# Programme Outcomes (PO): B.Sc. Physics (CBCS)

## Goals :

**The Department has formulated three broad educational goals for the undergraduate degree programs:**

**Physics knowledge:** To provide students with the basic foundation in physics and Nanotechnology, the interplay of theory and experiment, and to motivate scientific enthusiasm and curiosity and the joy of learning.

**Problem solving skills:** To provide students with the tools needed to analyse problems, apply mathematical formalism and experimentation, and synthesize ideas.

**Employment and technical skills:** To provide the students with technical skills necessary for successful careers in physics/Nano-technology and related or alternative careers for which a physics foundation can be very useful. These include mathematics, computers, electronics and devices, and communication skills (oral and written

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| **Knowledge Outcome** | After completing B.Sc. Physics Programme students will be able to: <br><br> **PO1:** Transfer and apply the acquired fundamental knowledge of physics, including basic concepts and principles of 1) classical mechanics, electrodynamics, quantum mechanics, Statistical Mechanics and thermodynamics; (2) mathematical (analytic and numerical) methods and experimental methods for physics to study different branches of physics <br> **PO2:** Demonstrate the ability to translate a physical description to a mathematical equation, and conversely, explain the physical meaning of the mathematics, represent key aspects of physics through graphs and diagrams, and use geometric arguments in problem-solving |
| **Skills Outcome** | After completing B.Sc. Physics Programme students will be able to: <br><br> **PO3:** Apply and demonstrate knowledge of concepts of physics, to analyze a variety of physical phenomena <br> **PO4:** Demonstrate the learned laboratory skills, enabling them to take measurements in a physics laboratory and analyse the measurements to draw valid conclusions <br> **PO5:** Capable of oral and written scientific communication, and will prove that they can think critically and work independently. <br> **PO6:** Communicate effectively using graphical techniques, reports and presentations within a scientific environment. <br> **PO7:** Use and apply professional software for scientific data analysis and presentation <br> **PO8:** Respond effectively to unfamiliar problems in scientific contexts <br> **PO9:** Plan, execute and report the results of a complex extended experiment or investigation, using appropriate methods to analyze data and to evaluate the level of its uncertainty |

| | **PO10:** Integrate and apply these skills to study different branches of physics. |
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| **Generic Competencies** | **PO11:** Work comfortably with numbers and analyzing an issue quantitatively, acquire knowledge effectively by self-study and work independently, present information in a clear, concise and logical manner and apply appropriate analytical and approximation methods |
| **Attitude/Value Outcomes** | After completing B.Sc. Physics Programme students should have developed some positive attitudes and will have: <br> **PO12:** Willingness to take up responsibility in study and work <br> Confidence in his/her capabilities <br> Capacity to work effectively in a team <br> Motivation for learning and experimentation |

# Programme Specific Outcomes (PSO)

| Programme Specific Outcomes | After completing B.Sc. Physics, students will be able to |
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| | **PSO1:** Demonstrate and understanding of principles and theories of physics. These include: Newtonian Mechanics, thermodynamics, atomic and Molecular physics, electrodynamics, electronics, optics, nuclear physics, quantum mechanics; |
| | **PSO2:** Apply vector algebra, differential and integral calculus as well as graphical methods to solve physics problems; |
| | **PSO3:** Demonstrate ability to apply knowledge learned in classroom to set and perform simple laboratory experiments; |
| | **PSO4**: solve physics problems using the appropriate methods in mathematical, theoretical and computational physics |

# Course Outcomes (CO) B.Sc. Physics (CBCS)

| F.Y.B.Sc. Physics Semester I (CBCS) | |
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| **Course** | **Outcomes** |
| | After completion of these courses' students should be able to; |
| **PHY111: Mechanics and Properties of Matter** | CO1: Demonstrate an intermediate knowledge of Newton's Laws and the equations of motion<br>CO2: Analyse the forces on the object and apply them in calculations of the motion of simple systems using the free body diagrams<br>CO3: Determine whether using conservation of energy or conservation of momentum would be more appropriate for solving a dynamics problem<br>CO4: Apply the concepts of elasticity to real world problems.<br>CO5: List fundamental forces in nature, applications and factors affecting surface tension.<br>CO6: Demonstrate different applications of Bernoulli's theorem, laws of elasticity, surface tension. |
| **PHY112: Physics principles and applications** | CO1: Define absorption, spontaneous emission and stimulated emission process and describe Laser action describe different atomic models in order to understand atomic structure<br>CO2: Classify different types of bonding & their properties.<br>CO3: Draw electromagnetic spectrum showing different regions and analyze vibrational& rotational spectra of diatomic molecule.<br>CO4: Study the properties of Laser and its applications.<br>CO5: Quote essential principles of operation of radar system and develop the radar for any given frequency |
| **PHY-113 :Physics Laboratory-IA** | CO1: acquire technical and manipulative skills in using laboratory equipment's, tools and materials.<br>CO2: understand of laboratory procedures including safety and scientific techniques.<br>CO3: skill development in collaborative learning and teamwork in lab setting. |
| **F.Y.B.Sc. Physics Semester II (CBCS)** | |
| **PHY121: Heat and Thermodynamics** | CO1: Define laws of thermodynamics, entropy, thermodynamic processes etc.<br>CO2: Describe Andrew's experiment, Amagat's experiment, Carnot engine concept of entropy.<br>CO3: Derive expression for efficiency of heat engine (Otto cycle, Diesel cycle, Carnot cycle), latent heat equation, adiabatic relations for perfect gas, work done during isothermal and adiabatic change.<br>CO4 : Determine critical constants using Vander Waal's gas equation Reduced equation of state<br>CO5: Compare reversible and irreversible processes, adiabatic and isothermal process,<br>CO6: Illustrate that work is a path dependent function using PV diagram and to solve entropy for reversible and irreversible process.<br>CO7: Apply first law of thermodynamics to solve problems.<br>CO8: Categorize thermometers and state its applications |
| **PHY122: Electricity and Magnetism** | CO1: Define the basic terms such as electric field, electric potential, magnetic intensity, magnetic induction, magnetic susceptibility and electric and magnetic flux.<br>CO2: State and conceptualise basic laws in electromagnetic. |

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| | CO3: Explain the superposition principle, gauss's law in dielectrics and relation between three electric vectors.<br>CO4: Solve numerical problems using Coulombs Law ,Gauss's law, Biot-Savart's law,Ampere circuital law and principle of superposition<br>CO5: Determine the electric field and potential due to an electric dipole and different types of charge distribution.<br>CO6: Determine magnetic induction due to various current distributions<br>CO7: Derive the relation between three magnetic vectors and compare different types of magnetic material.<br>CO8: Describe soft and hard magnets on the basis of hysteresis loop. |
| **PHY123: Physics Laboratory-IB** | CO1: Demonstrate an ability to collect data through observation<br>CO2: Acquire technical and manipulative skills in using laboratory equipment, tools and materials<br>CO3: Experimentation and interpreting data.<br>CO4: Demonstrate an understanding of laboratory procedures including safety, and scientific methods.<br>CO5: Demonstrate a deeper understanding of abstract concepts and theories gained by experiencing and visualizing them as authentic phenomena.<br>CO6: Acquire the complementary skills of collaborative learning and teamwork in laboratory settings |
| **Course Outcomes)** | |
| **S.Y.B.Sc. Physics Semester III (CBCS)** | |
| **PHY231:Mathematical Methods in Physics** | CO1: define the basic operations in complex numbers;<br>CO2: explain graphical representation of complex numbers and calculate roots of complex numbers;<br>CO3: solve partial differential equations in Physics;<br>CO4: discuss vector algebra required in Physics;<br>CO5: define and calculate the gradient, divergence and curl of a field;<br>CO6: define order, degree and homogeneity of ordinary differential equation;<br>CO7: explain singular points of ordinary differential equation;<br>CO8: develop problem-solving skills of identifying strategies to solve unfamiliar problem |
| **PHY232: Electronics** | CO1: Apply different theorems and laws to electrical circuits.<br>CO2: Understand the relations in electricity.<br>CO3: Understand the parameters, characteristics and working of transistors.<br>CO4: Understand the functions of operational amplifiers.<br>CO5: Design circuits using transistors and applications of operational amplifiers.<br>CO6: Understand the Boolean algebra and logic circuits. |
| **PHY233: Physics Laboratory-2A** | CO1: Use various instruments and equipment.<br>CO2: design experiments to test a hypothesis and/or determine the value of an unknown quantity.<br>CO3: Describe the methodology of science and the relationship between observation and theory.<br>CO4: Set up experimental equipment to implement an experimental approach. |

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| | CO5: Analyse data, plot appropriate graphs and reach conclusions from your data analysis. |
| | CO6: Work in a group to plan, implement and report on a project/ experiment. |
| | CO7: Keep a well-maintained and instructive laboratory logbook. |
| | CO8: Express their knowledge and ideas through oral and written language. |
| **S.Y.B.Sc. Physics Semester IV (CBCS)** | |
| **PHY241: Oscillations, Waves and sound** | CO1: define periodic and oscillatory motion; |
| | CO2: setup and solve differential equations of motion for simple harmonic, damped, and forced oscillators; |
| | CO3: describe oscillatory motion with graphs and equations, and use these descriptions to solve problems of oscillatory motion; |
| | CO4: discuss phenomenon of resonance and apply in different applications; |
| | CO5: set and solve differential equation for wave motion for longitudinal and transverse waves; |
| | CO6: calculate the phase velocity, energy and intensity of simple harmonic waves; |
| | CO7: discuss the Doppler effect, and predict in qualitative terms the frequency change that will occur for relative motion between source and observer or listener; |
| | CO8: Explain in qualitative terms how frequency, amplitude, and wave shape affect the pitch, intensity, and quality of tones produced by musical instruments. |
| **PHY242: Optics** | CO1: Describe the geometrical formation of images by thin lenses, lens equation and lens makers formula using fundamental laws of geometrical optics. |
| | CO2: Use mathematical analysis to calculate properties of image, formed by combination of lenses and applies theory of optics to calculate the cardinal points of an optical system and design optical devices |
| | CO3: Describe optical aberrations produced in image by lenses and methods of their removal. |
| | CO4: Describe the construction and operation of optical devices, including, eyepieces, compound microscope, grating, polarizers etc. |
| | CO5: Use mathematical analysis to find bright and dark fringes in an interference pattern of thin and wedge shaped film and find a wavelength of light using newton's rings |
| | CO6: Interpret a diffraction pattern to determine resolution of an optical system and grating |
| | CO7: Demonstrate an ability to solve problems using 'paraxial' optics-based formulae, numerical calculations and graphical drawings. |
| | CO8: Geometrical determination of polarization of light and concept and determine a polarization state of light by interpreting polarizer |
| **PHY243: Physics Laboratory-2B** | CO1: Use various instruments and equipment. |
| | CO2: design experiments to test a hypothesis and/or determine the value of an unknown quantity. |
| | CO3: Describe the methodology of science and the relationship between observation and theory. |
| | CO4: Set up experimental equipment to implement an experimental |

| | approach. |
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| | CO5: Analyse data, plot appropriate graphs and reach conclusions from your data analysis. |
| | CO6: Work in a group to plan, implement and report on a project/ experiment. |
| | CO7: Keep a well-maintained and instructive laboratory logbook. |
| | CO8: Express their knowledge and ideas through oral and written language. |

## Course Outcomes

### T.Y.B.Sc. Physics Semester V (CBCS)

| PHY351: Mathematical methods of Physics | CO1: Define and generate a general equation for gradient, divergence, curl & laplacian in an orthogonal curvilinear coordinate system & their applications in physics. |
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| | CO2: Define proper time , minkowskis space ,Time dilation , length contraction |
| | CO3: Describe Michelson Morley experiment & its negative result. |
| | CO4: Illustrate the problems on Frobenius method of series solution and to differentiate point of expansion of given differential equations. |
| | CO5: Evaluate & plot Legendre polynomials, Hermite polynomials, Bessel functions of first kind. |
| | CO6: List the most important special functions in physics and to solve different properties related to special functions. |
| PHY352: Solid State Physics: | CO1: Define crystal structure to develop it in 2D as well as 3D and to determine Indices for 'Directions' and 'Planes' in a crystal structure. |
| | CO2: Give original examples of crystal structures and to analyze them with packing fraction, coordination number, number of atoms per unit cell etc. |
| | CO3: Derive Bragg Diffraction condition in direct lattice and to relate it in reciprocal lattice using Ewald construction. |
| | CO4: Classify the crystal structure by XRD diffraction and to simplify formula for interplaner distance. |
| | CO5: Apply free electron theory to restate thermal and electrical properties |
| | CO6: Explain superconductivity and Meissner effect |
| PHY353: Classical Mechanics: | CO1: Solve advanced problems involving the dynamic motion of classical mechanical systems with an intermediate knowledge of Newton's laws of motion |
| | CO2: Apply the concept of centre of mass and mechanics of system of particles and conservation of energy, linear and angular momentum to solve dynamics problems |
| | CO3: Demonstrate an intermediate knowledge of central-force motion and the concept of converting two body problems to single body problem and apply advanced methods to complex central-force motion problems. |
| | CO4: Demonstrate an I ntermediate knowledge of concept of laboratory frame and centre of mass frame and their use to calculate results of scattering experiments. |
| | CO5: Apply the concept scattering to get important information regarding |

| | the nature of interaction between atomic and subatomic particles through experiments<br><br>CO6: Derive Lagrange and Hamilton's equations, and represent the equations of motion for simple mechanical systems such as: the Atwood's machine, Simple pendulum using these formulations of classical mechanics.<br><br>CO7: Acquire working knowledge of the methods of Hamiltonian Dynamics and compute the Hamilton equations of motion for mechanical systems |
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| **PHY354: Atomic and Molecular Physics:** | CO1: Derive the formulae for total energy of an atom so that energy level diagram can be drawn and also able to obtain the expression for spin orbit interaction energy.<br><br>CO2: State laws, postulates in atomic and molecular Physics and able to compare various models of atomic structure.<br><br>CO3: Calculate quantum state of electrons in an atom, spectral notation and electronic configuration of atom.<br><br>CO4: Obtain formulae for Zeeman shift, wavelength of emitted X-ray s, Raman shift , rotational and vibrational energy for diatomic molecule and apply it.<br><br>CO5: Explain origin of line spectra and able to compare continuous spectra, characteristic spectra and can differentiate between rotational, vibrational and electronic spectra.<br><br>CO6: Explain application of Duane and Hunt's rule, Moseley's law and its importance, applications of X-rays, Raman effect and Auger effect.<br><br>CO7: Draw and explain X-ray spectra, spectrum with and without magnetic field ( Zeeman effect),Raman spectra and molecular spectra using quantum treatment<br><br>CO8: Explain experimental arrangement to produce X-ray,, to observe Raman effect and Zeeman effect. |
| **PHY355: Computational Physics:** | CO1: define types of programming languages and their uses;<br><br>CO2: gain basic competency with a widely used C-language for both general and scientific programming;<br><br>CO3: define operators and expression in C-programming and navigate commands;<br><br>CO4: explain control statements and loops as well as capable of writing C-program to solve problems;<br><br>CO5: describe arrays and pointers and apply them in C program;<br><br>CO6: critically present different numerical methods to solve different types of physical and technical problems;<br><br>CO7: implement numerical algorithms into C-program and visualize the results of the computations<br><br>CO8: demonstrate the ability to estimate the errors in the use of numerical methods |

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| **PHY356(B): Elements of Material Science** | CO1: Define and outline the rules of solubility, deformation in metals, basic concepts in phase diagram, molecular phases and the concept of smart materials.<br>CO2: Explain the imperfections in solids, mechanism of plastic deformation by slip, properties of ceramic materials, the importance and objective of phase diagram.<br>CO3: Calculate and solve problems on stress and strain of materials, CRSS of single phase metals, weight in percentage of compositions using lever rule.<br>CO4: List the defects in solids, diffusion mechanisms and types of phase diagram.<br>CO5: Classify between elastic deformation and plastic deformation<br>CO6: Derive the CRSS of metals and the lever rule for phase diagrams.<br>CO7: Discuss the types of smart materials, properties of smart materials and their applications. |
| **PHY-357 Physics Laboratory-3A** | CO1: Describe the underlying theory of experiments in the course.<br>CO2: Perform derivations of theoretical models of relevance for the experiments in the course.<br>CO3: Follow instructions to perform laboratory experiments in Optics, Thermodynamics, Mechanics, Modern Physics, Electronics and Electromagnetics.<br>CO4: Document their results, using correct procedures and protocols.<br>CO5: Perform a quantitative analysis of experimental data including the use of computational and statistical methods where relevant.<br>CO6: Interpret relationships in graphed data and develop an intuition for alternative plotting methods and communicate results from laboratory experiments, orally or in a written laboratory report.<br>CO7: Calculate permissible standard error in any physics experiment<br>CO8: Derive conclusions from the analysis of own data.<br>CO9: Assess the language used to describe physics experiments and how it can alter perceptions of the method and results |
| **PHY-358 Physics Laboratory-3B** | CO1: Describe the underlying theory of experiments in the course.<br>CO2: Perform derivations of theoretical models of relevance for the experiments in the course.<br>CO3: Follow instructions to perform laboratory experiments in Optics, Thermodynamics, Mechanics, Modern Physics, Electronics and Electromagnetics.<br>CO4: Document their results, using correct procedures and protocols.<br>CO5: Perform a quantitative analysis of experimental data including the use of computational and statistical methods where relevant.<br>CO6: Interpret relationships in graphed data and develop an intuition for alternative plotting methods and communicate results from laboratory experiments, orally or in a written laboratory report.<br>CO7: Calculate permissible standard error in any physics experiment<br>CO8: Derive conclusions from the analysis of own data.<br>CO9: Assess the language used to describe physics experiments and how it can alter perceptions of the method and results |
| **PHY-359 Project-I** | CO1: design and test hypothesis<br>CO2: Describe the underlying theory of experiments in the course.<br>CO3: Perform derivations of theoretical models of relevance for the |

| | experiments in the course. |
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| | CO4: Document their results, using correct procedures and protocols. |
| | CO5: Perform a quantitative analysis of experimental data including the use of computational and statistical methods where relevant. |
| | CO6: Interpret relationships in graphed data and develop an intuition for alternative plotting methods and communicate results from laboratory experiments, orally or in a written laboratory report. |
| | CO7: write a project report with literature review. |
| | CO8: defend the outcome of project work in scientific manner. |
| **PHY-3510(I) Energy studies** | CO1:Students become capable of conducting energy audits and give consultancy in that field. |
| | CO2: Students can design different types of solar heaters for small domestic as well as large scale community level applications. |
| | CO3:Students acquire skills to implement solar P-V systems at domestic levels as well as for office premises and educational institutions. Students become able to start their own enterprise in net metering. |
| | CO4: Students get ideas and hence become self-employed in the field of design , production, commissioningand implementation of bio-mass energy sources , bio-gas plants, gasifiers, wind mills,hybrid systems etc. |
| | CO5:Students can go for research in the fields of super-capacitors, battery technologies, fuel cells andmaterial synthesis for implementation of these technologies. |
| | CO6: Students become successful entrepreneurs in the energy field. |
| | CO7: Students strive to make the regions where they live and work self-sufficient in generating and fulfilling theirown energy needs using different energy solutions. |
| **PHY-3511 SEC (M): Biomedical Instruments** | CO1: Students will acquire basic knowledge of biomedical instrumentation. |
| | CO2: Students can handle and operate different equipment's like ECG, Oxymeter, and Glucometer. |
| | CO3: Students will be able to record the different health parameters using it. |
| | CO4: Student will also able to analyze and interpret the recorded data. |
| **T.Y.B.Sc. Physics Semester VI (CBCS)** | |
| **PHY361: Classical Electrodynamics:** | CO1: Define the Biot-savart law, Amperes law, Coulombs law, Electric field, Electric susceptibility, Magnetic field &Faradays law. |
| | CO2: Equation of continuity, Magnetic vector potential, B.H curve, Maxwell's equation &wave equations. |
| | CO3: Solve numerical problem on coulombs force, magnetic induction, magnetic permeability and induced voltage, magnitude of electric &magnetic vectors. |
| | CO4: Summarize pointing vector, polarization, reflection &refraction. |
| | CO5:Apply Biot Savart law in different symmetry problem. |
| | CO6: List the applications of Amperes law, Biot Savart law, Poynting theorem. |
| | CO7: Elaborate magnetic properties of the material. |
| **PHY362: Quantum Mechanics:** | CO1: outline the historical aspects of development of quantum mechanics; |
| | CO2: explain the differences between classical and quantum mechanics; |
| | CO3: describe matter waves, wave function and uncertainty principle; |
| | CO4: describe Schrodinger's equation and its steady state form; |

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| | CO5: solve Schrodinger's steady state equation for simple potentials to obtain eigen functions and eigen values<br>CO6: apply Schrodinger's steady state equation for spherically symmetric potentials obtain eigen functions and eigen values;<br>CO7: interpret quantum numbers in atomic system;<br>CO8: discuss operator algebra in quantum mechanics. |
| **PHY363:**<br>**Thermodynamics and**<br>**statistical physics:** | CO1: Describe transport phenomena and compute coefficient of thermal conductivity, viscosity and diffusion in terms of mean free path<br>CO2: Define and discuss the concepts and roles of thermodynamic functions from the view point of statistical mechanics<br>CO3: Derive Binomial distribution and Gaussian probability distribution using random walk problem and calculate mean values for a statistical system<br>CO4: Discuss the concepts of microstate and macro state, basic postulates and behaviour of density of states for model system and calculate the number of microstates for different statistical systems<br>CO5: Differentiate thermal, mechanical and general interaction between statistical system<br>CO6: Derive and compare Maxwell Boltzmann, Bose-Einstein and Fermi-Dirac distributions; state where they are applicable and explain the connection between classical<br>CO7: Derive probability distribution formula for micro canonical, canonical ensemble and calculate mean values in canonical ensemble<br>CO8: Discuss applications for canonical ensemble |
| **PHY364: Nuclear**<br>**Physics:** | CO1: Define threshold voltage, dead time and recovery time in GM counter, threshold energy, nuclear fission, nuclear fusion, critical size, critical mass.<br>CO2: Determine the basic properties of nucleus.<br>CO3: Classify nuclear radiations, elementary particles and nuclear states, nuclear detectors.<br>CO4: Compose baryons and mesons with Quark model.<br>CO5: Derive expression for energy of ions and frequency of RF signal in cyclotron, Q value equation, threshold energy, decay constant.<br>CO6: Estimate binding energy from fission<br>CO7: Justify nuclear reactions using conservation laws<br>CO8: Explain the different processes by which energetic particles interact with matter, kinematics of various reactors and decay processes |
| **PHY365: Advanced**<br>**Electronics:** | CO1: Know basic components like diode and its types, BJT, FET<br>CO2: Study of amplifiers and its types.<br>CO3: Introduction to power supplies.<br>CO4: Details of Digital electronics. |
| **PHY366(Q): Physics of**<br>**Nanomaterials (Elective)** | CO1: to introduce the basic physics behind size and effect of nano materials.<br>CO2: to understand the working principle of equipments used in nanostructures.<br>CO3: students will gain knowledge of introduction to nanomaterials and their properties and growth techniques..<br>CO4: It also discusses tools like UV, XRD, SEM and TEM to characterize the nanomaterials and applications of nanomaterials. broadening. |

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| **PHY367: Laboratory course I** | CO1: Describe the underlying theory of experiments in the course.<br>CO2: Perform derivations of theoretical models of relevance for the experiments in the course.<br>CO3: Follow instructions to perform laboratory experiments in Optics, Thermodynamics, Mechanics, Modern Physics, Electronics and Electromagnetics.<br>CO4: Document their results, using correct procedures and protocols.<br>CO5: Perform a quantitative analysis of experimental data including the use of computational and statistical methods where relevant.<br>CO6: Interpret relationships in graphed data and develop an intuition for alternative plotting methods and communicate results from laboratory experiments, orally or in a written laboratory report.<br>CO7: Calculate permissible standard error in any physics experiment<br>CO8: Derive conclusions from the analysis of own data.<br>CO9: Assess the language used to describe physics experiments and how it can alter perceptions of the method and results |
| **PHY368: Laboratory course II** | CO1: Describe the underlying theory of experiments in the course.<br>CO2: Perform derivations of theoretical models of relevance for the experiments in the course.<br>CO3: Follow instructions to perform laboratory experiments in Optics, Thermodynamics, Mechanics, Modern Physics, Electronics and Electromagnetics.<br>CO4: Document their results, using correct procedures and protocols.<br>CO5: Perform a quantitative analysis of experimental data including the use of computational and statistical methods where relevant.<br>CO6: Interpret relationships in graphed data and develop an intuition for alternative plotting methods and communicate results from laboratory experiments, orally or in a written laboratory report.<br>CO7: Calculate permissible standard error in any physics experiment<br>CO8: Derive conclusions from the analysis of own data.<br>CO9: Assess the language used to describe physics experiments and how it can alter perceptions of the method and results |
| **PHY369: Laboratory course III (Project)** | CO1: design and test hypothesis<br>CO2: Describe the underlying theory of experiments in the course.<br>CO3: Perform derivations of theoretical models of relevance for the experiments in the course.<br>CO4: Document their results, using correct procedures and protocols.<br>CO5: Perform a quantitative analysis of experimental data including the use of computational and statistical methods where relevant. \<br>CO6: Interpret relationships in graphed data and develop an intuition for alternative plotting methods and communicate results from laboratory experiments, orally or in a written laboratory report.<br>CO7: write a project report with literature review.<br>CO8: defend the outcome of project work in scientific manner. |
| **PHY-3610(Z) Caibration Techniques** | CO1: Calibrate hydraulic, pneumatic and mechanical measuring and control equipment: setting, adjustment, validation or verification of mechanical, pneumatic, hydraulic, measuring and control instruments using reference standards in accordance with predetermined procedures.<br>CO2: Calibrate electrical and electronic measuring and control equipment: setting, adjustment, validation or verification of electrical, |

| | electronic measuring and control instruments using reference standards in accordance with predetermined procedures.<br>CO3: Carryout maintenance activities on instrumentation and control panel. |
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| **PHY- 3611(AB)**<br>**Instrumentation for**<br>**Agriculture** | CO1: Able to test soil and water parameters.<br>CO2: Able to develop their own juice extract plant.<br>CO3: Able to developed their own green house |