



सत्यमेव जयते

Government of West Bengal

Government General Degree College Nakashipara

Department of Physics

MURAGACHHA, , NADIA, PIN- 741154

Phone No.: 03474-268008 web: www.muragachhagovtcollege.org e-mail:

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Ref. No.....

Date

B. Sc. Honours (CBCS) in Physics

COURSE OUTCOME

SEMESTER: I

PHY-H-CC-T-01: MATHEMATICAL PHYSICS-I:

OUTCOMES:

Calculus:-

- Students will develop the ability to solve the mathematical problems like Limits, continuity, average and instantaneous quantities and differentiation.
- Students will demonstrate proficiency in crafting thorough solutions utilizing suitable mathematical terminology and language.
- Students will gain the ability to recognize applications of calculus in various mathematical and interdisciplinary contexts.
- Students will develop the ability to solve the mathematical problems of First Order Differential Equations and Integrating Factor and learn about Taylor and binomial series



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Vector Calculus:

- The student possesses a comprehensive understanding of directional derivatives, multivariable analysis, encompassing concepts such as space curves, gradients, multiple integrals, properties of vectors under rotations, Scalar product and its invariance under rotations, vector product, scalar triple product and their interpretation in terms of area and volume respectively
- The student will develop the ability to establish and address mathematical models, infer straightforward mathematical outcomes, and perform integral calculations. Furthermore, the student displays proficiency in formulating and resolving straightforward optimization problems, including those featuring constraints. Students will also gain the ability to learn Green's and Stokes Theorems and their applications.

Orthogonal Curvilinear Coordinates:

- Students will demonstrate the ability to articulate detailed solutions utilizing Orthogonal Curvilinear Coordinates.
- Students will be proficient in recognizing the Divergence of Gradient.
- Students will be capable of identifying Curl and Laplacian in Cartesian coordinates and also able to solve mathematical problems using Spherical and Cylindrical Coordinate Systems.

Matrices:

- Student will learn about Null Matrices, Diagonal Transpose of a



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Matrix, Symmetric and Skew-Symmetric Matrices, Hermitian and Skew- Hermitian Matrices. Singular and Non-Singular matrices.

- Student can calculate Eigenvalue and Eigen function of matrices.
- Student will capable to learn about Orthogonal and Unitary Matrices
- Student will be able to find out Eigen-values and Eigenvectors (Degenerate and non-degenerate).

Probability:

- Students will gain the ability to recognize independent random variables.
- Students will develop proficiency in writing detailed probability distribution functions
- Students will learn to identify and work with binomial, Gaussian, and Poisson distribution with examples.

Dirac Delta Function:

- Student will able to learn Dirac Delta function and its properties.
- Student will be able to know Representation as limit of a Gaussian function and rectangular function.

PHY-H-CC-T-02: MECHANICS:

Outcomes:

Fundamentals of Dynamics

- Students will able to learn about Reference frames, Inertial frames, Newton's Laws of Motion and Galilean transformations and Galilean invariance.
- Students will able to solve centre of mass problems.
- Students will learn about principle of conservation of momentum



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and motion of rocket.

Work and Energy

- Students will able to know about Conservative and non-conservative forces, Potential Energy and energy diagram.
- Students will be capable to find Stable and unstable equilibrium condition.
- Students will able to know force as gradient of potential energy.
- Students will able to learn about Work done by non-conservative forces and Law of conservation of Energy.

Collisions

- Students will able to know about Centre of Mass and Laboratory frames and elastic and inelastic collisions between particles.

Rotational Dynamics

- Students will be introduced to the Principle of Conservation of Angular Momentum,
- Students will learn about Rotation about a fixed axis. Moment of Inertia.
- Students will learn about Angular momentum of a particle and system of particles.
- Students will understand motion scenarios involving both translation and rotation.

Elasticity

Students will know about elastic constants, twisting torque on a cylinder or Wire.

Fluid Motion

- Students will capable to learn about Poiseuille's equation for



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flow of a liquid through a capillary.

Gravitation and Central Force Motion

- Students will develop the ability to learn about Inertial and gravitational mass and law of gravitation.
- Students will know the Potential and field due to spherical shell and solid sphere.
- Students will be able to calculate Motion of a particle under a central force field.

Oscillations

- Students will know about Simple Harmonic Oscillations.
- Students will be capable to solve the problems related to Damped oscillation, Forced oscillations.
- Students will learn the Transient and steady states, resonance and sharpness of resonance.

Non-Inertial Systems

- Students will gain the understanding about Non-inertial frames and fictitious forces.
- Students will know about Uniformly rotating frame, laws of Physics in rotating coordinate systems.

Special Theory of Relativity:

- Students will learn about postulates of special theory of relativity.
- Students will gain the understanding about Lorentz Transformations, Lorentz contraction, Time dilation.
- Students will gain the ability to solve relativistic transformation of velocity, frequency and wave number and Transformation of Energy and Momentum.



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SEMESTER:II

PHY-H-CC-T-03: ELECTRICITY AND MAGNETISM:

- Students will be familiar with Electric Field and Electric Potential, enabling them to solve related problems.
- Students Additionally, understand Dielectric Properties of Matter and Magnetic Properties of Matter.
- Furthermore, students will grasp concepts such as Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem, and Maximum Power Transfer theorem.
- Student will also be proficient in solving problems related to magnetism

PHY-H-CC-T-04: WAVES AND OPTICS:

- Students will delve into the concept of the superposition of collinear harmonic oscillations along with understanding the Superposition Principle.
- Additionally, students will grasp graphical and analytical methods in Lissajous Figures, comprehending their significance in cases of equal and unequal frequencies, and how these figures aid in solving various numerical problems.
- Moreover, students will familiarize themselves with Plane and Spherical Waves, distinguishing between Longitudinal and Transverse Waves, as well as understanding Plane Progressive (Travelling) Waves.
- Students will also learn to derive the differential equation of plane Progressive (Travelling) Waves.
- Furthermore, students will determine Particle and Wave Velocities using this Differential Equation and understand aspects such as Pressure of a Longitudinal Wave.

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SEMESTER-III

PHY-H-CC-T-05: MATHEMATICAL PHYSICS-II:

Outcomes:

Fourier Series:-

- Student will be able to gain the understanding the concept of Periodic Function.
- Student can learn related about dirichelet condition.
- Student can able to estimate even and odd function and their fourier expansion.

Special Function:-

- Student will be able to understand the singular point of second order linear differential equation.
- Student can learn legendre, bessel, hermite differential equation.
- Student can explain Bessel function and orthogonality.

Special Integrals :-

- Student can able to learn about beta and Gamma function and relation between them.
- Student can able to know the expressions of integral in terms of Gamma function and also learn error function of probability integral.

Variational Claculus :-

- Student will able to obtain basic principle of mechanics.
- Student will capable to learn canonical equation of motion

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and legendre transformation.

Partial Differential Equation :-

Students can able to estimate partial differential equation using separation of variables.

Can able to estimate

- Student will be able to understand laplace's equation in problems of rectangular, cylindrical and spherical symmetry.
- Student will be able to know diffusion equation.

PHY-H-CC-T-06: THERMAL PHYSICS

- Students will gain understanding of the First and Second Laws of Thermodynamics and be proficient in problem-solving using these principles.
- Students will grasp the concept of Entropy.
- Students will be acquainted with Thermodynamic Potentials including Internal Energy, Enthalpy, Helmholtz Free Energy, and Gibbs Free Energy.
- Students will comprehend the Maxwell-Boltzmann Law of Distribution and be capable of solving related problems.
- Students will explore the Behavior of Real Gases and understand deviations from the Ideal Gas Equation.

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Digital Systems and Applications

Outcomes:

- Students will be introduced to Integrated Circuits and various types of logic gates.
- Students will understand De Morgan's Theorems, Boolean Laws, and how to simplify logic circuits using Boolean Algebra.
- Students will explore Half and Full Adders, as well as Half & Full Subtractors, including the construction of a 4-bit binary Adder/Subtractor. Sequential Circuits will also be covered.
- Students will become familiar with different types of shift registers such as Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out, and Parallel-in-Parallel-out, offering alternative sentence structures to enhance comprehension.



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SEMESTER IV

PHY-H-CC-T-08: MATHEMATICAL PHYSICS-III

OUTCOMES:

Complex Analysis:

- Student will be able to know De Moivre's theorem, functions of Complex Variables and Euler's formula.
- Student will understand about analytic functions, Singular functions.
- Student will be able to solve problems related to Cauchy's Integral formula. Simply and multiply connected region. Laurent and Taylor's expansion. Residues and Residue Theorem. Application in solving Definite Integrals.

Integrals Transforms:

- Student will know the basic concept of Fourier Transforms: Fourier Integral theorem. Fourier Transform. Examples. Fourier transform of trigonometric, Gaussian, finite wave train & other functions. Representation of Dirac delta function as a Fourier Integral.
- Student can be able to learn Inverse Fourier transform, Convolution theorem.
- Student can apply Fourier Transforms to differential equations: One dimensional Wave and Diffusion/Heat Flow Equations.

PHY-H-CC-T-09: ELEMENTS OF MODERN PHYSICS:

OUTCOMES:

Planck's quantum:

- Student will be able to learn the concept of photon, photoelectric

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effect, Compton scattering.

- Student will understand the concept of De Broglie wavelength and matter waves.
- Student will be able to know Davisson-Germer experiment

Problems with Rutherford model:

- Student can calculate the energy levels for hydrogen like atoms and their spectra.
- Student can observe Instability of atoms and observation of discrete atomic spectra and Bohr's quantization rule and atomic stability.

Position measurement:

- Student can understand about Gamma ray microscope thought experiment.
- Student will learn about Wave-particle duality and Heisenberg uncertainty principle.
- Student can estimate minimum energy of a confined particle using uncertainty principle and Energy-time uncertainty principle.

slit interference experiment:

- Students will gain knowledge about Integrated Circuits and various types of logic gates.
- Students will acquire a foundational understanding of the linear superposition principle, leading to comprehension of matter waves and wave amplitudes.
- Students will develop the ability to solve the Schrödinger equation for non-relativistic particles.
- Students will understand the relationship between momentum and energy operators.



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- Students will be capable of estimating probabilities and probability current densities in one dimension based on any given wave function.

One Dimensional infinitely Rigid Box:

- Student can able to calculate energy eigenvalues and Eigen functions, normalization constant.
- Student can able to understand Quantum mechanical scattering and tunneling in one dimension - across a step potential and across a rectangular potential barrier.

Size and structure of atomic nucleus and its relation with atomic weigh:

- Student can learn the nature of nuclear force, NZ graph,
- Student will be able to estimate semi-empirical mass formula and binding energy.

Radioactivity:

- Student will be able to estimate Law of radioactive decay.
- Student can calculate Mean life and half-life; decay.
- Student will be able to learn decay - energy released, spectrum and Pauli's prediction of neutrino; -ray emission.

Fission and fusion:

- Student can able to calculate Mass deficit, relativity and generation of energy;
- Student will understand Fission - nature of fragments and emission of neutrons.

Elements of Modern Physics Lab:



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- The measurement of Planck's constant can be conducted by students through the analysis of black body radiation coupled with a photo-detector.
- Students can ascertain the work function of the material comprising the filament of a directly heated vacuum diode.
- Using LEDs spanning at least four distinct colors, students can derive the value of Planck's constant.
- Through experimentation, students can determine the wavelength of the H-alpha emission line emitted by a hydrogen atom.
- Students can investigate the ionization potential of mercury as part of their experimental work.
- By examining the absorption lines within the rotational spectrum of iodine vapor, students can gain valuable insights into molecular behavior.

PHY-H-CC-T-10: ANALOG SYSTEMS AND APPLICATIONS

- Students will know about Conductivity and Mobility, Concept of Drift velocity, PN Junction Fabrication etc.
- Students will understand about the Principle and structures of LEDs, Photodiode and Solar Cell.
- Students will learn about n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations.
- Students will be able to learn about analysis of a single-stage CE amplifier using Hybrid Model. and Output Impedance. Current, Voltage and Power Gains. Classification of Class A, B & C Amplifiers.
- Student will know about Op-Amps applications as Inverting and non-inverting amplifiers, Adder, Subtractor, Differentiator, Integrator, Log amplifier, Zero crossing detector, Wein bridge oscillator.

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SEMESTER V

PHY-H-CC-T-11: QUANTUM MECHANICS AND APPLICATIONS

Outcomes:

Schrodinger equation:

- Students will gain an understanding of the interpretation of wave function probability and probability current densities in three dimensions, allowing them to comprehend the probabilistic nature of quantum mechanics. They will also learn about the conditions necessary for the physical acceptability of wave functions, ensuring they grasp the fundamental principles underlying quantum mechanics.
- Furthermore, students will be introduced to the concepts of linearity and superposition principles, eigenvalues, and eigenfunctions. They will explore the operators associated with physical observables such as position, momentum, and energy, including the commutator of position and momentum operators, providing them with a solid foundation in quantum mechanics principles.
- Moreover, students will delve into the calculation of expectation values for position and momentum, enabling them to predict the behavior of quantum systems with greater accuracy. Additionally, they will study the wave function of a free particle and the time-independent Schrödinger

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equation, including its application to stationary states and the determination of energy eigenvalues.

- To reinforce their understanding, students will explore applications such as the spread of Gaussian wave-packets for free particles in one dimension, as well as wave and Fourier transforms and momentum space wave functions. This comprehensive approach will equip students with the necessary tools to tackle complex quantum mechanical problems effectively.

Many electron atoms:

- Students will learn Pauli's Exclusion Principle and Symmetric & Antisymmetric Wave Functions.
- Students can learn about Fine structure and Spin Orbit coupling. Spectral Notations for Atomic States and also Total angular momentum.
- Students will learn about Spin-orbit coupling in atoms - L- S and J-J couplings and Hund's Rule.

PHY-H-CC-T-12: SOLID STATE PHYSICS

Outcomes:

- Students will know about Amorphous and Crystalline Materials.
- Students will understand about Lattice Vibrations and Phonons.
- Students will learn about Dia-, Para-, Ferri- and Ferromagnetic Materials.
- Students will be able to learn about Dielectric Properties of Materials.
- Students will be able to understand about superconducting behaviour of materials.
- Students will be capable to understand about Kronig Penny model. Band Gap. Conductor, Semiconductor (P and N type) and insulator.



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SEMESTER VI

PHY-H-CC-T-13: ELECTROMAGNETIC THEORY

Outcomes:

- Students will be capable to learn about Maxwell's equations and Displacement Current and also Vector and Scalar Potentials.
- Students will know the Gauge Transformations and their classes (Lorentz and Coulomb Gauge.)

- Students will understand about Boundary Conditions at Interface between Different Media and Wave Equations and also Plane Waves in Dielectric Media.
- Students can learn about Poynting Theorem and Poynting Vectors and Physical Concept of Electromagnetic Field Energy Density, Momentum Density and Angular Momentum Density.

EM Wave Propagation in Unbounded Media

- Students will know about Plane EM waves through vacuum and isotropic dielectric medium, transverse nature of plane EM waves, refractive index and dielectric constant, wave impedance. Propagation through conducting media, relaxation time, skin depth.



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Ref. No.....

Date

- Students will learn Wave propagation through dilute plasma, electrical conductivity of ionized gases, plasma frequency, refractive index and skin depth.

EM Wave Propagation in bounded Media

- Students will able to understand Boundary conditions at a plane interface between two media. Reflection & Refraction of plane waves at plane interface between two dielectric media-Laws of Reflection & Refraction.
- Students will know Fresnel's Formulae for perpendicular & parallel polarization cases,
- Students will capable to know Brewster's law. Reflection & Transmission coefficients and Total internal reflection, evanescent waves. Metallic reflection (normal Incidence).

Polarization of Electromagnetic Waves

- Students will understand Description of Linear, Circular and Elliptical Polarization. Propagation of E.M. Waves in Anisotropic Media.
- Students will learn about Symmetric Nature of Dielectric Tensor. Fresnel's Formula. Uniaxial and Biaxial Crystals. Light Propagation in Uniaxial Crystal. Double Refraction. Polarization by Double Refraction.



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- Students will know Nicol Prism. Ordinary & extraordinary refractive indices. Production & detection of Plane, Circularly and Elliptically Polarized Light.
- Students will be able to know about Quarter-Wave and Half-Wave Plates. Babinet Compensator and its Uses. Analysis of Polarized Light
- Students will learn about Rotatory Polarization: Optical Rotation, Biot's Laws for Rotatory Polarization, Specific rotation.

Wave Guides

- Students will know Planar optical waveguides. Planar dielectric waveguide. Condition of continuity at interface. Phase
- Students will learn about shifts in total reflection. Eigenvalue equations. Phase and group velocity of guided waves. Field
- Students will learn about energy and Power transmission.

Optical Fibres

- Students will be able to understand about the Numerical Aperture. Step and Graded Indices.

PHY-H-CC-P-14: STATISTICAL MECHANICS:

Outcomes:

Classical Statistical Mechanics :-

- Student will be able to understand macrostate and microstate elementary particle
- Student can be able to learn phase space, entropy and thermodynamic probability.

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Classical Theory Of Radiation :-

- Student can able understand blackbody radiation, kirchhoff's law , Stefan Boltzmann law .
- Student will be able to wien's displacement law , wien's distribution law
- Student can able to understand sasha's ionization formula.

Quantum Theory of radiation :-

- Student will be able to know blackbody radiation planck's quantum postulates, planck's law .
- Student can estimate wien's distribution law , Rayleigh jeans law .

Bose Einstein Statistics :-

- Student will able to understand B.E distribution law .
- Student can explain radiation as a photon gas and thermodynamics function of photo gas.
- Student can able to learn Planck's law.

Fermi Dirac Statistics :-

- student will be able to learn F.D distribution law .

PHSHSE01: -Electrical Circuits and Network Skills

Outcomes:

- Students will learn about Single-phase and three-phase alternating

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current sources.

- Students will know about Ladder diagrams, Electrical Schematics, Power circuits, Control circuits.
- Students will understand about DC Power sources. AC/DC generators. Inductance, capacitance, and impedance.
- Student will understand about Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors

PHSHDS01: -CLASSICAL DYNAMICS

Outcomes:

- Students will understand about Lagrangian and Hamiltonian mechanics.
- Students will learn about motion of particle in uniform electric field, magnetic field- gyro radius and gyro frequency, motion in crossed electric and magnetic fields.
- Students will able to solve problems on Small Amplitude Oscillations.
- Students will learn about relativity and know about Time – dilation, length contraction and twin paradox. Four-vectors: space-like, time-like and light-like. Four-velocity and acceleration.
- Student will know about viscosity, stream-lined motion, laminar flow, Poiseuille's equation for flow of a liquid through a pipe.



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PHSHDS02: Nuclear and Particle Physics

Outcomes:

General properties of Nuclei:

- Student will be able to understand mass , radii, charge, density, binding energy, average energy.
- Student will obtain of binding energy versus mass number curve. Student can understand angular momentum parity .magnetic moment , electric moment , nuclear excited states

Nuclear Models:

- Student will be able to know liquid drop model approach .
- Student can calculate two nucleon separation energies.
- Student can understand concept of mean field , residual interaction , concept to nuclear force .

Radioactive decay:

- Student will be able to explain type of Alpha decay, Beta decay and Gamma decay.
- Student will be able to learn basics of Alpha decay process.
- Student will be able to understand energy kinematics for Beta decay .
- Student will be able to know Gamma ray emission and kinematics , internal conversion.

Nuclear Reaction :-

- Student will know the concept of conservation law .
- Student can estimate Q value , reaction rate, reaction cross section .
- Student will be able to learn resonance reaction , coulomb scattering.

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Intersection Of Nuclear Radiation With Matter :-

- Student will obtain a energy lose of electron.
- Student will be able to learn Gamma ray interaction through matter .
- Student can understand photoelectric effect, Compton scattering , pair production, neutron interaction with matter.

Detector for nuclear radiations :-

- Student will be able to know mobility of particle for ionization chamber.
- Student will be able to learn semiconductor detectors for charge particle and photon detection , neutron detection .

Particle accelerators :-

- Student will be able to know cyclotron .

Particle Physics :-

- Student can explain of types of particle.
- Student can able to learn of conservations of laws.

PHY-H-DSE-T-03: DIGITAL SIGNAL PROCESSING:

Outcomes:

- Students will know about Classification of Signals, Periodic and Aperiodic Signals, Energy and Power Signals, Even and Odd Signals, Discrete-Time Systems, System Properties.
- Students will learn about the Differencing in Time Domain; Differentiation in Frequency Domain;



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- Students will understand about phase Delay and Group delay, Zero-Phase Filter, Linear-Phase Filter
- Students will know about Circular Time Shifting; Circular Frequency Shifting; Circular Time Reversal; Multiplication Property.

PHSHDS04: BIOPHYSICS

Outcomes:

- Students will know about building blocks & structure of living state: atoms and ions, molecules essential for life, what is life and living state interactions.
- Students will learn about S Composite systems, Casimir contribution of free energy, Protein folding and unfolding .
- Students will learn about sedimentation of cell cultures, diffusion in a centrifuge, diffusion in an electric field, lateral diffusion in membranes.
- Students will know about fluid dynamics of circulatory systems, capillary action and bioenergetics and molecular motors



Officer-in-Charge
Govt. General Degree College, Nakashipara
Muragachha, Nadia



Government of West Bengal

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Department of Physics

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Ref. No.....

Date

PROGRAMME SPECIFIC OUTCOME

- The course aims to provide students with a comprehensive understanding of fundamental physics laws and concepts, fostering the ability to apply theoretical knowledge to real-world scenarios.
- Students will engage in hands-on experiments to grasp the significance of various physical phenomena, emphasizing the importance of precise measurements and laboratory techniques.
- Through problem-solving exercises, students will develop analytical and technical skills essential for addressing contemporary challenges.
- The curriculum seeks to cultivate not only academic prowess but also personal qualities and transferable skills, nurturing responsible citizenship and leadership qualities.
- By motivating students to pursue advanced studies in reputable institutions, the program aims to foster a culture of academic excellence and continuous learning.
- This course is designed to familiarize students with experimental methods in physics, with a particular focus on laboratory techniques and the importance of accuracy in measurements.
- Practical activities will offer students a hands-on learning experience, enabling them to explore fundamental concepts in matter properties, heat, optics, electricity, and electronics.

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