UNIVERSITY, COIMBATORE – 46
M.Sc. PHYSICS (UNIVERSITY DEPARTMENT)
(For the students admitted during the academic year 2016-17 onwards)
SCHEME OF EXAMINATION (CBCS PATTERN)

Sem	Course Title		Exam Dur.	Exam			Credits
				CIA	Univ. Exam	Total	
I	Paper – 1	Classical Mechanics	3	25	75	100	4
	Paper – 2	Mathematical Physics – I	3	25	75	100	4
	Paper – 3	Quantum Mechanics-I	3	25	75	100	4
	Elective -1	Advanced Electronics (or) **Molecular Physics**	3	25	75	100	4
	Practical-1	Electronics Experiments	6	25	75	100	4
	Supportive 1	Offered from other Departments	-	-	-	50	2
II	Paper – 4	Mathematical Physics – II	3	25	75	100	4
	Paper – 5	Quantum Mechanics – II	3	25	75	100	4
	Paper -6	Condensed Matter Physics	3	25	75	100	4
	Elective – 2	Thermodynamics and Statistical Mechanics (or) **Data Analysis Techniques**	3	25	75	100	4
	Practical-2	Advanced Physics Laboratory	6	25	75	100	4
	Supportive 2	Offered from other Departments	-	-	-	50	2
III	Paper – 7	Advanced Condensed Matter Physics	3	25	75	100	4
	Paper – 8	Computational Methods and Programming	3	25	75	100	4
	Elective -3	Semiconductor Devices (or) **Plasma Physics**	3	25	75	100	4
	Paper – 9	Electro Magnetic Theory	3	25	75	100	4
	Practical-3	Computational Programming Lab	3	25	75	100	4
	Supportive 3	Offered from other Departments	-	-	-	50	2
IV	Paper – 10	Modern Optics	3	25	75	100	4
	Paper – 11	Nuclear and Particle Physics	3	25	75	100	4
	Paper – 12	Atomic Physics and Molecular Spectroscopy	3	25	75	100	4
	Practical-4	Optics and Laser Laboratory	6	25	75	100	4
		Project & Viva-voce				200	8
Total						**2250**	**90**

Supportive Courses for Other Department Students:
1. Basic Electronics; 2. Energy Resources

Note: ***Three electives papers are added for the candidates admitted from the academic year 2016-17 onwards. The syllabus are given below be followed and there is no change in the scheme of examination and syllabus of remaining papers.***

MOLECULAR PHYSICS Elective Paper 1

Unit I Molecular structure and bonding

Chemical bonding - The VSEPR model - Valence bond theory – The hydrogen molecule - Homonuclear diatomic molecules - Polyatomic molecules - Molecular orbital theory –Homonuclear diatomic molecules – Heteronuclear diatomic molecules – Bond properties - Polyatomic molecules - Molecular shape in terms of molecular orbitals - Molecular structure, properties and conformations

Unit II Molecular symmetry

Symmetry elements and operations – The symmetry classification of molecules – Some immediate consequences of symmetry – Applications to molecular orbital theory – Character tables and symmetry labels – Vanishing integrals and orbital overlap - Vanishing integrals and selection rule

Unit III Molecular interactions and mechanics

Electric properties of molecules - Electric dipole moments - Polarizabilities - Relative permittivities - Interactions between dipoles - Repulsive and total interactions - Molecular interactions in gases - Potential energy (force field) in molecular mechanics – Bond stretching - Valance angle bending - Torsions - van der Waals interactions - Electrostatic interactions

Unit IV Molecular reaction dynamics

Collision theory – Diffusion controlled reactions – Reactive collisions – Potential energy surfaces – Transition state theory – The Eyring equation – Thermodynamic aspects - Microscopic–macroscopic connection - Zero-point vibrational energy - Molecular electronic, rotational, vibrational and translational partition functions

Unit V Electron transfer, electronic structure and spectra

The rates of electron transfer processes – Theory of electron transfer processes – Crystal-field theory - Ligand-field theory - Electronic spectra of atoms - Electronic spectra of complexes - Charge-transfer bands - Selection rules and intensities - Luminescence

Books for Study & Reference:

1. Physical chemistry – Peter Atkins and Julio Depaula, Oxford University Press, 2009.
2. Inorganic chemistry - Peter Atkins, Tina Overton , Jonathan Rourke and Mark Weller, Oxford University Press, 2009.
3. Essential of Computational Chemistry - Theories and Models , IInd Edition, Christopher J. Cramer; John Wiley & Sons, England, 2004.

Tutorials:

1. Determine the bond orders of (a) S_2, (b) Cl_2, and (c) NO_2 from their molecular orbital configurations and compare the values with the bond orders determined from Lewis structures. (NO has orbitals like those of O_2.)
2. When an He atom absorbs a photon to form the excited configuration 1s12s1 (here called He*) a weak bond forms with another He atom to give the diatomic molecule HeHe*. Construct a molecular orbital description of the bonding in this species.
3. Use symmetry properties to determine whether or not the integral $\int p_x z p_z d\tau$ is necessarily zero in a molecule with symmetry C_{4v}.
4. The polarizability volume of NH_3 is 2.22×10^{-30} m^3; calculate the dipole moment of the molecule (in addition to the permanent dipole moment) induced by an applied electric field strength 15 kV m^{-1}.
5. Calculate the collision frequency, z, and the collision density, Z, in carbon monoxide, R=180 pm at 25˚C and 100 kPa. What is the percentage increase when the temperature is raised by 10 K at constant volume?
6. A rate constant is found to fit the expression $k_2 = (6.45 \times 10^{13})\ e^{-(5375\ K)/T}$ $dm^3\ mol^{-1}\ s^{-1}$ near 25˚C. Calculate $\Delta^{\ddagger}G$ for the reaction at 25˚C.

ELECTIVE PAPER 2

Data Analysis Techniques

Unit 1:

Approximate numbers and Significant Figures – Rounding of Numbers – Absolute, Relative and Percentage errors – Relation between Relative error and the significant figures – The general formula for errors – Formulas to the fundamental operations of arithmetic and logarithms – Accuracy in the evaluation of a Formula – Accuracy in the Determination of arguments from a tabulated functions – Accuracy of Series approximations – Errors in Determinants

Unit – 2

Errors of Observations and Measurement – The law of accidental errors – The probability of errors lying between given limits – The probability equation – The law of error of a linear function of independent quantitities – The probability integral and its evaluations – The probability of hitting a target – The principle of least squares – Weighted observations – Residuals – The most probable value of a set of direct measurements – Law of error for residuals – Agreement between theory and experience

Unit –3

Chance Experiments and Events – Definition of Probability – Basic Properties: Additon and multiplication laws of Probability – Conditional Probability, population, variants, collection, tabulation and graphical representation of data– Some General Probability Rules – Estimating Probabilities Empirically using Simulation -frequency distributions, averages or measures of central tendency, arithmetic mean, properties of arithmetic mean, median, mode, geometric mean, harmonic mean, dispersion, standarddeviation, root mean square deviation, standard error and variance, moments, skewness and kurtosis

Unit - 4

Random variables – Probability distribution for discrete random variables – Probability distribution for continuous random variables – Mean and Standard deviation of a random variable - Binomial and geometric distribution – Normal distributions - Poisson distribution - Gaussian distribution, exponential distribution – additiveproperty of normal variants, confidence limits, Bivarite distribution, Correlation and Regression, Chi-Square distribution

Unit – 5

Meaurement, Direct and Indirect – Precision and Accuracy – Measures of Precision – Relations between the Precission measures – Geometric significance of μ, r and η – Relation between probable error, and the probable errors of the arithmetic and weighted means – Computation of the precision measures from the residuals – The combinations of sets of measurements when the P.E.'s of Sets are given – The probable error of any function of independent quantitites whose P.E.'s are known – The two fundamental problems of indirect measurements – Rejection of observations and measurements

Text Books and Reference

1. Numerical Mathematical Analysis – James B. Scarborough, Oxford and IBH Publishing Company, Sixth Edition, 1990
2. Introduction to Statistics and Data Analysis – R. Peck, C. Olsen and J.L. Devore, Cengage Learning, Fifth Edition, 2014

ELECTIVE PAPER 3
Plasma Physics

Unit I

Introduction- Occurrence of Plasmas in Nature, Definition of Plasma, Concept of temperature, Debye shielding, the plasma parameter, Criteria for plasmas, Applications of plasma physics.

Unit II

Motion of charged particles in electric and magnetic fields: Uniform E and B fields, Non uniform E and B fields, magnetic mirrors, time varying E and B fields, adiabatic invariants, first, second and third.

Unit III

Fluid equations for plasma, equilibrium and stability: Relation of plasma physics to ordinary electromagnetic, the fluid equations for plasma, fluid drifts perpendicular and parallel to B, the plasma approximation. Hydro magnetic equilibrium, the concept of â diffusion of magnetic field into a plasma, classification of instabilities, two stream and gravitational instabilities.

Unit IV

Waves in plasma: Representation of waves, group velocity, plasma oscillations, electron plasma waves, sound waves, ion waves, validity of plasma approximation, comparison of ion and electron waves, electrostatic electron oscillations perpendicular to B, electrostatic ion waves perpendicular to B, the lower hybrid frequency, electromagnetic waves with $B_0=0$, experimental applications, electromagnetic waves perpendicular to B_0 cutoffs and resonances, the CMA diagram, hydromagnetic waves, Alfven waves and their measurement.

Unit V

Kinetic theory for plasma: The meaning of the distribution function f(v), equation of kinetic theory, Vlasov equation, Fokker-Plank equation-Plank equation, derivation of fluid equation, plasma oscillations, plasma oscillation and landau damping, the meaning of Landau damping, kinetic energy of a beam of electron, BGK and Van Kampen modes, experimental verifications, Plasma diagnostics: Electrical methods, Langmuir profits spectroscopic methods

Books for study and reference:

1. F.F.Chen: Introduction to Plasma Physics and Controlled Fusion: Volume I Plasma Physics, Plenum Press, New York, 1984.
2. I M podgomyl : Topics in plasma diagnostics (plenum press)
3. Nocholas A. Krail and Alvin W. Trivelpiece – Principles of plasma physics (McGraw Hill Kogkush Ltd.)
4. Richard H Huddlestone and Stanely Leonard – Plasma diagnostics techniques (Academic press)