Shri Davara University, Raipur

Curriculum

Master of Science in Physics

Semester-II

Effective from Session: 2025-26

Programme Code:- FOSMSC2PHY

Shri Davara University, Naya Raipur
Faculty of Science,
(Master of Science in Physics)

Semester-II

Examination Scheme

Program Code: - FOSMSC2PHY

(Effective from the session: 2025-26)

S. No.	Course Code	Th/Pr	Subject	Type of Course	Teaching Hours /week			Credit	Examination Scheme				Total Marks
									Theory		Practical		
					L	T	P		EX	IN	EX	IN	
1.	SMS10201T	Th	QUANTUM MECHANICS –II	DSC	3	2	-	5	70	30	-	-	100
2.	SMS10202T	Th	STATISTICAL MECHANICS	DSC	3	2	-	5	70	30	-	-	100
3.	SMS10203T	Th	ELECTRODYNAMICS & PLASMA PHYSICS	DSC	3	2	-	5	70	30	-	-	100
4.	SMS10204T	Th	ATOMIC & MOLECULAR PHYSICS	DSE	3	2	-	5	70	30	-	-	100
5.	SMS10205T	Th	RESEARCH METHODOLOGY	GE	2	-		2	35	15			50
6.	SMS10291P	Pr	Lab Course - III	Laboratory	-	-	4	2	-	-	35	15	50
7.	SMS10292P	Pr	Lab Course - IV	Laboratory	-	-	4	2	-	-	35	15	50
Total					**14**			**26**					**550**

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<table>
<tr><td>Course Title</td><td colspan="5">QUANTUM MECHANICS –II</td></tr>
<tr><td>Course Code</td><td colspan="5">SMS10201T</td></tr>
<tr><td rowspan="2">Course Credit</td><td>L</td><td>T</td><td>P</td><td>TC</td><td></td></tr>
<tr><td>3</td><td>2</td><td>-</td><td>5</td><td></td></tr>
<tr><td>Prerequisite</td><td colspan="5">Student must have the knowledge of Quantum Mechanics-I.</td></tr>
<tr><td>Course Objective</td><td colspan="5">• To study Quantum Mechanics in advance and establish foundation to research in the respective domain.</td></tr>
<tr><td>Course Outcome</td><td colspan="5">• On the completion of this course, successfully student will be able to understand the development of the Quantum Mechanics.</td></tr>
<tr><td>Course Content</td><td colspan="5">UNIT-I
Vibration method, expectation value of energy, application to excited states, ground state of He-atom, Zero point energy of one-dimensional harmonic oscillator, Vander-wall interaction, the W.K.B. approximation, approximate solutions, asymptotic nature of the solution, solution near turning point, connection formulae, energy levels of a potential well and quantization rule.
UNIT–II
Theory of scattering: differential and total scattering cross section, wave mechanical picture of scattering & the scattering amplitude, Green’s functions and formal expression for scattering amplitude, The Born approximation and its validity, Partial wave analysis, asymptomatic behavior of partial waves and phase shifts, optical theorem, scattering by a square well potential, scattering by a hard sphere, scattering by a Coulomb potential.
UNIT – III
Time-dependent perturbation theory, first order perturbation, Harmonic perturbation, Fermi`s Golden rule, Ionization of a H-atom, absorption and induced emission, Selection rules. Identical particles, symmetric and anti-symmetric wave functions
UNIT –IV
Relativistic quantum mechanics, formulation of relativistic quantum theory, the Klein Gordon equation; plane wave solutions, charge and current densities, The Dirac equation for a free particle, matrices alpha and beta, Lorentz covariance of the Dirac equation, free particle solutions and the energy spectrum, charge and current densities.</td></tr>
<tr><td></td><td colspan="5"></td></tr>
</table>

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Reference Books	1. S. Gasiorowicz: 2nd addition 1866 Add.- Colby Motorway Hettinger mouth (Wiley). Quantum Mechanics 2. Landau and Lifshitz: 3rd Publication1958. Add-Long Island city (New-York) Quantum Mechanics. 3. B. Crossman and Z. D. Powell: Publish 1961 London (England) Quantum Mechanics (Addison Wesley)

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Course Title	**STATISTICAL MECHANICS**				
Course Code	**SMS10202T**				
Course Credit	**L**	**T**	**P**	**TC**	
	3	**2**	**-**	**5**	
Prerequisite	Student must have the knowledge of Physics.				
Course Objective	• To study Statistical Mechanics in advance and establish foundation to research in the respective domain.				
Course Outcome	• On the completion of this course successfully student will be able to understand the development of the Statistical Mechanics.				
Course Content	**UNIT-I** **Foundation of statistical mechanics:** macroscopic and microscopic states, contact between statistics and thermodynamics, physical significance of Ω(N, V, E), the classical gas, entropy of mixing and Gibb's paradox, phase space of classical system, Lowville's theorem and its consequences, quantum states and phase space. **UNIT- II** **Elements of ensemble theory:** A system in micro canonical, canonical, and grand canonical ensembles, partition functions, physical significance of statistical quantities, example of classical system, energy and energy-density fluctuations and mutual correspondence of various ensembles. **UNIT –III** **Formulation of quantum statistics:** Quantum mechanical ensemble theory, density matrix, statistics of various quantum mechanical ensembles, system composed of indistinguishable particles. Theory of simple gases –Ideal gas in various quantum mechanical ensemble, Maxwell-Boltzmann, Bose-Einstein, Fermi-Dirac distributions, statistics of occupation number. **UNIT - IV** **Ideal Bose and Fermi gases:** Thermodynamic behavior of an ideal Bose gas, Bose-Einstein condensation and, elementary excitations in liquid helium II, Thermodynamic behavior of an ideal Fermi gas, the electron gas, no relativistic and relativistic degenerate electron gas, theory of white dwarf stars.				
References Books	1. R K.Pathria,1st Publish 1972,Kidington,Oxford UK Statistical Mechanics (Pergamum Press). 2. R K.Pathria,1st Publish 1972,Kidington,Oxford UK Statistical Mechanics (Pergamum Press).				

	3. R K.Pathria,1st Publish 1972,Kidington,Oxford UK Statistical Mechanics (Pergamum Press). 4. L.D.Landau1937 Moscow (Russia) Hill Publication.

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<table>
<tr><td>Course Title</td><td colspan="5">ELECTRODYNAMICS & PLASMA PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">SMS10203T</td></tr>
<tr><td rowspan="2">Course Credit</td><td>L</td><td>T</td><td>P</td><td>TC</td><td></td></tr>
<tr><td>3</td><td>2</td><td>-</td><td>5</td><td></td></tr>
<tr><td>Prerequisite</td><td colspan="5">Student must have the knowledge of Physics.</td></tr>
<tr><td>Course Objective</td><td colspan="5">• To study Electrodynamics & Plasma Physics in advance and establish foundation to research in the respective domain.</td></tr>
<tr><td>Course Outcome</td><td colspan="5">• On the completion of this course, successfully student will be able to understand the development of the Electrodynamics & Plasma Physics.</td></tr>
<tr><td>Course Content</td><td colspan="5">UNIT-I
Maxwell’s equations: vector and scalar potentials and the wave equation, Gauge transformations, Lorenz gauge, Coulomb gauge, Green function for the wave equation, four-vectors, mathematical properties of the space-time in special relativity, matrix representation of Lorentz transformation, covariance of electrodynamics, transformation of electromagnetic fields.
UNIT-II
Radiation by moving charges, Lienard-Wiechert potential and fields for a point charge, total power radiated by an accelerated charge- Larmor’s formula and its relativistic generalization, angular distribution of radiation emitted by an accelerated charge, radiation emitted by a charge in arbitrary extremely relativistic motion, distribution in frequency and angle of energy radiated by accelerated charge.
UNIT -III
Bremsstrahlung: emission from single-speed electrons, thermal Bremsstrahlung emission and absorption, Synchrotron radiation: spectrum of synchrotron radiation, spectral index for power law electron distribution, transition from Cyclotron to Synchrotron emission, Cherenkov radiation
UNIT-IV
Plasma: definition, Debye shielding phenomenon and criteria for plasma motion of charged particles in electromagnetic field; Uniform E & B fields, Electric field drift, non-uniform magneto static field, Gradient B drift, Parallel acceleration and magnetic mirror effect, Curvature drift, adiabatic invariants.</td></tr>
</table>

References Books	1. J. Jackson, Publisher Wiley (John Wiley & Sons) 1st Publish 1962 3rd addition (1998) Classical electrodynamics. 2 A. C. Phillips: Publish 1994, Publisher – Longman Scientific & Technical, (United Kingdom) UK.

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<table>
<tr><td>Course Title</td><td colspan="5">ATOMIC & MOLECULAR PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">SMS10204T</td></tr>
<tr><td rowspan="2">Course Credit</td><td>L</td><td>T</td><td>P</td><td>TC</td><td></td></tr>
<tr><td>3</td><td>2</td><td>-</td><td>5</td><td></td></tr>
<tr><td>Prerequisite</td><td colspan="5">Student must have the knowledge of Physics.</td></tr>
<tr><td>Course Objective</td><td colspan="5">• To study atomic and molecular physics in advance and establish foundation to research in the respective domain.</td></tr>
<tr><td>Course Outcome</td><td colspan="5">• On the completion of this course successfully student will be able to understand the development of the atomic and molecular physics.</td></tr>
<tr><td>Course Content</td><td colspan="5">UNIT-I
Quantum states of one electron atoms-atomic orbital’s, Hydrogen spectrum, spin- orbit(l-s) interaction energy, fine structure of hydrogen spectrum including l-s interaction and relativistic correction, spectra of alkali elements, fine structure in alkali spectra, penetrating and non-penetrating orbits, intensity rules.
UNIT-II
Pauli’s principle, equivalent and non-equivalent electrons, ground state(basic level of different elements), two electron systems, interaction energy in L-S. and J-J. Coupling, Hyperfine structure, line broadening mechanisms (general ideas).
UNIT–III
Normal and anomalous Zeeman effect, early discoveries and developments, vector models of one electron system in a weak magnetic field, magnetic moment of a bound electron, magnetic interaction energy, selection rules, intensity rules, Paschal-Back (PB) effect – principal series effect, Zeeman and PB effects in hydrogen, Stark effect- discovery, Stark effect in Hydrogen, orbital model, weak and strong effect in Hydrogen.
UNIT-IV
Types of molecules: linear diatomic molecules, symmetric top, asymmetric top and spherical top molecules. Rotational spectra of diatomic molecules: rigid rotator model, energy levels, selection rule, spectrum, comparison with observed spectrum and non-rigid rotator model, Intensities of spectral lines, microwave spectrometer, Raman spectrum; classical and quantum theory of Raman Effect, pure rotational Raman spectrum.</td></tr>
<tr><td></td><td colspan="5"></td></tr>
</table>

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References Books	1. Introduction to atomic spectra - H.E. White (T). (McGreevy- Hill, New-York) 1944 2. Fundamentals of molecular spectroscopy – C.N.Banwell and E.MM Cash (T).) 1983 3rdAdditionHaryana 3. Spectroscopy vol. I, II and III – Walker and Straighter. 10th Addition Printed in the USA. 4. Introduction to Molecular spectroscopy – G.M.Barrow.1962 by the McGraw-Hill Book Company. Printed in the USA.

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Course Title: Research Methodology

Course Code - SMS10205T

L	T	P	TOTAL CREDITS
2	0	0	2

Course Objectives: The course aims to enable the students learn the concepts of Research techniques and it's applicability in the various minor and major researches. Fundamentalsofresearchwithspecific reference to quantitative research methods would facilitate the students towards exploring the area of their interest.

Course Outcome: The paper focuses on the the oreticalaspect of sampling methods, types of scientific methods and their usage in researches. It also enhances the students' knowledge about the stages of conductive research methods.

UNIT-I Research: An Introduction

a) Types of Scientific Methods: Hypothetic-Deductive and Inductive Research

b) Types of Research: Basicvs.Applied, Quantitativevs.Qualitative Research

c) Principles of a Good Research

UNIT-II The Research Process

a) Stages of conducting a Research

b) Problem and Hypothesis: Definition, Types

c) Variables: Types, Operational definition

UNIT-III Behavioral Research I

a) Control of Extraneous Variables

b) Laboratory experiments, Field Experiments

c) Field study, Survey

UNIT-IV Behavioral Research II

a) Research: Causality and It's criteria

b) Threats to Internal and External Validity

c) Non-Experimental Research: Co-relational Research, Survey Research, Archival Research

d) Sampling Issues: Representativeness and Adequacy

e) Sampling Strategies: Probability and Non-probability Sampling, Sampling Errors

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Books Recommended:

- Aronson,E.and EllsworthD.C.,Carlsmith,J.M.,Gonzales,M.I.

  (1990).Method so research in Social Psychology.McGrawHill International Edition

- Breakwell,G.M.,Hammond,SandSchow,C.F.(Edited)(1995).ResearchMethodsinPsychology. Sage Publications

- Ebnes,D.G,Kantowitz,B.M.,Roediger,H.L,(1989).ResearchMethodsinPsychology.West Publishing Company

- Greenberg, Jand Folger, R (1988). Controver sial Issues in Social Research Method. New York.Springerverlag

- Katz,D. and Festinger, L. (1953). Research Methods in Behavioral Sciences. Holt, Rinehart and Winston, Inc

- Kerlinger,F.N.(1964).FoundationsofBehavioralResearch.Holt,RinehartandWinston,Inc

- Mohsin,S.M.(1984).ResearchMethodsinBehavioralSciences.OrientLongmanLtd

- Schaugneassey,J.J.,Zechmeister,B(1990).ResearchMethodsinPsychology.McGrawhill Publishing Company, New Delhi

- SommerandSommer,R(1997).APracticalGuidetoBehavioralResearch.OxfordUniversityPress

- Weiner,B.J.,Brown,D.R.,Michels,K.M.(1991).StatisticalPrinciplesinExperimentalDesign

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Course Title	**Lab Course - III**				
Course Code	**SMS10291P**				
Course Credit	**L**	**T**	**P**	**TC**	
	-	**-**	**4**	**2**	
Prerequisite	Student must have the knowledge of Physics.				
Course Objective	• To enable the students to develop skills Numerical Analysis.				
Course Outcome	• On the completion of this course lab, successfully student will be able to understand the development of the Numerical Analysis.				
Course Content	1. To solve simultaneous Linear equation by Gauss Elimination method. 2. To calculate the root of a transcendental equation by Newton – Rap son method. 3. Solving the system of linear simultaneous equation by Gauss Seidel method. 4. Numerical Integration by Simpson's 1/3Rule. 5. Solving simultaneous Linear equation by Gauss-Jordon method. 6. Solution of Differential equation by Euler's Method. 7. To invert a given matrix by Gauss-Jordon Method. 8. Solution of Differential equation by Range Kutta Method. 9. To fit the given data in a straight line by linear regression Method. 10. WAP to find the Largest of 'n' number of series. 11. To calculate the standard deviation of a given set of data.				
References Books	1. Introduction to Physics Lab - H.E. White(T). (McGrave- Hill, New-York) 1944 2. Introduction to Physics Lab – J.M.Brown.				

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Course Title	**Lab Course– IV**				
Course Code	**SMS10292P**				
Course Credit	**L**	**T**	**P**	**TC**	
	-	**-**	**4**	**2**	
Prerequisite	Student must have the knowledge of Physics.				
Course Objective	• To enable the students to develop skills Electronic Physics.				
Course Outcome	• On the completion of this course lab, successfully student will be able to understand the development of the Electronics Physics.				
Course Content	1. Study of R-S, D/T, J-KFlip-Flops. 2. Study of counters: Ripple, Mode 3, Mode 5counters. 3. Study of Shift Register. 4. Study of R-2R D/A Converter. 5. Study of Random Access Memory (RAM) Read Only Memory(ROM) 6. Study of A/D Converter. 7. To arrange N numbers in an ascending order. 8. Logic gate study DTL and RTL. 9. Study of adder/Subtractor.				
References Books	1 Introduction to Physics Lab - H.E. White(T). (McGrave- Hill, New-York) 1944 2. Fundamentals of Physics Lab – C.N. Banwell and E.M McCash(T).				