd. Bombay.
	20/1/25	25/01/25	04	Total angular momentum, L-S coupling, J-J coupling.	The students will be able to: 1.Evaluate total angular momentum 2.Understand the concept of LS coupling and JJ coupling		Arthur Beiser, (1999) Concepts Of Modern Physics. Tata McGraw-Hill Publishing Company Limited New Delhi. Namjoshi A.V., Rao Jyoti A., (1997) Atomic and Molecular Physics And Electrodynamics. Sheth Publishers pvt. Ltd. Bombay.
Jan/Feb	27/01/25	1/2/25	04	Atomic Spectra Spectroscopic notation, Selection rules (derivation from transition probabilities),	The students will be able to: 1. Explain spectroscopic notation or term symbols for atoms.		H.E.White H.Semat and J.R.Albright, Introduction to Atomic Physics, McGraw Hill Book

					2.list selection rules for transitions.		Company Namjoshi A.V., Rao Jyoti A., (1997) Atomic and Molecular Physics And Electrodynamics. Sheth Publishers pvt. Ltd. Bombay.
Feb	3/2/25	8/2//25	04	Alkali metal type spectra, Principal, Sharp, Diffused and Fundamental series, fine structure in alkali spectra.	The students will be able to: 1.Explain alkali metal type spectra. 2.Classify principal, sharp,Diffused, and fundamental series. 3.Explain fine structure in alkali spectra.		H.E.White H.Semat and J.R.Albright, Introduction to Atomic Physics, McGraw Hill Book Company Namjoshi A.V., Rao Jyoti A., (1997) Atomic and Molecular Physics And Electrodynamics. Sheth Publishers pvt. Ltd. Bombay.
Feb	10/2/25	15/2/25	04	Atoms in a Magnetic Field Effects of magnetic field on an atom, The Stern-Gerlach experiment, Larmor Precession,	The students will be able to: 1.Explain the behaviour of atoms in presence of magnetic field. 2.Explain the concept of Stern-Gerlach experiment.		H.Semat and J.R.Albright, Introduction to Atomic and nuclear Physics, Chapman and Hall Namjoshi A.V., Rao Jyoti A., (1997) Atomic and Molecular Physics And Electrodynamics.

							Sheth Publishers pvt. Ltd. Bombay.
February	17/2/25	22/2/25	04	The Normal Zeeman effect, Lande 'g' factor, Zeeman pattern in a weak field (Anomalous Zeeman effect	The students will be able to: 1.Explain Normal Zeeman effect 2.Calculate lande g factor 2.Explain concept of Anamalous Zeeman effect.		H.Semat and J.R.Albright, Introduction to Atomic and nuclear Physics, Chapman and Hall Arthur Beiser, Perspectives of Modern Physics. McGraw-Hill International Editions., Singapore.
Feb/March	24/2/25	1/3/25	04	X-ray Spectra Characteristic spectrum, Moseley's law, Explanation of X-ray spectra on the basis of quantum mechanics, Energy levels and characteristic X-ray lines,	The students will be able to : 1.Expalin the characteristics of Xray spectra. 2.Understand Moseley's law. 3. Explain Xray spectra on the basis of quantum mechanics. 4. Understand the concept of energy levels and xray characteristic lines.		H.Semat and J.R.Albright, Introduction to Atomic and nuclear Physics, Chapman and Hall Namjoshi A.V., Rao Jyoti A., (1997) Atomic and Molecular Physics And Electrodynamics. Sheth Publishers pvt. Ltd. Bombay.
March	3/3/25	8/3/25	04	X-ray absorption spectra, Fluorescence and Auger effect. Spectra of Diatomic Molecules	The students will be able to: 1.Understand the concept of Xray absorption spectra.		H.Semat and J.R.Albright, Introduction to Atomic and nuclear Physics, Chapman

				Rotational energy levels, Rotational spectra,	2.Explain Fluorescence yield and Auger effect. 3. Explain the formation of spectra due to diatomic molecules. 4.Understand the concept of rotational energy levels and rotational spectra.		and Hall Namjoshi A.V., Rao Jyoti A., (1997) Atomic and Molecular Physics And Electrodynamics. Sheth Publishers pvt. Ltd. Bombay.
Mar	10/3/25	15/3/25	04	Rotational energy levels, Rotational spectra,(cont.) Vibrational energy levels, Vibrational energy levels,(cont.)	The students will be able to: 1.understand the concept of vibrational energy levels.		Banwell, Fundamentals of Molecular Spectroscopy, TMH (2012) Namjoshi A.V., Rao Jyoti A., (1997) Atomic and Molecular Physics And Electrodynamics. Sheth Publishers pvt. Ltd. Bombay.
March	17/3/25	22/3/25	04	Vibration-Rotation spectra, Vibration-Rotation spectra, Vibration-Rotation spectra,(cont.)	The students will be able to : 1.Explain the theory of vibration rotation spectra.		Banwell, Fundamentals of Molecular Spectroscopy, TMH (2012) Namjoshi A.V., Rao Jyoti A., (1997) Atomic and Molecular Physics And Electrodynamics. Sheth Publishers pvt. Ltd. Bombay.

March	24/3/25	29/3/25	04	Fortrat Parabolas and explanation of band structure on its basis Electronic spectra	The students will bw able to 1.Explain the concept of Fortrat parabolas ad explain the formation of band structure on its basis.		Banwell, Fundamentals of Molecular Spectroscopy, TMH (2012) Namjoshi A.V., Rao Jyoti A., (1997) Atomic and Molecular Physics And Electrodynamics. Sheth Publishers pvt. Ltd. Bombay.
March/April	31/3/25	5/4/25	04	Raman Effect Raman Effect: Classical and Quantum mechanical explanation, Pure rotational Raman spectra,	The students will be able to : 1.State Raman effect 2.Give classical and quantum mechanical explanation for Raman effect. 3. Explain the formation of pure rotational Raman spectra.		G. Arhuldas, Molecular Structure & Spectroscopy, PHI. Namjoshi A.V., Rao Jyoti A., (1997) Atomic and Molecular Physics And Electrodynamics. Sheth Publishers pvt. Ltd. Bombay.
April	7/4/25	11/4/25	04	Pure rotational Raman spectra, Vibrational Raman spectra, Rotational fine structure, Experimental set up for Raman spectroscopy.	The students will be able to: 1.Explain pure vibrational Raman spectra. 2.Understand the concept of rotational fine structure. 3.Describe the experimental set up		G. Arhuldas, Molecular Structure & Spectroscopy, PHI. Namjoshi A.V., Rao Jyoti A., (1997) Atomic and Molecular Physics And Electrodynamics. Sheth Publishers pvt. Ltd. Bombay.

					for Raman spectroscopy.		
				Discussion and revision			