CHAITANYA SCIENCE AND ARTS COLLEGE

(AUTONOMOUS)
PAMGARH, JANJGIR-CHAMPA (C.G.)

ACCREDIATED "A" GRADE BY NAAC

DEPARTMENT
OF
PHYSICS

COURSE CURRICULUM & MARKING SCHEME

POSTGRADUATE PROGRAMME
M.SC. PHYSICS

PROGRAM CODE: CCMS02
FIRST & SECOND SEMESTER

Approved By	Board of Studies	Academic Council
Date	30/08/2025	0 4 SEP 2025

ACADEMIC YEAR 2025-26
SYALLBUS FRAMED ACCORDING TO THE NEP-2020
UNDER THE SCHEME OF CBCS (CHOICE BASED CREDIT SYSTEM)

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Proposed Scheme For 2-Year Postgraduate Program

PROGRAMME STRUCTURE: PART	YEAR	SEMESTER	SEMESTER
Part-I	First Year	Semester-I	Semester-II
Part-II	Second Year	Semester-III	Semester-IV

COURSE STRUCTURE:

The syllabus with the paper combination is as under:

SEMESTER-I

SR. NO.	COURSE CODE	TITLE OF COURSE
01.	MPHT101	Mathematical Methods -I
02.	MPHT102	Classical Mechanics
03.	MPHT103	Numerical Methods and Python
04.	MPHT104	Electronics -1
05.	MPHP105	Lab-1 Optics and Electronics
06	MPHP106	Lab-II Python Programming

SEMESTER -II

SR. NO.	COURSE CODE	TITLE OF COURSE
01.	MPHT201	Mathematical Methods -II
02.	MPHT202	Quantum Mechanics-I
03.	MPHT203	Electrodynamics
04.	MPHT204	Electronics -II
05.	MPHP205	Lab-1 Electronics
06	MPHP206	Lab-II General

SYLLABUS AND MARKING SCHEME FOR THE FIRST & SECOND SEMESTER SESSION-2025-26

SEMESTER I

Sr. No.	Subject Code	Title	L	T	P	TOTAL	External	Internal	Total
						Credits	**Marks**		
1	MPHT101	Mathematical Methods -1	3	1	-	4	70	30	100
2	MPHT102	Classical Mechanics	3	1	-	4	70	30	100
3	MPHT103	Numerical Methods and Python	3	1	-	4	70	30	100
4	MPHT104	Electronics -1	3	1	-	4	70	30	100
5	MPHP105	Lab-1 Optics and Electronics	-	-	2	2	-	-	100
6	MPHP106	Lab-II Python Programming	-	-	2	2	-	-	100
		Total				**20**			**600**

SEMESTER-II

SR. No.	Subject Code	Title	L	T	P	TOTAL	External	Internal	Total
						Credits	**Marks**		
1	MPHT201	Mathematical Methods - II	3	1	-	4	70	30	100
2	MPHT202	Quantum Mechanics-I	3	1	-	4	70	30	100
3	MPHT203	Electrodynamics	3	1	-	4	70	30	100
4	MPHT204	Electronics -II	3	1	-	4	70	30	100
5	MPHP205	Lab-1 Electronics	-	-	2	2	-	-	100
6	MPHP206	Lab-II General	-	-	2	2	-	-	100
		Total				**20**			**600**

SEMESTER-III

SR. No.	Subject Code	Title	Credits				Marks		Total
			L	T	P	TOTAL	External	Internal	
1	MPHT301	Quantum Mechanics II	3	1	-	4	70	30	100
2	MPHT302	Statistical Mechanics	3	1	-	4	70	30	100
3	MPHT303	Condensed Matter Physics I	3	1	-	4	70	30	100
4	MPHT304	Electronics III	3	1	-	4	70	30	100
5	MPHP305	Lab A: Digital Electronics I	-	-	2	2	-	-	100
6	MPHP306	Lab B: Digital Electronics II	-	-	2	2	-	-	100
		Total				**20**			**600**

SEMESTER-IV

SR. No.	Subject Code	Title	Credits				Marks		Total
			L	T	P	TOTAL	External	Internal	
1	MPHT401	Condensed Matter Physics II	3	1	-	4	70	30	100
2	MPHT402	Nuclear Physics	3	1	-	4	70	30	100
3	MPHT403	Atomics and Molecular physics	3	1	-	4	70	30	100
4	MPHT404	Electronics IV	3	1	-	4	70	30	100
5	MPHP405	PROJECT			4	4	-	-	200
		Total				**20**			600
	GRAND TOTAL [SEMESTER I (600) + SEMESTER II (600)] [SEMESTER III (600) + SEMESTER IV (600)]								**2400**

PROGRAMME	M.SC. PHYSICS
CORE COURSE	COURSE CODE: MPHT101
TITLE	**Mathematical Methods -1**
Course Credits	04 Credits
Total Marks	**Internal Assessment: 30 Marks Maximum Marks: 70 Minimum Passing Marks: 40**
No. of Hours Per	L+T+P (3+1+0)
Course Objective	- To develop a strong understanding of vector spaces, matrices, eigenvalues, eigenvectors, and their applications in solving linear algebraic problems. - To study and apply special functions (Legendre, Laguerre, Bessel, Hermite) with their generating functions, recurrence relations, and orthogonality properties in mathematical physics. - To gain proficiency in integral transforms such as Laplace and Fourier transforms for solving differential equations and analyzing physical systems.
Course Outcomes	**CO1:** To understand mathematical concepts used for solving physics problems. **CO2:** Understand special function, Laplace transform (LT), Fourier Series. **CO3:** Master vector spaces, matrices, linear algebra, eigenvalues, eigenvectors, and their applications. **CO4:** Master orthogonal functions: Legendre, Bessel, Hermite, Laguerre, properties, solutions, orthogonality. **CO5:** Use Mathematical methods that will be used in many of the other courses in the M.Sc. Syllabus.

UNIT	Description	No. of Lectures / Hours
I	**Vector Spaces and Matrices:** Definition of Vector Space, basis of a vector space, Dimensionality of a vector space, Inner Product, Linear Independence of a vector, Linear Transformation of a vector, Inverse of a matrix, Orthogonal, Unitary matrix, Eigen values and eigenvectors, Cayley Hamilton theorem, Diagonalization, Complete orthonormal sets of functions.	15
II	**Special Function:** Solution by series expansion, Legendre Polynomial, Generating function, recursion relation, Rodrigue formula, Orthogonal properties, recurrence formulae and orthogonal properties. Laguerre polynomial generating function, recursion relations, Rodrigue formula, associated Laguerre differential equation and polynomial.	15
III	**Bessel's Function**: Bessel's differential equations, first and second kind, recurrence formulae and generating function for J (x), Jacobi series, Bessel's orthogonality of Bessel's function. Integrals, Hermit differential equation and polynomials, generating function, recurrence relation, Rodrigue formula, orthogonality.	15
IV	**Integral transform:** Laplace transform, first and second shifting theorem, inverse LT by partial fraction, LT of derivative and integral of a function. Fourier series, arbitrary period, half-wave expansion partial sums, Fourier integral and transform, Dirac delta function.	15

Text Books and Reference Books:

1. Mathematical Methods or Physics, by g Arfken
2. Matrices and Tensors for Physicists, by AW Joshi
3. Advanced Engineering Mathematics, by E Kreyszig
4. Special Functions, by ED Rainville
5. Special Functions, by WW Bell
6. Mathematical Method, by H.K. Das
7. Mathematical Method for Physicists and Engineers. By KF Relliy, M P Hobson and SJ Bence
8. Mathematica for Physicists, by Mary L. Boas

E -Resources:

1. https://nptel.ac.in/courses/115103036
2. https://nptel.ac.in/courses/115105097
3. https://nptel.ac.in/courses/115106086
4. https://nptel.ac.in/courses/111106152

PROGRAMME	**M.SC. PHYSICS**
CORE COURSE	**COURSE CODE: MPHT102**
TITLE	**CLASSICAL MECHANICS**
Course Credits	**04 Credits**
Total Marks	**Internal Assessment: 30 Marks Maximum Marks: 70 Minimum Passing Marks: 40**
No. of Hours Per	L+T+P (3+1+0)
Course Objective	- To understand conservation principles, generalized coordinates, and formulate equations of motion for diverse systems. - To apply variational principles, Lagrangian and Hamiltonian formulations for analyzing conservative and non-conservative mechanical systems. - To explore Poisson brackets, canonical transformations, and Hamilton–Jacobi theory for solving complex dynamical problems.
Course Outcomes	**CO1:** To analyze the motion of particles and systems of particles. **CO2:** To Formulate and solve equations of motion using D'Alembert's principle, Lagrange's equations, and their applications to various mechanical systems. **CO3:** Have a deep understanding of Newtons law **CO4:** Analyze Poisson and Lagrange brackets, their properties, and their role in understanding the dynamics of physical systems.

UNIT	Description	No. of Lectures / Hours
I	**Conservation Principles:** Mechanics of particle conservation Principles for system of particles. Constrained motion constraints and degrees of freedom generalized coordinates, Generalized Notations (1) Generalized Displacement velocity, Acceleration, momentum force and potential, [Imitations of Newton's laws. D'Alembert's Principle, Lagrange's equations form D'Alembert principal Application of Lagrange's equation of motion (1) Linear Harmonic oscillator (II) Simple pendulum (III) spherical pendulum (iv) Isotropic oscillator (v) Atwood's Machine.	**15**
II	**Variational Principle:** calculus of variation, some techniques of calculus of variables, Euler Lagrange differential equation. Hamilton variational principal Deduction of Hamilton's Principle from D'Alembert's principle. Deduction of Newton's second law of motion from Hamilton's Principle. Deduction of Lagrange's equations of motion from Hamilton's Principle for conservation and for non-conservative systems Non conservative forces. Dissipative system, Rayleigh's Dissipation function, Lagrangian for a charged particle in an electromagnetic field.	**15**
III	**Hamiltonian formulation of mechanics:** Phase space and the motion of the system, Hamiltonian function, Hamilton's canonical equation of motion. Physical significance of H Deduction of Canonical equation from variational principle. Hamilton's canonical equations of motion in different coordinate systems. Application of Hamilton equation of motion (i) Simple pendulum (II) compound pendulum (iii) Two-dimensional Isotropic Harmonic oscillator	**15**

	(iv) Linear Harmonic oscillator (v) Particle in central field of force. Hamiltonian for a charged particle in an electromagnetic field, Principle of least action statement and its proof.		
IV	**Canonical or constant transformation:** its advantage example of canonical transformation, necessary and sufficient condition for a trans formation to be canonical Infinitesimal contact transformations. Hamilton-Jacobi partial differential equation for Hamilton's Principal function. Solution of Harmonic oscillator problem by Hamilton-Jacobi method. Hamilton- Jacoby theory. Poisson Bracket: Definition and properties. Invariance of Poisson-Brackets with respect to canonical transformation, Equations of motion in Poisson bracket form Jacoby Identity. Infinitesimal contact transformations Interpretation in terms of Poisson Brackets. The angular momentum and Poisson Bracket Lagrange's Brackets definition and properties, relation with Poisson Brackets.	**15**	

Text Books and Reference Books:

1. **Classical mechanics. H. Goldstein**
2. **Classical mechanics Gupta Kumar, Sharma**
3. **Classical mechanics of particle and rigid body- Kiran C. Gupta**
4. **Principal of mechanics Synge and Griffith**

E -Resources:

1. https://archive.nptel.ac.in/courses/115105098/
2. https://youtu.be/rk0rp2Jpidc
3. https://youtu.be/941RpKWr2qo
4. https://youtu.be/c10eRk9aUBs
5. https://youtu.be/YXk-mcS2np4

SEMESTER I

PROGRAMME	M.SC. PHYSICS
CORE COURSE	COURSE CODE: MPHT103
TITLE	NUMERICAL METHOD AND PYTHON
Course Credits	04 Credits
Total Marks	Internal Assessment: 30 Marks Maximum Marks: 70 Minimum Passing Marks: 40
No. of Hours Per	L+T+P (3+1+0)
Course Objective	• To introduce Python programming concepts, decision-making structures, loops, functions, modules, and basic plotting techniques. • To develop computational skills for solving equations, curve fitting, interpolation, differentiation, integration, and ODEs numerically. • To apply numerical methods and Python libraries for analyzing mathematical problems in scientific and engineering applications.
Course Outcomes	**CO1:** Find roots of different types of equations and obtain the eigenvalues of matrices and understand its applicability in various physics aspects. **CO2:** Understand experimental data, its behavior and various interpolating techniques. **CO3:** Understand techniques to evaluate integrals bounded in a range and solve initial value and boundary value problems of ordinary differential equation. **CO4:** To know about Various Control statements of Python. **CO5:** To know about Functions and Module structures in Python.

UNIT	Description	No. of Lectures / Hours
I	**(With Programming)** **Introduction Of Python and Decision Making:** keywords and Identifiers, Statements and comments, variables data types and type conversion Output Input. Operator's expression, hierarchy of operators, scope and namespace. Flow control statements, if, if else and nested if else, Loops (for, do while, while), break and continue	15
II	**Functions, Module and Plotting:** Built in and user defined functions, function definition and calling the function, function with argument and return, Variable scope. Python module, import, module, packages, library (SciPy, NumPy, math, Matplotlib), python array. Basic plotting using matplotlib: polynomial (linear, quadratic), sine and cosine function.	15
III	**(Without Programming)** **Roots Of Simultaneous Equation & Non – Linear algebraic & Transcendental Equations**: Solution of simultaneous linear equations using Gaussian elimination method, Concept of Pivoting, Matrix inversion method, Iterative Methods: False position method, Bisection Method, & Newton Raphson method & their convergence. Determination of Eigen values & Eigen vectors of a matrix by Power & Jacobi Method	15
IV	**Calculus of finite difference**: Forward, Backward Central difference and Relation between the operators. **Interpolation:** Newtons forward interpolation formula & backward interpolations, Lagranges interpolation unequally spaced data points.	15

	Curve Fitting: Method of curve fitting by least square curve fitting, straight line and polynomial fits. **Numerical Integration & Differentiation:** Newton-Cotes method, Trapezoidal ruler, Simpson's Method.	

Text Books and Reference Books:

(a) For Numerical Methods

1. B.S. Grewal, Numerical Methods in Engineering & Science with Programs in C, C++ & MATLAB, Khanna Publishers

2. S. S. Sastry, Introductory methods of numerical analysis, Prentice Hall of India

(b) For Python Programming

1. Fundamentals of Python: First Programs, Course Technology, Kenneth Lambert. Cengage Learning.

2. Dr Pooja Sharma, Programming in Python 2017, BPB

3. Numerical Recipes, Teukolsky, Vetterling and Flannery, Cambridge University Press

4. Numerical Mathematical Analysis, J. B. Scarborough, Oxford Publishing, 6th Edition, 1990

5. Numerical methods for mathematics, science and engineering. John H. Matthews, Prentice Hall of India, 2nd Edition, 2000 4. Making Use of Python, Rashi Gupta, Wiley Publishing

E -Resources:

1. https://nptel.ac.in/courses/115104095
2. www.python.org
3. https://wiki.python.org/moin/BeginnersGuide
4. https://www.w3schools.com/python/

PROGRAMME	**M.SC. PHYSICS**
CORE COURSE	**COURSE CODE: MPHT104**
TITLE	**ELECTRONICS I**
Course Credits	**04 Credits**
Total Marks	**Internal Assessment: 30 Marks Maximum Marks: 70 Minimum Passing Marks: 40**
No. of Hours Per	L+T+P (3+1+0)
Course Objective	• To understand working principles, characteristics, and applications of FET, MOSFET, BJT, and UJT devices. • To study semiconductor devices, MIS and MOS diodes, and charge-coupled device operations comprehensively. • To analyze modulation techniques, demodulation processes, and multiplexing methods for efficient communication systems.
Course Outcomes	**CO1:** Understand principle of transistors and its application. **CO2:** Understand working principle of MIS, MOS diode. **CO3:** Understand concept of Modulation. **CO4:** Understand concept of multiplexing.

UNIT	Description	No. of Lectures / Hours
I	**Transistors: FET and MOSFET:** Junction Field Effect Transistor (FET) N channel and P channel FET, working principle, static and dynamic characteristic curves, pinched off voltage, Coefficient of FET, and Relation between different coefficients. Metal Oxide Field Effect Transistor (MOSFET) DE MOSFET and E-MOSFET, construction and working principle, static and dynamic characteristics.	15
II	**BJT and UJT:** Bipolar Junction transistor (BJT) Different methods of biasing. Thermal stabilization stability factor, h parameters. Feedback in amplifiers Advantages of negative feedback, Principle of oscillators. Uni-junction transistor (UJT) basis structure, working principle. Voltage Current characteristics and important parameters.	15
III	**Semiconductor Devices and Charge-Coupled Devices:** MIS Diode: Introduction, Energy band diagram, accumulation, depletion and inversion condition concept of surface space charge, surface potential, surface capacitance, Ideal MIS curves. MOS diode: structure, Ideal MOS, surface depletion region, Ideal MOS curves, Si-S10 MOS diode- (real case) interface trapped charge, oxide charges. Charged Couple Device (CCD): Basic structure, working principle, charge transfer with clock voltage.	15
IV	**Modulation and Multiplexing:** Modulation: Definition, Types of Modulation Mathematical expression of modulation Percentage of modulation, Amplitude modulation, Generation of Amplitude modulation, Demodulation, Demodulation of Amplitude modulated wave, side bands, band width DSBSC modulation, Generation of DSBSC waves, SSB modulation, Generation and Detection of Multiplexing: Frequency division multiplexing (FDM). SSB waves.	15

Text Books and Reference Books:

1. Principles of Electronics, V.K. Mehta, Rohit Mehta, S. Chand
2. Hand Book of Electronics, Gupta Kumar Pragati Prakashan
3. Physics of semiconductor Devices, S.M. Sze. Wiley Eastern Ltd.
4. Foundation of Electronics, D. Chattopadhyay, P.C. Rakshit, B. Saha, N. N.
Purkait, New Age International Pvt. Ltd.
5. Electronic Devices and Circuits, Jacob Millman, Christos C. Halkias, Tata McGraw Hill

E -Resources:

1. https://nptel.ac.in/courses/108101091
2. https://nptel.ac.in/courses/115102014
3. https://nptel.ac.in/courses/117103063
4. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=+4mIqRALksfwQH9v8YSMrw==

MPHP105 (LAB-1) Optics and Electronics

List of Experiments

1	To study the diffraction pattern by using single slit.
2	To study light spread when passes through a narrow aperture by using laser kit.
3	To determine the separation between the plates of a Fabry Perot Etalon.
4	To study the prismatic spectrum by using Cauchy's relation.
5	Calibration of constant deviation spectrometer and determination of unknown wavelength.
6	To Determine Young modulus of glass by Cornu's method.
7	To Verify the Brewster law of reflection for polarized light.
8	To study the characteristic of NPN transistor in CE mode.
9	To study the characteristic of UJT.
10	To study characteristics of FET.
11	To study the characteristic of MOSFET.
12	To study the energy band gap & diffusion of P-N junction.
13	To study Zener regulated and IC regulated power supply.

MPHP106 **(LAB-2) Python Programming**

List of Experiments

1	Python program to find roots of quadratic equation.
2	Python program to add and subtract matrices.
3	Python program to multiply matrices.
4	Python program to short number in ascending order.
5	Python program to find largest of N number.
6	Write a program to print factors of a given number.
7	Write a function that takes an integer input and calculates the factorial of that number.
8	Using while loop, produce a table of sins, cosines and tangents. Make a variable x in range from 0 to 10 m steps of 0.2. For each value of x. print the value of sin(x), cos(x) and tan(x).
9	Write a function that takes an integer 'n' as input and calculates the value of $(1+1/1! +1/2! +......+1/n!)$.
10	Using for loop, print a table of Celsius/Fahrenheit equivalences (Let C be the Celsius temperatures ranging from 0 to 100, for each value of e, print the corresponding Fahrenheit temperature.)
11	Python program to find result, relative error, percentage error of an experiment.
12	Python program to plot straight line. (In which user enters slope and y- intercept of straight line)
13	Python program to plot potential and wavefunction of one-dimensional harmonic oscillator. (potential and wavefunction for ground state)
14	Python program to plot y = Asin (Bs +C)
15	Python program to find roots of cubic polynomial using bisection method.
16	Python program to perform integration using Simpson's 13td rule.

SEMESTER -II

PROGRAMME	M.SC. PHYSICS
CORE COURSE	COURSE CODE: MPHT201
TITLE	Mathematical Methods -II
Course Credits	04 Credits
JTotal Marks	Internal Assessment: 30 Marks Maximum Marks: 70 Minimum Passing Marks: 40
No. of Hours Per	L+T+P (3+1+0)
Course Objective	• To study complex differentiability, analytic functions, Cauchy theorems, residues, and contour integration techniques. • To solve boundary value problems using Fourier, Laplace transforms, and Green's function methods effectively. • To understand tensor algebra, transformations, covariant differentiation, and their applications in physics and mathematics.
Course Outcomes	**CO1:** Basic knowledge about the complex variable function. **CO2:** Uses of partial differential equation to solve boundary value problem. **CO3:** Basic knowledge about Tensor. **CO4:** Use concept of Green's function to solve Differential Equation.

UNIT	Description	No. of Lectures / Hours
I	**Complex differentiability. Analysis:** Function of Complex Variables, limit, continuity and function to be analytic, Analytic function, the necessary and sufficient condition for a Cauchy-Riemann condition, Cauchy integral theorem, Taylor's Residues, series and Laurent's series expansion, Zeros and singular points, Residue theorem. Evaluation of line integral by indefinite integration, Singularities Cauchy's integral formula, Derivatives of an analytic function. of analytic functions, Contour integration.	15
II	**Boundary value problems:** Transverse vibration of a stretched sting. D'Alembert solution. Two-dimensional heat flow, rectangular membrane. Poisson's Fourier and Laplace equations, Solution of partial differential equation by and Laplace transform methods	15
III	**Green's function:** non-homogeneous boundary value problem, Greens function for one dimensional problem, eigen function expansion of Green's function, method of constructing Green's function, Green's function for electrostatic boundary value problems and quantum mechanical scattering problem.	15
IV	**Tensors:** Definition of Tensor, contra variant and covariant tensors, the algebra of-tensor, Quotient low, Symmetric & antisymmetric tensors, invariant tensors, associate tensors, conjugate tensors, metric tensors; length of a vector, angle. Between tensors, Christophers symbol and their transformation law, equation of geodesies, Covariant differentiation of vectors and tensors of higher rank.	15

TEXT AND REFERENCE BOOK:

1. Advance Engineering Mathematics, H.K Das, S. Chand Publishing
2. Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers, 44 Edition
3. Mathematical Methods for Physicists (60): G.B. Arikan und H.J. Weber, Elsevier Academic Press
4. Applied Mathematics for Engineers and Physicists, L.A. Pipes and L.R. Harvill. McGraw-Hil
5. Complex variables and applications,R. V. Churchill and J.W. Brown,
6. Advanced Engineering Mathematics, E. Kreyzig (2nd Ed., Pearson, 2002) McGraw-Hill, Edition 5th Edition
7. Group Theory in Physies, Wi-K.Tung, World Scientific

E -Resources:

1. https://nptel.ac.in/courses/115106086
2. https://nptel.ac.in/courses/115105097
3. https://nptel.ac.in/courses/115103036
4. https://nptel.ac.in/courses/111107119

SEMESTER -II

PROGRAMME	M.SC. PHYSICS
CORE COURSE	COURSE CODE: MPHT202
TITLE	Quantum Mechanics-I
Course Credits	04 Credits
Total Marks	Internal Assessment: 30 Marks Maximum Marks: 70 Minimum Passing Marks: 40
No. of Hours Per	L+T+P (3+1+0)
Course Objective	- To understand quantum mechanics fundamentals, wave-particle duality, Schrödinger equation, and interpretation of acceptable wavefunctions. - To analyze angular momentum, spin, and their matrix representations using operator methods and commutation relations. - To solve one- and three-dimensional quantum problems including potential wells, barriers, and hydrogen atom systems.
Course Outcomes	**CO1:** Understand general formalism and quantum mechanics. **CO2:** Master the applications of quantum mechanics in one dimensional and three-dimensional physics problems. **CO3:** Apply angular momentum algebra to find out C G coefficients. **CO4:** Apply Quantum mechanics to solve hydrogen atom problem. **CO5:** Understand Heisenberg and Dirac formalism of Quantum mechanics.

UNIT	Description	No. of Lectures / Hours
I	**Review of concepts:** Limitations of Classical Mechanics, Wave-particle duality, Schrodinger equation, Acceptable wavefunctions, Probability interpretation, Continuity equation, Ehrenfest theorem, Stationary states.	15
II	**Postulates of quantum mechanics:** Basic postulates, Superposition principle, observables and operators. Measurements, expectation value, symmetries and conservation laws. 15 General properties of one-dimensional motion, One dimensional problems, Problems, potential wells and barriers, Harmonic oscillator operator method.	15
III	**Angular momentum:** Commutation relations of angular momentum operators, Eigenvalues, eigenvectors. Ladder operators and their matrix representations. Spin angular momentum and Pauli matrices, addition of angular momentum rotation in quantum mechanics, Clebsch-Gordan coefficients.	15
IV	**Three-Dimensional problem:** Central force problem, Solution of Schrodinger equation for spherically, symmetric potentials, Hydrogen atom, Three-dimensional Square Well Potential and Energy levels, degeneracy.	15

Text and Reference Books:

1. Quantum Mechanics-Concepts and Applications, N. Zettili,(2009), Wiley
2. Quantum Mechanics, E.Merzbacher,(2011)
3. Quantum Mechanics. Theory and Applications, Ajoy Glansk and 3 Lokanathan, 5th edition, Macmillan India Ltd
4. A Textbook of Quantum Mechanics, K. Venkatesan, (2010). P.M. Mathews, Dorling Kindersley (India) Pvt. Ltd

E -Resources:

1. https://nptel.ac.in/courses/115101107
2. https://nptel.ac.in/courses/115106066
3. https://nptel.ac.in/courses/115102023
4. https://hcverma.in/QuantumMechanics
5. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=+4mIqRALksfwQH9v8YSMrw==
6. https://ocw.mit.edu/courses/8-04-quantum-physics-i-spring-2016/

SEMESTER -II

PROGRAMME	M.SC. PHYSICS
CORE COURSE	**COURSE CODE: MPHT203**
TITLE	**Electrodynamics**
Course Credits	**04 Credits**
Total Marks	**Internal Assessment: 30 Marks Maximum Marks: 70 Minimum Passing Marks: 40**
No. of Hours Per	L+T+P (3+1+0)
Course Objective	- To study electrostatics, magnetostatics, and Maxwell's equations for understanding electromagnetic field behavior. - To analyze electromagnetic wave propagation, reflection, refraction, and interactions across different media and boundaries. - To explore electromagnetic radiation principles, emission mechanisms, and radiation from various sources and antennas.
Course Outcomes	**CO1:** Solve problems involving electrostatics and magnetostatics. **CO2:** Solve problems involving electrostatics and magnetostatics wave behavior. **CO3:** Predict and explain the reflection, refraction, and transmission of electromagnetic waves. **CO4:** Comprehend the characteristics and sources of electromagnetic radiation.

UNIT	Description	No. of Lectures / Hours
I	**Electrostatics:** Gauss's law and its applications, Laplace and Poisson equations, boundary value problems, dielectrics, polarization of a medium, electrostatic **Magnetostatics:** Biet Savart law, differential equation for static magnetic field, vector potential, examples of magnetostatic problems, Faraday's law of induction, magnetic energy of steady current distributions.	**15**
II	**Maxwell's Equations:** Maxwell's Equation of continuity, Maxwell's equations (S1 Unit) and its derivation, Integral form of equation, Maxwell's equations in some particular cases, Electromagnetic energy Poynting Theorem. The wave equation, electromagnetic waves in free space. Plane electromagnetic waves in a Non conducting isotropic medium (i.e. isotropic dielectrics). Plane electromagnetic waves in Anisotropic Non-conducting medium (Anisotropic dielectric), Plane electromagnetic waves in conducting medium, Propagation of electromagnetic waves in ionized gases. Gauge symmetry. Coulomb and Lorentz gauges.	**15**
III	**Interaction of EM Waves:** Boundary conditions at the interface two media, Reflection and Refraction of electromagnetic waves at the interface conducting media, Reflection and transmission coefficients at the interface between two non-conducting media. Brewster's law and degree of polarization, Total-internal reflection. Propagation of Electromagnetic waves between parallel conducting planes Wave guides. TM modes and TE modes.	**15**

IV	**Electromagnetic Radiation:** Electromagnetic vector and scalar potential, Lorenz Gauge, Lienard Wichert potentials, the electromagnetic field of a uniformly moving point charge, Radiation from an accelerated charge at low velocity Larmor's formula. Angular distribution of radiation emitted by an accelerated charge, Radiation damping, Cherenkov radiation. Radiation due to an oscillating electric dipole electric quadra pole radiation, Radiation due to small current element. Radiation from linear antenna.	**15**

Text and Reference Books:

1. Classical Electrodynamics; J.D. Jackson, Wiley
2. Introduction to Electrodynamics; D.J. Griffiths, Pearson
3. Electrodynamics, Gupta,Kumar, Sharma, Pragati Prakashan
4. Modern Electrodynamics, A. Zangwil: Cambridge University Press,Cambridge, U.K.
5. Principles of Electrodynamics, Melvin Schwartz (Dover Publications, 1987)

E -Resources:

1. https://nptel.ac.in/courses/115101004
2. https://nptel.ac.in/courses/115105132
3. https://nptel.ac.in/courses/115101005
4. https://nptel.ac.in/courses/115104134
5. https://nptel.ac.in/courses/115106122

SEMESTER -II

PROGRAMME	M.SC. PHYSICS
CORE COURSE	**COURSE CODE: MPHT204**
TITLE	**Electronics -II**
Course Credits	**04 Credits**
Total Marks	**Internal Assessment: 30 Marks Maximum Marks: 70 Minimum Passing Marks: 40**
o. of Hours Per	L+T+P (3+1+0)
Course Objective	• To understand fundamentals of optoelectronic devices, radiative transitions, LEDs, and diode laser operation principles. • To study photodetectors, phototransistors, and solar cells with their characteristics and conversion efficiencies. • To analyze operational amplifiers, configurations, feedback mechanisms, and their applications in electronic circuits.
Course Outcomes	**CO1:** Understand radiative and nonradiative transitions in electronic devices. **CO2:** Analyze performance of photoconductive devices and emission spectra. **CO3:** Design and analyze light-emitting diodes (LEDs) and photodetectors. **CO4:** Apply operational amplifier principles in differential amplifier circuits. **CO5:** Gain practical skills in analyzing and designing Op-amp circuits, including oscillators and comparators

UNIT	Description	No. of Lectures / Hours
I	**Fundamental of Optoelectronics Devices:** Radiative and nonradiative transitions Optical-Absorption, bulk and thin film, photoconductive devices (LDL). Emission spectra. Luminescent efficiency, method of excitation. Light emitting diode (LED): high frequency limit, effect of surface and indirect combination current, operation of LED, Visible LEDs, and infrared LEDs. Diode Laser Condition for population inversion in active region light confinement Factor, optical gun and threshold current for lasing, Fabry Perrot Cavity Length for losing and the separation	**15**
UNIT - II	**Photodetectors, Phototransistors, and Solar Cells:** Photoconductor, equivalent circuit of photoconductor Phototransistor Bipolar phototransistor photo Darlington transistor, V-1 characteristic of bilateral hetero structure phototransistor, Solar cells. Solar radiation, solar-spectrum, ideal conversion efficiency. Energy band diagram of solar cell, I-V characteristics of solar cell, PN junction solar cells, Hetero junction, and Interface thin fin solar cells.	**15**
UNIT - III	**Introduction in Op-amp:** Basic Op-amp, Differential amplifies circuit configurations, dual input, balanced output, differential amplifier -DC analysis, Block diagram of a typical Op-amp, Analysis open loop configuration, inverting Block diagram of a typical Op-amp, Analysis open loop configuration, inverting and non-inverting amplifier. Op-amp with negative feedback Voltage series feedback, effect of feedback un closed loop gain input persistence output resistance bandwidth and output offset voltage, voltage follower.	**15**
UNIT - IV	**Oscillators, Comparators, and Waveform Generators:** Oscillator's principles, oscillator types, frequency, stability response, the phase shin oscillator. Wein bridge oscillator, Multivibrators, Monostable and A stable Comparators, square wave and triangle wave generators.	**15**

Text and Reference Books
1. Hand Book of electronics gupta Kumar (Pragati Prakashan)
2. Electronic Devices and circuit theory-Robert Baylested and Iquis Nashdaky, PHI, New Delhi
3. Semiconductor Devices - Physics and Technology S.M. Sze, Wiley, 1985
4. Introduction to Semiconductor Devices M.S.Tyagi, John Wiley & sons
5. Electronic Fundamentals and applications-John D. Ryder PHI, New Delhi
6. Operational Amplifier and their applications Subir Kumar Sarker, S.Chand & Son

E -Resources:
1. https://nptel.ac.in/courses/108101091
2. https://nptel.ac.in/courses/115102014
3. https://nptel.ac.in/courses/117103063

MPHP205 (LAB-1) Electronics

List of Experiments

1	To study the characteristic of LDR
2	To study the characteristic of LED
3	To study the characteristic of Photo transistor
4	To study the characteristic of Photodiode.
5	To design an inverting amplifier using Op-amp (741,351) for de voltage of given gain.
6	To design an inverting amplifier using Op-amp (741,351) and study its frequency response.
7	To design non-inverting amplifier using Op-amp (741,351) & study its frequency response
8	To add two de voltages using Op-amp in inverting and non-inverting mode.
9	To design a precision Differential amplifier of given I/O specification using Op-amp.
10	To investigate the use of an op-amp as an Integrator
11	To investigate the use of an op-amp as a Differentiator
12	To design a Wien bridge oscillator for given frequency using an op-amp
13	To design a phase shift oscillator of given specifications using BJT
14	To study the Colpitis oscillator,
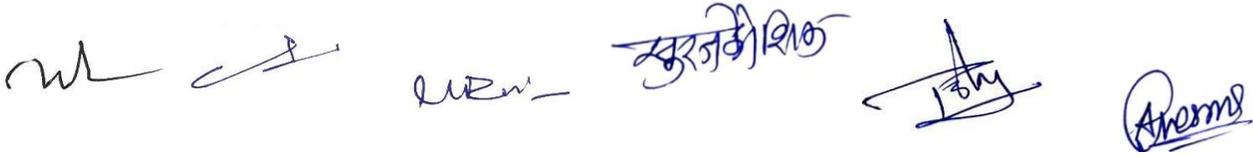
MPHP206 **(LAB-2) General**

List of Experiments

1	To verify Title the law of Malas for plane polarized light.
2	To determine the refractive Index of (1) glass and (2) a liquid by total internal reflection using a Gaussian eyepiece.
3	To verify the Stefan's law of radiation and to determine Stefan's constant.
4	To determine Curie temperature of Monel metal by using a transformer.
5	To Determination of Planck's constant and work function of Materials by photoelectric effect.
6	Study of Electron spin resonance- determine magnetic field as a function ofthe resonance frequency.
7	Study of Zeeman effect with external magnetic field, Hyperfine splitting.
8	To determine the e/m of electron by Thomson method
9	Plot Planck's law for Black Body radiation and compare it with Wein'sLaw and Kali Law at high temperature (room temperature) and low temperature.)
10	Plot Specific Heat of Solids by comparing (a) Dulong-Petit law, (b) Emstein distribution function, (c) Debye distribution function for high temperature (room temperature) and low temperature and compare them for these two cases.
11	Plot Maxwell-Boltzmann distribution function versus temperature.
12	Plot Fermi-Dirac distribution function versus temperature.
13	Plot Bose-Einstein distribution function versus temperature.

IMPORTANT NOTES:

1. **From the academic session 2025–2026**, all question papers in the first and second semesters of the M.Sc. Physics program will be compulsory.

2. **Evaluation Structure (Semesters I & II):**
   - Total Theory Papers: 04 (280 Marks), Internal Assessment 04 Paper: 120 Marks, Practical Exam 02 Paper: 200 Marks.
   - **Total Marks:** 600
   - **Minimum Passing Marks:** 40 in each course including External and Internal Exam.

3. **Examination Scheme:**
   - **Each paper will be evaluated as follows:**
   o End-Semester Examination: 70 Marks
     - **Section A** – 10 objective-type questions, one from each unit, without internal choice ($1 \times 10 = 10$ marks).
     - **Section B** – 4 short-answer questions, 5 marks each, one from each unit with internal choice ($5 \times 4 = 20$ marks). At least one question from every unit must be included.
     - **Section C** – 4 long-answer questions, 10 marks each, one from each unit with internal choice ($10 \times 4 = 40$ marks). At least one question from every unit must be included.

   o Continuous Internal Evaluation (CIE)/Internal Assessment includes**:** 30 Marks
     - Two tests (20 marks each), 10 marks for assignment, attendance, group discussions, and presentations, and as decided by the institution.

4. **Project Work (Semester IV):**
   - A **project report** must be submitted in the fourth semester, The report will be evaluated in two stages by an external examiner: