Shri Rawatpura Sarkar University, Raipur

Examination Scheme & Syllabus

of CBCS Pattern for

Master of Science in Physics

Semester-I

(Effective from the session: 2022-2023)

Shri Rawatpura Sarkar University, Raipur
Faculty of Science
Department of Physics

Two Years Master of Science Program
Scheme of Teaching & Examination
M. Sc. in Physics Semester-I
Outcome Based Education (OBE) & Choice Based Credit Systems (CBCS)
(Effective from the Academic Year: 2022-2023)

S. No.	Course Code	Course Title	Hours/ Week			Credit	Maximum Marks			Sem End Exam Duration (Hrs)
			L	T	P		Continuous Evaluation	Sem End Exam	Total	
1.	SMS10101T	Mathematical Physics	4	-	-	4	30	70	100	3.0
2.	SMS10102T	Classical Mechanics	4	-	-	4	30	70	100	3.0
3.	SMS10103T	Quantum Mechanics – I	4	-	-	4	30	70	100	3.0
4.	SMS10104T	Electronics	4	-	-	4	30	70	100	3.0
5.	SMS10105T	Computational Physics	2	-	-	2	15	35	50	2.0
6.	SMS10191P	Physics Lab Course I (General)	-	-	4	2	15	35	50	5.0
7.	SMS10192P	Physics Lab Course II (Analog Electronics)	-	-	4	2	15	35	50	5.0
	Total teaching hrs/week: 26		**Total Credits**			**22**	**Total Marks**		**550**	

Master of Science in Physics
Semester-I
2022-23

Course Title	**Mathematical Physics**				
Course Code	**SMS10101T**				
Course Credit	**L**	**T**	**P**	**TC**	
	4	**-**	**-**	**4**	
Prerequisite	Student must have the knowledge of Mathematics physics and Mathematics.				
Course Objective	• To study Mathematical Physics in advance and establish foundation to research in the respective domain.				
Course Content	**UNIT-I** **Vector Space and Matrices:** Linear independence, Bases, dimensionality, Inner product, Linear transformation, matrices, Inverse, Orthogonal and Unitary matrices, Independent element of a matrix, Eigen values and eigen Vectors, Diagonalization, Complete orthonormal sets of functions. **UNIT-II** **Complex Variables:** Cauchy- Riemann condition, analytic functions, Cauchy's theorem, Cauchy integral formula, Laurent series, singularities, residue theorem, contour integration, evaluation of definite integrals, problems. **UNIT-III** **Differential Equations:** first order differential equation, second order differential equation with constant coefficients, second order linear ODEs with variable coefficients, Solution by series expansion, non-homogenous differential equations and solution by the method of Green's functions. **UNIT-IV** **Special Functions:** Legendre, Bessel, Hermite and Laguerre functions with their physical applications, generating functions, orthogonality conditions, recursion relations, **UNIT-V** **Integral Transforms:** Fourier integral and transforms, inversion theorem, Fourier transform of derivatives, convolution theorem, Laplace Transform (LT), LT of Derivatives, Inverse LT, Fourier series; properties and applications, discrete Fourier transform.				
Course Outcome	• On the completion of this course, successfully student will be able to understand the development of the Mathematical Physics. 1. The purpose of the course is to introduce students to knowledge about vector space & matrices. 2. The purpose of the course is to introduce students to learning about functions of complex variables. 3. The purpose of the course is to introduce students to introduction about				

	differential equations. 4. The purpose of the course is to introduce students to information about special function. 5. The purpose of the course is to introduce students to knowledge about integral transform. 6. Develop required mathematical skills to solve problems in quantum mechanics, electrodynamics and other fields of theoretical physics.
Text Books	1. Mathematical Methods for Physics, by G. Arfken. 2. Matrices and Tensors for Physicist, by A.W. Joshi. 3. Advanced Engineering Mathematics, by E. Kroyazig. 4. Special Functions, by E.B. Rainville.
Reference Books	1. Special Functions, by W.W. Bell. 2. Mathematical Method for Physicist and Engineers, by K. F. Relly, M. P. Hobson and S.J. Bence 3. Mathematics for Physicists, By Marry L. Boas.

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2022-23

Course Title	**Classical Mechanics**				
Course Code	**SMS10102T**				
Course Credit	**L**	**T**	**P**	**TC**	
	4	**-**	**-**	**4**	
Prerequisite	Student must have the knowledge of Physics.				
Course Objective	• To study Classical Mechanics in advance and establish foundation to research in the respective domain.				
Course Content	**UNIT-I** Preliminaries, Newtonian mechanics of one and many particle systems, Conservation laws, Constraints & their classification, Principle of virtual work, Generalized coordinates, D'Alembert's principle and Lagrange's equations, Velocity-dependent potentials and dissipation function, Simple applications of the Lagrangian formulation, Hamilton's principle, Lagrange's equations from Hamilton's principle, Conservation theorems and Symmetry properties, Energy function and the conservation of energy. **UNIT-II** The Hamiltonian formulation of mechanics, Legendre transformations and the Hamilton's equations of motion, Cyclic coordinates and Conservation Theorems, Hamilton's equations from Hamilton's principle, The principle of least action, Simple applications of the Hamiltonian formulation. **UNIT-III** Canonical transformations with examples, The harmonic oscillator, Poisson's brackets, Equations of motion and conservation theorems in the Poisson Bracket formulation. Hamilton-Jacobi (HJ) theory: The HJ equation for Hamilton's principal function, Harmonic oscillator as an example of the HJ method, The HJ equation for Hamilton's characteristic function, The action-angle variables **UNIT –IV** The Central force: Two-body central force problem and its reduction to the equivalent one-body problem, The equation of motion and first integrals, The equivalent one-dimensional problem and classification of orbits, The differential equation of the orbit, Closure and stability of orbits, The Kepler problem, Scattering in a central force field: Rutherford scattering. **UNIT – V** Rigid body dynamics, The Euler angles, Euler's theorem on the motion of a rigid body, Rate of change of a vector, The Coriolis force, Angular momentum and Kinetic energy of motion about a point, The Euler equations of motion of				

	rigid bodies. Formulation of the problem of small oscillations, The eigen-value equation and the principal axis transformation, Frequencies of free vibration and normal coordinates, Free vibration of linear triatomic molecule.
Course Outcome	• On the completion of this course successfully student will be able to understand the development of the Classical Mechanics. 1. The purpose of the course is to introduce students to knowledge about Newtonian mechanics, D'Alembert's principle & Lagrange's equations. 2. The purpose of the course is to introduce students to learning about Hamilton's principle & Hamiltonian formulation. 3. The purpose of the course is to introduce students to introduction about Poisson Bracket formulation. 4. The purpose of the course is to introduce students to information about Central force. 5. The purpose of the course is to introduce students to knowledge about Euler's theorem. 6. Develop required classical phenomenon to solve problems in quantum mechanics, electrodynamics and other fields of theoretical physics.
Text books	1. Classical Mechanics, By N.C. Rana and P.S. Joag (Tata McGraw-Hill,1991) 2. Classical Mechanics, by H. Goldstein (Addison Wesley,1980) 3. Classical Mechanics, by H. Goldstein, C Poole & J Fafko (Pearson Education, Inc,2002)
References Books	1. Mechanics, by A. Sommerfeld, (Academic press,1952) 2. Introduction to Dynamics by Perceival and D. Richaeds (Cambridge University, press,1982).

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<table>
<tr><td>Course Title</td><td colspan="5">Quantum Mechanics – I</td></tr>
<tr><td>Course Code</td><td colspan="5">SMS10103T</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>4</td><td>-</td><td>-</td><td>4</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 Quantum Mechanics in advance and establish foundation to research in the respective domain.</td></tr>
<tr><td>Course Content</td><td colspan="5">UNIT – I
Inadequacy of classical mechanics, Plank quantum hypothesis and radiation law, Photoelectric effect, De-broglie’s theory. Schrödinger equation, continuity equation, Ehrenfest theorem, admissible wave functions, general formalism of wave mechanics, representation of states and dynamical variables, stationary states, one-dimensional problems; walls and barriers, Schrödinger equation for harmonic oscillator and its solution.
UNIT –II
Superposition principle, uncertainty relations, states with minimum uncertainty product, commutation relationship, completeness and normalization of eigen functions, Dirac-delta function, Bra & Ket notation, matrix representation of an operator, harmonic oscillator and its solution by matrix method, Heisenberg equation of motion.
UNIT –III
Angular momentum in quantum mechanics, commutation relationships, eigen values, Spin angular momentum, Pauli`s matrices, addition of angular momentum, Clebsch-Gordon coefficients.
UNIT – IV
Central force problem, spherically symmetric potentials in three dimensions, separation of wave equation, parity, three-dimensional square-well potential and energy levels, the hydrogen atom; solution of the radial equation, energy levels and stationery state wave functions, discussion of bound states, degeneracy.
UNIT –V
Time- independent perturbation theory, non-degenerate case, first order and second perturbations with the example of an oscillator, degenerate cases, removal of degeneracy in second order, Zeeman effect without electron spin, first-order Stark effect in hydrogen, perturbed energy levels, correct eigen function, occurrence of permanent electric dipole moments.</td></tr>
</table>

Course Outcome	• On the completion of this course, successfully student will be able to understand the development of the Quantum Mechanics. 1. The purpose of the course is to introduce students to knowledge about Plank quantum hypothesis & Schrödinger equation. 2. The purpose of the course is to introduce students to learning about functions of Dirac-delta function, Bra & Ket notation. 3. The purpose of the course is to introduce students to introduction about Clebsch-Gordon coefficients. 4. The purpose of the course is to introduce students to information about Central force problem. 5. The purpose of the course is to introduce students to knowledge about Time- independent perturbation theory.
Text Books	1. Jackson, classical electrodynamics. 2. Quantum Mechanics: Satyaprakash
References Books	1. Introduction to Quantum Mechanics: David J. Griffiths 2. Bitten court, Plasma physics. Chen: Plasma physics.

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<table>
<tr><td>Course Title</td><td colspan="5">Electronics</td></tr>
<tr><td>Course Code</td><td colspan="5">SMS10104T</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>4</td><td>-</td><td>-</td><td>4</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 Electronics in advance and establish foundation to research in the respective domain.</td></tr>
<tr><td>Course Content</td><td colspan="5">UNIT-I
Operational Amplifier: Basic Op.-Amp., Differential amplifier, the emitter coupled difference amplifier, transfer characteristics of a difference amplifier, an example of an IC Op.-Amp., off set error voltage and currents, measurement of Op.-Amp. Parameters, frequency response of Op-amp. Linear analog systems: Basic Op.-Amp. Applications, Analog integration and differentiation, Electronic analog computation.
UNIT-II
Combinational Logic, Basic logic gates: OR, AND and NOT gates, NOR and NAND gates, Boolean algebra, De-Morgan’s theorems, exclusive OR gate, characteristics of logic families. ALU Memories: RAM, ROM, PROM, EPROM, A/D and D/A converters.
UNIT -III
Sequential Logic Flip-flops: RS Flip-flop, level clocking, Edge triggered Flip Flops, D Flip flops. JK Flip-flops, J.K. master slave Flip-flops, Registers: buffer, shift and control shift registers, counters: ripple synchronous & ring counters, tri-state registers, Buffer: controlled buffer Register, Bus organized structure, Latch, multiplexer, Demultiplexer, encoder and decoder.
UNIT-IV
Microprocessors: Building concept of microprocessors, developing inside of microprocessor, Instruction codes, Instruction Register, Introducing RESET Pin, Introducing on chip oscillator, Interfacing I/O devices, Introducing Interrupt lines :Stack, Push, Pop operation ,delay in servicing interrupts, multiply interrupts, location for interrupts .Introducing slow and fast data transfer, Status of microprocessor, interrupt pins, General purpose Register, flag Register, Increment/decrement register.
UNIT – V
Features of 8085 micro-processor: Pin diagram of 8085, block</td></tr>
</table>

	diagram of 8085. CPU of a microprocessor, timing and control, system timings and interrupt timings of 8085, registers in 8085, interfacing memory and I/O devices- a preliminary ideas. Number system, examples of Assembly language programs of 8085, summing of two 8-bit numbers to result a 16-bit number, summing two 16-bit number, multiplying two 8-bit number to result a 16-bit product, block transfer of data from one memory block to other, BCD to hexadecimal data, finding the largest number in a series.
Course Outcome	• On the completion of this course successfully student will be able to understand the development of the Electronics. 1. The purpose of the course is to introduce students to knowledge about Basic Op.-Amp. & Differential amplifier. 2. The purpose of the course is to introduce students to learning about Combinational Logic & Basic logic gates. 3. The purpose of the course is to introduce students to introduction about Sequential Logic Flip-flops. 4. The purpose of the course is to introduce students to information about Microprocessors. 5. The purpose of the course is to introduce students to knowledge about Features of 8085 micro-processor.
Text Books	1. Linear Integrated Circuits: Godse & Bakshi 2. Electronic Devices & Circuits: Godse & Bakshi 3. Principle of Electronics: V.K. Mehta
References Books	1. Basic Electronics: B.L. Theraja

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<table>
<tr><td>Course Title</td><td colspan="5">Computational Physics</td></tr>
<tr><td>Course Code</td><td colspan="5">SMS10105T</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>2</td><td>-</td><td>-</td><td>2</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 Computational physics skills in advance and establish foundation to research in the respective domain.</td></tr>
<tr><td>Course Content</td><td colspan="5">UNIT – I
Introduction: Importance of computers in Physics, paradigm for solving physics problems for solution. Usage of linux as an Editor.
UNIT – II
Algorithms and Flowcharts: Algorithm: Definition, properties and development. Flowchart: Concept of flowchart, symbols, guidelines, types. Examples: Cartesian to Spherical Polar Coordinates, Roots68of Quadratic Equation, Sum of two matrices, Sum and Product of a finite series, calculation of sin(x) as a series, algorithm for plotting (1) Lissajous figures and (2) trajectory of a projectile thrown at an angle with the horizontal.
UNIT – III
Scientific Programming: Some fundamental Linux Commands (Internal and External commands). Development of FORTRAN, Basic elements of FORTRAN: Character Set, Constants and their types, Variables and their types, Keywords, Variable Declaration and concept of instruction and program. Operators: Arithmetic, Relational, Logical and Assignment Operators. Expressions: Arithmetic, Relational, Logical, Character and Assignment Expressions. Fortran Statements: I/O Statements (unformatted/formatted), Executable and Non-Executable Statements, Layout of Fortran Program, Format of writing Program and concept of coding, Initialization and Replacement Logic. Examples from physics problems.
UNIT – IV
Control Statements: Types of Logic (Sequential, Selection, Repetition), Branching Statements (Logical IF, Arithmetic IF, Block IF, Nested Block IF, SELECT CASE and ELSE IF Ladder statements), Looping Statements (DO-CONTINUE, DO-ENDDO, DOWHILE, Implied and Nested DO Loops), Jumping Statements (Unconditional GOTO, Computed GOTO, Assigned GOTO) Subscripted Variables (Arrays: Types of Arrays, DIMENSION Statement, Reading and Writing Arrays), Functions and Subroutines(Arithmetic Statement Function, Function Subprogram and Subroutine), RETURN,CALL,</td></tr>
</table>

	COMMON and EQUIVALENCE Statements), Structure, Disk I/O Statements, open a file, writing in a file, reading from a file. Examples from physics problems. **UNIT – V** **Programming:** 1. Exercises on syntax on usage of FORTRAN. 2. Usage of GUI Windows, Linux Commands, familiarity with DOS commands and working in an editor to write sources codes in FORTRAN. 3. To print out all natural even/ odd numbers between given limits. 4. To find maximum, minimum and range of a given set of numbers. 5. Calculating Euler number using exp(x) series evaluated at x=1
Course Outcome	• On the completion of this course, successfully student will be able to understand the development of the Computational physics skills. 1. The purpose of the course is to introduce students to knowledge about Importance of computers in Physics. 2. The purpose of the course is to introduce students to learning about Algorithms & Flowcharts. 3. The purpose of the course is to introduce students to introduction about Scientific Programming. 4. The purpose of the course is to introduce students to information about Control Statements. 5. The purpose of the course is to introduce students to knowledge about Programming.
Text Books	1. Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., 2012, PHI Learning Pvt. Ltd. 2. Computer Programming in Fortran 77". V. Rajaraman (Publisher: PHI). 3. LaTeX–A Document Preparation System", Leslie Lamport (Second Edition, Addison-Wesley, 1994). 4. Gnuplot in action: understanding data with graphs, Philip K Janert, (Manning 2010) 5. Schaum's Outline of Theory and Problems of Programming with
References Books	1. Lipsdutz and A Poe, 1986 Mc-Graw Hill Book Co. 2. Computational Physics: An Introduction, R. C. Verma, et al. New Age International Publishers, New Delhi (1999) 3. A first course in Numerical Methods, U.M. Ascher and C. Greif, 2012, PHI Learning 4. Elementary Numerical Analysis, K.E. Atkinson, 3rd Edn., 2007, Wiley India Edition.

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<table>
<tr><td>Course Title</td><td colspan="5">Physics Lab Course I (General)</td></tr>
<tr><td>Course Code</td><td colspan="5">SMS10191P</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>-</td><td>-</td><td>4</td><td>2</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 enable the students to develop skills General and Optics Physics.</td></tr>
<tr><td>Course Content</td><td colspan="5">1. Determination of band gap of semiconductor by four probe method.
2. Measurement of Hall Coefficient of given semiconductor identification of type of semiconductor and estimation of charge carrier concentration.
3. Determination of wavelength of mercury light by constant deviation spectrometer using Hartmann formula.
4. Ultrasonic velocity in a liquid as a function of temperature using ultrasonic interferometer.
5. Experiment on transmission line:
(A) Determination of characteristics impedance,
(B) Study of voltage distribution.
6. Determination of the Curie temperature of ferromagnetic material.
7. Determination of forbidden gap of a diode by plotting reverse saturation current as a function of temperature.
8. Determination of operating voltage and study the characteristics of a GM tube.
9. Determination of operating voltage of a GM tube and determine the linear absorption coefficient.
10. Determination of operating voltage of a GM tube and verify inverse-square law.
11. Determination of short half-life of a given source which can be obtained from a mini generator or produced with a neutron source by activation.
12. X-ray diffraction by Telexometer.
13. Determination of ionization potential of Lithium/</td></tr>
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	Mercury. 14. Determination of e/m of electron by Normal Zeeman Effect using Febry-Perot Etalon. 15. Determination of Dissociation energy of iodine (I_2) Molecule by photography, the absorption bands of I_2 in the visible region. 16. Measurement of wavelength of He-Ne Laser light using a ruler and thickness of thin wire by the laser. 17. To study Faraday Effect using He-Ne Laser.
Course Outcome	• On the completion of this course lab, successfully student will be able to understand the development of the General Physics.
Text Books	1. Introduction to Physics Lab - H.E. White (T). 2. Fundamentals of Physics Lab – C.N. Banwell and E.M McCash(T).
References Books	1. Introduction to Physics Lab – J.M. Brown. 2. Fundamentals of Physics Lab –P.F. Bemath.

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Course Title	**Physics Lab Course II (Analog Electronics)**				
Course Code	**SMS10192P**				
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 Content	1. Design & Study of Regulated Power supply. 2. Study of Transistor Amplifiers in CE, CB, and CC modes. 3. Study of Transistor Bias Stability. 4. Study of Astable, Monostable and Bistable Multivibrator. 5. Study of Silicon Controlled Rectifier. 6. Experiment of Uni – Junction Transistor and its application. 7. Experiment of FET characterization and application as an amplifier. 8. Study of Differential Amplifier. 9. Study of Basic Operational Amplifier (741). 10. Study of Opto- Electronics devices. 11. Experiment of MOSFET characterization and application as an amplifier. 12. To verify the characteristics curve of PN Junction Diode. 13. To verify the characteristics curve of Zener Diode. 14. To verify the characteristics curve of LED. 15. To verify the characteristics curve of Solar Cell.				
Course Outcome	• On the completion of this course lab, successfully student will be able to understand the development of the Analog Electronics.				
Text Books	1. Introduction to Physics Lab - H.E. White(T). 2. Fundamentals of Physics Lab – C.N. Banwell and E.M. McCash(T).				
References Books	1. Introduction to Physics Lab – J.M. Brown. 2. Fundamentals of Physics Lab –P.F. Bemath.				
