SCHOOL OF VOCATIONAL STUDIES & APPLIED SCIENCES

Programme and Course Objectives

DEPARTMENT OF APPLIED PHYSICS

Department of Applied Physics

NUMBER OF PROGRAMMES OFFERED : 03
Ph.D in Applied Physics
M. Sc. Applied Physics
B.Sc [Hons.] Physics

Programme Name: M.Sc. Applied Physics

About the Programme: M.Sc. Applied Physics is a two-year program that provides the students a comprehensive insight into the fundamentals and real-world applications of Physics and Applied Physics.

Program Objectives

- The primary objective of this programme is to build a strong understanding of pure and Applied Physics through theoretical and practical approaches throughout the programme duration.
- This programme is designed so as to inculcate scientific attitude enriched with a multidisciplinary perspective in the students which make the generation of youth which can apply the subject knowledge in their careers and life.
- Furthermore, students are alsoeducated and motivated to pursue research in the important areas. It opens up many career opportunities for students interested in a wide range of areas.
- The students are updated with the needs of the industry and feel responsible towards the society and the nation.

Course Objectives

Course Code	Course Name	Objectives
First Semester		
PH401	Classical Mechanics and Relativity	• To demonstrate knowledge and understanding of the following fundamental concepts in: • the dynamics of system of particles, • motion of rigid body, • Lagrangian and Hamiltonian formulation of mechanics • To represent the equations of motion for complicated mechanical systems using the Lagrangian and Hamiltonian formulation of classical mechanics. • The develop concept of 4 vectors in relativity and search for conserved quantities • This is a course which forms the basis of Physics of many areas of Physics.
PH403	Electrodynamics	• This course aims to introduce the student to topics in Electromagnetic theory, Relativity and the Relativistic formulation of electromagnetism. • The course reviews and builds on the students' knowledge of Relativity and introduces the formulation of relativity in 4-vector notation. It also builds up a covariant formulation of electrodynamics and includes a study of motion of charges in fields as well as radiation from moving charges as well as antennae.

PH405	Quantum Mechanics-I	• The primary objective of this course is to teach the students the physical and mathematical basis of quantum mechanics for non-relativistic systems. • Different methods to solve the important quantum mechanical problems are taught. • This course forms the basis for solving the problems of other areas of physics such as solid state physics, electronics, optics etc.
PH407	Mathematical Physics	• The objective of this course is to teach the students basic mathematical methods that are also be used in the other courses.
PH409	Statistical Physics	• This course introduces students to statistical mechanics, which is part of the foundation of several branches of physics and has many applications beyond physics. • The course demonstrate the postulates of statistical mechanics and shows how the postulates explain the general laws of thermodynamics as well as properties of classical and quantum gases, other condensed matter systems in equilibrium, and phase transitions.
PH411	Physics Laboratory-I	• Students learn the concept of optics, Thermodynamics, Solid State Physics, Electromagnetic waves and Atomic Physics by performing experiments on Michelson Interferometer, Diffrraction grating, Semiconductors in magnetic field etc.
Second Semester		
PH402	Quantum Mechanics II	• This is an advanced level course in Quantum mechanics which objects to teach about various approximation methods in physics to calculate the approximate values of energy for various systems. • Students will be able to learn the methods to find transition probability for absorption and emission. • This course will let students appreciate the beauty

		of quantum mechanics in the form of the Born approximation and its validity. • Students will be able to study the wave functions of system of identical particles.
PH404	Solid State Physics	• The objective of the paper is to make the students aware about the Physics of Solid State part of the Condensed Matter Physics. • This paper enable the students to understand about the crystal structure, interaction with X-ray, lattice vibrations, defects, electronic properties and the magnetic properties etc. • It also helps the students to understand various properties about crystals. • This paper deals with the study of structural and other properties of solids.
PH406	Electronics	• The objective of the course is to build up on the basic knowledge of electronics with the introduction of advanced topics like circuit analysis and applications of semiconductor devices in analog and digital circuits.
PH408	Physics Laboratory-II	• Students will learn the concept of analog and digital electronics by performing experiments on diodes, transistors, operational amplifiers, timer circuits, logic gates, A/D and D/A converters in the laboratory
PH410	MATLAB Programming	• This course is intended to be an Introduction to MATLAB programming Language. • The course would impart training in the structure of the MATLAB programming language as well as train the students in using programs to numerically solve problems in various areas.
PH412	Design and Simulation Experiments in Physics	• The primary objective of this course is to impart students a holistic view of the fundamentals of experimental designs, simulation software, interpretation and applications.
Third Semester		
PH501	Atomic and Molecular Physics	• The main objective is to teach the students the basic atomic and molecular (diatomic) structures with quantum mechanical approach leading to their understanding of fundamental spectroscopies. The fundamentals and properties of a coherent light source as Laser (various types) will also be taught.

PH503	Nuclear and Particle Physics	• The primary objective is to introduce the basic concept of Nuclear and Particle Physics and impart of knowledge for nuclear models, elementary particles interactions and real life applications of Nuclear reactions.
PH505	Applied Optics	• The objective of the course is to teach the students the concept of wave optics at an advanced level. • The students will be introduced to topics such as degree of coherence, spatial filtering, Fourier - transform spectroscopy etc. This course has been designed to be a bridge between undergraduate optics and research level optics.
PH507	Physics Laboratory-III	• Students will learn the concept of photonics and material science by performing experiments in the laboratory.
PH509	Computational Physics	• This course is intended to introduction of Numerical Methods, for obtaining approximate representative numerical results of the problems. • The course would impart training in solving the problems in the field of Applied Mathematics, Theoretical Physics and Engineering which requires computing of numerical results using certain raw data.
Discipline Specific Elective (DSE)		
DSE-I		
PH414	Semiconductor Physics and Devices	• The course will provide the students about the electronic Components diode,transistor. • This will provide the students the knowledge of IC fabrication. • It give an important Information about the optoelectronic devices. • This course offered a variety of diodes like zenerdiode . • It will give the knowledge of switching circuit.
PH420	Nanoscience and Nanotechnology	• The main goal of this subject is to provide basic understanding of fabrication and characterization of nano structured materials by different analytical methods. • The students will have enriched knowledge on the properties of materials at the nanoscale and implementing it for various applications.
PH422	Soft Electronic	• Control over p-type and n-type carrier

	Materials and Devices	concentrations in inorganic materials such as ZnO is very difficult but it is quite easy in case of organic materials and hence organic semiconductors plays a significant role in development of modern devices. • The course offers fundamental understanding of organic semiconductors and comparisons with inorganic semiconductors. • In addition to theoretical understanding the course is enriched with the fabrication of devices based on organic semiconductors.
DSE-II		
PH424	Laser Systems and Applications	• To familiarize the student with the fundamentals of the characteristics of lasers, their use for experiments in the time domain. • To provide an exposure to instrumentation such as light sources, spectrometers, optical detectors, optical and opto-mechanical components, gain experience in spectroscopic techniques for measurement, analyses of various kinds of spectra.
PH511	Characterization of Solid State Materials	• The course familiarizes students with various type of functional materials, there properties and applications in development of devices. • It offers a detailed understanding of various research instruments, their working principles and instrument user instructions. The course also expertise students for analysis of data acquired from various material characterization instruments. • Acquire experience working in industrial or research lab settings as a part of a team.
PH513	Selected Topics in Photonics	• The primary objective is to learn the fundamental principles of photonics and light-matter interactions, • Develop the ability to formulate problems related to photonic structures/processes and analyze them • Understand processes that help to manipulate the fundamental properties of light.
PH515	Nanophotonics and Nanoplasmonics	• The objective of this course is to enable students to gain a basic knowledge in key areas in nanophotonics, plasmonics, metamaterials, and nano/micro lasers.

Programme Name: B.Sc. (Hons.) Physics

About the Programme:B.Sc. (Hons.) Physics is a 3-year undergraduate programme that is designed in such a way that the students get to learn thefundamentals of various concepts of physics.

Programme Objectives:

- The primary objective of the programme is to teachthe essential topics such as mechanics, quantum mechanics, Electromagnetism, optics, semiconductors, solid state physics etc.in a detailed manner.
- The programme focuses more on the practical applications of subjects through the practical courses along with the theoretical understanding of the courses.
- The other objective is to make the students gainknowledge about interdisciplinary subjects through the Generic Elective courses offered by other departments**.**
- To inculcate some basic theoretical and experimental skills in students by giving hand-on training to the students during skill enhancement courses.
- To educate and enrich the students' knowledge about the various other advanced and updated areas physics through Discipline Specific Elective (DSE) courses.
- To give an initial understanding of theoretical and experimental research through dissertation of six-month duration at the end of the programme which motivate the students for taking research as career in future for the development and betterment of the society.

Course Code	Course Name	Course Objectives
First Semester		

Course Objectives

PH111	Mechanics	• This course comprises the study of basic concepts and formulations of Newton's Laws of Motion and ends with the Fictitious Forces and Special Theory of Relativity. • Moreover, students will also appreciate the Collisions in CM Frame, Gravitation, Rotational Motion and Oscillations. • The emphasis of this course is to enhance the understanding of the basics of mechanics. • By the end of this course, students should be able to solve the seen or unseen problems/numericals in mechanics.
PH113	Mechanics Lab	• This laboratory provides the practical knowledge about laws of motion, moment of inertia and gravitation etc. • Students would also get familiar with various measuring instruments and would learn the importance of accuracy of measurements.
PH115	Mathematical Physics-I	• The objective of the respective course is to enhance the understanding of mathematical tools in solving problems of interest to physicists. • By the end of this course, students are to be examined on the basis of problems, seen and unseen.
PH117	Mathematical Physics-I Lab	• This laboratory would introduce students with the basic knowledge of scientific programming languages and implementation of C++/C/Scilab simulations for Mathematical Physics problems.
Second Semester		
PH112	Electricity and Magnetism	• The course covers static and dynamic electric and magnetic field, and the principles of electromagnetic induction. • It also includes analysis of electrical circuits and introduction of network theorems. • Moreover, student will be able to appreciate Maxwell's equations.
PH 114	Electricity and Magnetism Lab	• The laboratory content compliments the theoretical knowledge of Electricity and Magnetism and henceforth, gives hands-on experience. • It also provides the observational understanding of the subject. • It enhances the qualitative and quantitative skills of the students.

PH 116	Waves and Optics	• This course begins with explaining ideas of superposition of harmonic oscillations leading to physics of travelling and standing waves. • It also provides an in depth understanding of wave phenomena of light, namely, interference and diffraction with emphasis on practical applications of the same.
PH118	Waves and Optics Lab	• The laboratory content compliments the theoretical knowledge of Waves and Optics and gives hands-on experience. • Also, it provides the observational understanding of the subject. It enhances the qualitative and quantitative skills of the students.
Third Semester		
PH-211	Mathematical Physics-II	• The focus of the course is on applications in problems solving of interest to physicists. • Students should able to learn, understand and apply the concepts/formulas of Fourier transformation, differential equations, Bessel function, Beta and Gamma functions etc. to solve the mathematical problems.
PH-213	Mathematical Physics-II Lab	• The aim of this Lab is to use the computational methods to solve physical problems. • The course will consist of lectures(both theory and practical) in the Computer Lab.
PH-215	Thermal Physics	• This course explains the relationship between macroscopic properties of the physical system in equilibrium. • Students will be able to apply the Zero/First/Second laws and Maxwell thermodynamics equations for solving the numerical problems. • It will also give basic knowledge of Heat engines, and exposure of Kinetic theory of gases, transport phenomenon involved in ideal gases, phase transitions and behaviour of real gases.
PH-217	Thermal Physics Lab-II	• The laboratory content develop experimental and data analysis skills through a wide range of experiment of Thermal Physics • Also, it provides the observational understanding of the subject. It enhances the

		qualitative and quantitative skills of the students
PH-219	Digital Systems and Applications	• This introduces the concept of Boolean algebra and the basic digital electronics of various logic Gates and memory elements. • In this course, students will be able to understand the working principle of CRO, Data processing circuits, Arithmetic Circuits, sequential circuits like registers, counters etc. based on flip flops. • In addition, students will get an overview of microprocessor architecture and programming.
PH-221	Digital Systems and Applications Lab	• The laboratory content develop experimental and data analysis skills through a wide range of experiment gives hands-on experience. • Also, it provides the observational understanding of the subject. It enhances the qualitative and quantitative skills of the students
Fourth Semester		
PH 212	Mathematical Physics-III	• This course introduces the mathematical methods essential for solving the advanced problems in physics. • The knowledge of mathematical concepts and techniques would be beneficial in further research and development as it serve as a tool in almost every branch of science and engineering.
PH214	Mathematical Physics-III lab	• This laboratory would introduce students with the basic knowledge of scientific programming languages and graphical analysis. • Also, the students would be able to implement C++/C/Scilab simulations for common and scientific problems.
PH 216	Elements of Modern Physics	• This course introduces modern development in Physics. Starting from Planck's law, it develops the idea of probability interpretation and then discusses the formulation of Schrodinger equation. • It also introduces basic concepts of nuclear physics.
PH 218	Elements of Modern Physics lab	• This laboratory provides the theoretical knowledge of Modern Physics and gives hands-on experience. • Students will learn how to measure different

		universal constantswith several experiments. • Also, it provides the observational understanding of the subject. It enhances the qualitative and quantitative skills of the students
PH 220	Analog Systems and Applications	• This course explains about the physics of semiconductor p-n junction and devices, transistor biasing and stabilization circuits are explained. • The concept of feedback in the amplifiers and oscillator circuits are also discussed in detail. • This will also give an understanding of working principle of operational amplifiers, CRO and their applications.
PH 222	Analog Systems and Applications lab	• This laboratory provides a hands-on experiments based on PN junction diode, transistors, Op-amp, amplifiers etc. • Also, it provides the observational understanding of the subject. It enhances the qualitative and quantitative skills of the students.
Fifth Semester		
PH311	Quantum Mechanics and Applications	• This course is an application of Schrodinger equation to various quantum mechanical problems. • This gives fair idea of formulation of eigenvalues and eigen functions.
PH313	Quantum Mechanics Lab	• This lab compliments the problem based on Quantum Mechanics using C++ programming language.
PH 315	Solid State Physics	• This aims to provide a general introduction to theoretical and experimental topics in solid state physics. • This course also elucidates the main features of crystal lattices and phonons, understand the elementary lattice dynamics and its influence on the properties of materials. • It also explains the main features of the physics of electrons in solids, explain the dielectric ferroelectric and magnetic properties of solids and understand the basic concept in superconductivity.
PH 317	Solid State Physics Lab	• The laboratory content compliments the theoretical knowledge of Solid state physics and gives hands-on experience. • Students will learn different kind of material and their nature by performing several experiments.

		• Also, it provides the observational understanding of the subject. It enhances the qualitative and quantitative skills of the students
Sixth Semester		
PH312	Electromagnetic Theory	• The course covers Maxwell's equations, propagation of electromagnetic (em) waves in different homogeneous-isotropic as well as anisotropic unbounded and bounded media, production and detection of different types of polarized em waves, general information as waveguides and fibre optics. • Students will be able to apply the laws/formulas to solve the numerical problems of quarter/half wave plates, internal reflection, numerical aperture etc.
PH314	Electromagnetic Theory Lab	• The laboratory content compliments the theoretical knowledge of Electromagnetic Theory and gives hands-on experience. • Also, it provides the observational understanding of the subject. It enhances the qualitative and quantitative skills of the students.
PH316	Statistical Mechanics	• This course provides elementary and applied Statistical Mechanics for exploring the Bose-Einstein statics, Fermi-Dirac statics, Relativistic Fermi-Gas, Black body radiation, Stefan-Boltzmann law etc. • The objective of this course work is to introduce and apply the techniques of Statistical Mechanics which have applications in; Astrophysics, Semiconductors, Plasma Physics, Bio-Physics, Chemistryetc.
PH318	Statistical Mechanics Lab	• The laboratory content develop experimental and data analysis skills through a wide range of experiment of Statistical Mechanics. • Also, it provides the observational understanding of the subject. It enhances the qualitative and quantitative data analysis skills of the students.
Discipline Specific Elective (DSE)		
DSE-I		
PH319	Experiments Techniques	• This course aims to describe the errors in measurement and statistical analysis of data required while performing an experiment. • Also, students will learn the working

		principle,efficiency and applications of transducers and industrial instruments like digital multimeter, RTD, Thermistor, Thermocouples and Semiconductor type temperature sensors.
PH321	Experiments Techniques Lab	• This laboratory guides the students to understand gauges, thermistors, vacuum pumps and other laboratory equipment's by performing experiments. • It enhances the qualitative and quantitative skills of the students.
PH 323	Physics of devices and communication	• This paper is based on advanced electronics which covers the devices such as UJT, JFET, MOSFET, CMOS etc. • Process of IC fabrication is discussed in detail. Digital Data serial and parallel Communication Standards are described along with the understanding of communication systems
PH325	Physics of devices and communication Lab	• This laboratory guide the students to understand the electronic devices such as filters, transistors etc., by performing experiments and simulations. • It enhances the qualitative and quantitative skills of the students.
PH327	Classical Dynamics	• This course begins with the review of Newton's Laws of Motion and ends with the Special Theory of Relativity by 4-vector approach and fluids. • Students will also appreciate the Lagrangian and Hamiltonian Mechanics. The emphasis of this course is to enhance the understanding of Classical Mechanics (Lagrangian and Hamiltonian Approach). • By the end of this course, students should be able to solve the seen or unseen problems/numericals in classical mechanics.
DSE-II		
PH329	Nanomaterials and Applications	• This course introduces the essence of nano materials, their synthesis, and characterization. • On successful completion of the module students should also be able to understand the optical properties and electron transport phenomenon in nanostructures. • It also covers few important applications of nano

		materials used in this technological era.
PH331:	Nanomaterial and Applications Lab	• This laboratory content compliment the students about the different kind of nanomaterial synthesis, their characterization by performing experiments. • It enhances the qualitative and quantitative skills of the students.
PH333	Astronomy & Astrophysics	• The objective of this course is to provide excellent platform for understanding the origin and evolution of the Universe. • It gives a comprehensive introduction on the measurement of basic astronomical parameters • This course gives an overview on key developments in observational astrophysics, reviews the formation of planetary system and its evolution with time and emphasizes on the physical laws that enable us to understand the origin and evolution of galaxies, presence of dark matter and large scale structures of the Universe
PH335	Atmospheric Physics	• This paper aims to describe the characteristics of earth's atmosphere and also its dynamics. Atmospheric waves along with the basic concepts of atmospheric Radar and Lidar are discussed in detail
PH337	Atmospheric Physics Lab	• This laboratory content compliment the students regarding the atmospheric physics problem by performing Scilab/C++ based simulation. • It enhances the qualitative skills of the students.
DSE-III		
PH 320	Applied Dynamics	• This course is to provide basic and applied knowledge of dynamical systems, phase space, trajectories and fluid dynamics. • By the end of this course, students should be able to solve the seen or unseen problems/numerical in applied dynamics.
PH 322	Applied Dynamics Lab	• The laboratory content develop experimental and data analysis skills through a wide range of experiment of Applied Dynamics lab. • Also, it provides the observational understanding of the subject. It enhances the qualitative and quantitative skills of the students
PH 324	Communication System	• This paper aims to describe the concepts of electronics in communication. • Communication techniques based on Analog Modulation, Analog and digital Pulse

		Modulation including PAM, PWM, PPM, ASK, PSK, FSK are described in detail. • Communication and Navigation systems such as GPS and mobile telephony system are introduced.
PH 326	Communication system Lab	• The laboratory content develop experimental and data analysis skills through a wide range of experiment of Communication lab. • Also, it provides the observational understanding of the communication in real systems. It enhances the qualitative and technical skills of the students
		DSE-IV
PH 328	Nuclear and Particle Physics	• The objective of the course is to impart the understanding of the sub atomic particles and their properties • It will emphasize to gain knowledge about the different nuclear techniques and their applications in different branches of Physics and societal application. • The acquire knowledge can be applied in the areas of nuclear, medical, archaeology, geology and other interdisciplinary fields of Physics and Chemistry. It will enhance the special skills required for these fields
PH 330	Digital Signal Processing	• This paper describes the discrete-time signals and systems, Fourier Transform Representation of Aperiodic Discrete-Time Signals. • This paper also highlights the concept of filters and realization of Digital Filters. • At the end of the syllabus, students will develop the understanding of Discrete and fast Fourier Transform.
PH 332	Digital Signal Processing Lab	• The laboratory content develop experimental and data analysis skills through a wide range of experiment of digital signal processing lab. • Also, it provides the observational understanding of the digital signal using MATLAB programming. It enhances the qualitative and quantitativeanalysis skills of the students.
PH 334	Dissertation	• The dissertation involves the students towards the high quality research and development in a specific branch of Physics.

		• In the dissertation, the student's ability towards conducting/planning of challenging experiments/programming, data collection/analysis, scientific writing and research paper communication will be developed.
Skill Enhancement Course (SEC)		
SEC-I		
PH223	Computational Physics	• The aim of this course is to teach computer programming and numerical analysis and emphasize its role in solving problems in Physics and Science. • It also highlights the use of computational methods to solve physical problems along with the use of computer language as a tool. • This course will also consist of hands on training on the problem solving on Computers.
PH225	Electrical Circuits and Network	• The aim of this course is to enable the students to design and troubleshoots the electrical circuits, networks and appliances through hands-on mode.
PH 227	Basic Instrumentation	• The course covers the Basic of Measurement that enables student to learn instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects. • It also covers multimeter that provides the learning of principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance
SEC-II		
PH224	Applied Optics	• The objective of this course to understand the 'nature of light' is a favourite inquiry of mankind since ancient times. • By the advent of lasers, holography, and optical fibres in twentieth century the optics now-a-days finds application in several branches of science and engineering. • This paper provides the conceptual understanding of these branches of modern optics to the students.
PH226	Renewable Energy and Energy Harvesting	• The aim of this course is to impart theoretical knowledge to the students and to provide them with exposure and hands-on learning wherever

		possible.
PH 228	Radiation Safety	• It is a course focus on the applications of nuclear techniques and radiation protection. • It will not only enhance the skills towards the basic understanding of the radiation but will also provide the knowledge about the protective measures against the radiation exposure. • This will prepare the work force for jobs in industry and medical fields. The list of laboratory skills and experiments listed below the course are to be done in continuation of the topics.

Programme Name: Ph.D. Applied Physics

About the Programme: Ph.D. Applied Physics is Doctorate programme of the Department of Applied Physics which provides the students a comprehensive insight about the ongoing research in some theoretical and experimental areas.

Program Objectives:

- The objective of Ph.D. Applied Physics program is to provide an education within experimental and theoretical physics and to give the research scholar a broad professional background in physics.
- The research scholars can focus towards theoretical or experimental topics of research based on ongoing research activities at the Department of Applied Physics.
- Through this study, the research scholars acquire and demonstrate advanced knowledge in foundational areas of physics with mastery of their selected subfield.
- To encourage and train the research scholars author or co-author publications in refereedjournals, make presentations at national or international meetings (poster/oral talks)

Course Objectives:

Course Code	Course Name	Objectives
PH601	Synthesis and Advanced Characterization Techniques of Materials	• In this course, the Ph.D. students learn about the various techniques of synthesis of the materials with key experimental details. • Furthermore, various important basic and advanced characterization techniques are also taught in this course. • The objective of the course is to make the students aware about the experimental techniques and error analysis in the experimental observations, so that they can

		apply these concepts during their research work.
PH603	Numerical and Computing Methods of Research	• The objective of the course is to introduce the Ph.D. students to computer programming through MATLAB. • In addition, the course will teach the students numerical methods for solving algebraic and differential equations. The course has been designed to enhance the problem-solving skill of prospective students.