PROGRAMME M.Sc. PHYSICS

Programme Outcomes

- The objective of the course is to create awareness in the field of Physics and cultivate scientific approach and research aptitude among the graduate students in various subjects of physics and emerging extensions of research activities
- The task includes preparation, enhancement etc. of human resources in strengthening the activities for the development of basic scientific knowledge, skills and application of scientific approach.
- An independent project is included in the course so that the candidate knows about the flavour of research methodology in science.

Programme Specific Outcomes

- Providing a more complete and logical framework in almost all the areas of advanced Physics

Course Outcomes

1. **Classical Mechanics**

- To demonstrate concept and understanding of the following fundamental topics in:
  i. Dynamics of system of particles,
  ii. Motion of rigid body,
  iii. 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.
- To develop familiarity with the physical concepts and facility through methods of classical mechanics.
- To understand the theory of Relativity.

2. **Mathematical Physics - I**

- Learners are well equipped in the basic techniques of mathematical Physics and able to solve physical problems.
- Learners will identify various types of matrices and explain how one type of matrix differs from another.
- Learners will develop expertise in vector differential calculus operators in order to learn Electro Magnetic Theory those are required in Physics.

3. **Integrated Electronics**

- Learners will enhance their comprehensive capabilities through understanding of electronic devices.
- Learners will get clear understanding of various fabrication techniques of semiconducting devices.

- Learners will understand the physical construction, working and operational characteristics of Semiconductor devices.
- Learners will get introduction in the basic building blocks of linear integrated circuits and digital converters.

4. Nonlinear Dynamics

- Students will be able to analyze the behaviour of dynamical systems (e.g. find periodic orbits and assess their stability, draw phase portraits, etc.) expressed as either a discrete-time mapping or a continuous-time flow.
- Students will be able to apply the techniques of nonlinear dynamics to physical processes drawn from a variety of scientific and engineering disciplines.
- Students will be able to analyze changes (i.e. bifurcations) to dynamical systems as system parameters are varied.
- Students will be able to independently find research topics in nonlinear dynamics and synthesize this work into coherent written presentations.

5. General Physics Experiments I

- It is expected to provide hands on experience in understanding the general physics experiments Quinke's Method, Cauchy's Constant, Anderson's Bridge and Thickness of a thin material/ diameter of a thread. Learners will acquire the basic skills and knowledge about the experiments. Learners will also get insight knowledge on experiments like magnetism, electricity, and their theory behind the experiments.

6. Electronics Experiments I

- To enhance comprehensive capabilities of students through understanding of electronic devices.
- To give clear understanding of various fabrication techniques of semiconducting devices.
- To understand the physical construction, working and operational characteristics of Semiconductor devices.
- To introduce the basic building blocks of linear integrated circuits and digital Converters.
- Learners will able to measure the FET characteristics and do simple experiments with it
- Students are able to construct a triangular and a ramp wave generator using OP Amp
- Learners will learn hardware experimental construction of counters and decoders
- Students are able to construct a constant current source using OP Amp and transistor/ FET

Semester II

7. Mathematical Physics II

- To understand the basic concepts of group theory and complex analysis
- To solve partial differential equations with appropriate initial or boundary conditions
- To understand the concepts of some special functions
    - Legendre differential equation and Legendre polynomial
    - Hermite differential equation and Hermite polynomial

8. Condensed Matter Physics

- Learners will get insight knowledge on the applications of Physics applied to study of solids and the relationships between their structures and properties.
- This paper serves as pre-requisite to study the optional subjects such as materials science, nano-science, etc.

9. Microprocessor & Microcontroller

- An in-depth understanding of the architecture and working of microprocessors and micro controllers
- To study the Architecture of 8085 microprocessor.
- To learn the design aspects of I/O and Memory Interfacing circuits
- To study the Architecture of 8051 microcontroller.

10. Numerical Methods & C++ Programming

- Apply numerical methods to obtain approximate solutions to mathematical problems.
- Apply numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of ordinary and partial differential equations.
- Apply C++ program using numerical methods to solve various problems

11. Field Work

12. General Physics Experiments II

- It is expected to provide hands on experience in understanding the general physics experiments Young's Double Slit, Hyperbolic fringes, Ultrasonic Interferometer and Optical Fibre Characteristics. Basic skills and knowledge about the experiments is required.

13. Electronics Experiments – II

- To present the basic tools for an understanding of the fundamental electronic devices.
- To develop an interest in the learning of advanced devices and their designing aspects.
- To study the SCR characteristics and simple experiments with it.
- To draw the characteristics of UJT and to construct a relaxation Oscillator.
- To construct code converters using ICs.
- To construct various electronic circuits using OP-AMP.

Semester III

14. Quantum Mechanics I

- This course imparts knowledge about wave functions and Schrodinger equations and matrix mechanics, Heisenberg uncertainty principle and different operators and certain solvable systems and various pictures involved in quantum mechanics. Basics of quantum mechanics are essential. Methods of solving some microscopic problems using quantum mechanical ideas are studied.

15. Electromagnetic Theory

- The scope of this course is to impart the knowledge of Maxwell's equation, propagation of electromagnetic waves through various media including waveguides.

16. Statistical Mechanics

- The basic concepts involved in statistical mechanics, classical and quantum statistics, applications of quantum statistics, phase transition in certain physical problems is expected to study. The theory of statistics and quantum ideas are prerequisites. Postulates of quantum

mechanics, Maxwell-Boltzmann distribution law, theory and applications of quantum statistics are studied.

17. Research Methodology

- Literature collection, activities involved in the research problem, method of writing the thesis, knowledge about Origin and Latex are expected to learn. Different methods of analysis and computer knowledge are prerequisites. The outcome of the course is how to collect literatures, write the research article and thesis.

18. Advanced Physics Experiments I

- It is expected to provide hands on experience in understanding the advanced physics experiments Gouy's method, elliptical fringes, Hall probe into Gauss meter, and Phototransistor characteristics. Basic skills and knowledge about the experiments is required. Experiments in magnetism, electricity, and the theory behind the experiments are also studied.

19. Microprocessor Experiments

- Provide hands on experience on microprocessor experiments. Learners are expected to give a detailed knowledge of arithmetic operation, data manipulation, interfacing experiments, ADC & DAC conversion etc…

Semester IV

20. Quantum Mechanics II

- The course provides knowledge on the theory of angular momentum, various approximation methods, and theory of scattering and relativistic quantum theory. The various aspects studied in the course quantum mechanics I is essential. This course is capable of solving many problems that cannot be exactly solved.

21. Spectroscopy

- This course gives detailed knowledge about various types of spectroscopy. The structure of different chemical compounds can be determined by studying these types.

22. Nuclear and Particle Physics

- This course imparts knowledge about the elementary particles, nuclear structure, nuclear reactions with the help of various nuclear models

23. Advanced Physics Experiments II

- It is expected to provide hands on experience in understanding the advanced physics experiments Hall effect, Hysteresis, Ultrasonic diffraction etc… Basic skills and knowledge about the experiments is required. The theory behind the experiments is also studied.

24. C++ Programming

- The course provides knowledge about the C++ programming and the course is able to solve many tedious physical problems numerically.

Renewable Energy Sources

- This course gives a brief knowledge about the types of various non-conventional energy sources. The societal application of these energy sources is studied.

Optoelectronics and Lasers

- This course provides the fundamentals of light waves, integrated wave guides, optic fiber wave guides. The applications of Laser and Holography are also studied.

Materials Science

- The course details about the temperature effect, elastic behavior of materials, solid structure, imperfections in the crystal, the various deformation of materials.

Characterization Techniques

- The principle behind the characterizations such as structural, thermal, microscopy, electrical and spectroscopy are studied.

PROGRAMME M.PHIL. PHYSICS

Programme Outcomes

- The objective of the course is to cultivate scientific approach and culture of research aptitude among the post-graduate students in the field of physics and other related activities.
- The task includes preparation, enhancement etc. of human resources in strengthening the activities for the development of basic scientific knowledge, skills, application of scientific approach etc. so as to derive the best from the same.
- This helps to carry out research problem independently and individually in a perfect scientific method

Programme Specific Outcomes

- The task includes preparation, enhancement etc. of human resources in strengthening the activities for the development of basic scientific knowledge, skills, application of scientific approach etc. so as to derive the best from the same.

Course Outcomes

1. **Research Methodology**

- To provide a qualitative idea on the fundamentals of research and types and methods of research.
- This paper will serve as an eye opener for students keen in research activities particularly in Physics.
- To equip on publishing the research outputs adopting accepted standards.

2. **Advanced Physics**

- To apply the concepts and theories of a range of advanced topics in physics

- To demonstrate an understanding of the close relationship between scientific research and the development of new knowledge in a global context.

3. Materials Science of Thin Films

- This course aims at developing a comprehensive understanding of thin film deposition principles and techniques.
- Film properties are correlated to the material used, as well as the microstructure that has been developed during the deposition process.
- Students will acquire the knowledge and develop the skill to design thin film systems and select appropriate deposition techniques through materials, microstructure, property and economic considerations.

4. Magnetism in Solids

- To understand the source of a materials magnetic behaviour and be able to distinguish types of magnetism.
- To identify crystal lattices and their structures.

5. Energy **Storage Materials**

- To introduce the basic concepts, physical/chemical principles and key materials applied in the latest technologies for energy conversion and storage processes, with focuses of developing a comprehensive understanding of materials used for energy conversion and storage devices.

6. Physical Properties of Materials

- To introduce the tensor aspect of physical properties and their relation to symmetry
- To learn mechanical, electrical, optical, magnetic, ferroelectric, magneto optic tensor properties and their measurements.

7. Crystal Growth and Characterization

- To provide a qualitative idea on the fundamentals of growing crystals and characterizing the grown samples.
- This paper will serve as an eye opener for students keen in research activities particularly in experimental physics.

8. Nanophysics

- The course will introduce the students to the rapidly developing field of nanoscience and technology with special focus on the methods of synthesis, characterization techniques and applications of nanomaterials with physics emphasis.

- The course is expected to provide the necessary understanding in nanotechnology and the students must be able to perform their project works related to the synthesis and characterization of nanomaterials by direct experience.

9. Advanced Nuclear Physics

- The students should able to use symmetries, conservation laws and kinematical conditions in order to give physical explanations for nuclear physics process.
- Able to calculate nuclear physics quantities and processes.
- Describe how the structure of nuclei is related to the many-body system of interacting nucleons.

10.Research And Teaching Methodology

- To introduce the knowledge on research. This paper provides a broad knowledge on methods of research, problem solving and analytical techniques
- To provide a qualitative idea on the fundamentals of research and types and methods of research.
- This paper will serve as an eye opener for students keen in research activities particularly in Physics.
- To equip on publishing the research outputs adopting accepted standards

11.Advanced Physics

- To impart knowledge on various materials of technological importance. To make the students learn the basics of quantum mechanical calculations, nanomaterials, thin films, environmental physics and biophysics.
- To apply the concepts and theories of a range of advanced topics in physics.
- To demonstrate an understanding of the close relationship between scientific research and the development of new knowledge in a global context.

1. Materials Science

- To expose the students with theoretical aspects of materials science. To provide the knowledge about phase diagrams, mechanical properties, ceramics, polymers, plastics and crystals.
- This course aims at developing a comprehensive understanding of thin film deposition principles and techniques.
- Film properties are correlated to the material used, as well as the microstructure that has been developed during the deposition process.

- 9 Students will acquire the knowledge and develop the skill to design thin film systems and select appropriate deposition techniques through materials, microstructure, property and economic considerations.

13.Nanomaterials

- To felicitates the knowledge on nanomaterials. To make the students understanding the fundamental aspects of nanomaterials, synthesis, nanostructures, properties and characterization techniques.
- The course will introduce the students to the rapidly developing field of nanoscience and technology with special focus on the methods of synthesis, characterization techniques and applications of nanomaterials with physics emphasis.
- The course is expected to provide the necessary understanding in nanotechnology and the students must be able to perform their project works related to the synthesis and characterization of nanomaterials by direct experience.

14.Space Physics

- To enlighten the students with the concepts of space physics. To make the students understanding the concepts of remote sensing of earth's climate system, space and plasma physics, space weather, introduction to magneto hydrodynamics, x-ray astronomy

15.Crystal Growth

- To introduce the knowledge on crystal growth and characterization. To expose the students with theories of nucleation & crystal growth, crystal growth from various techniques such as, solution, melt and vapour phase and their characterization.
- To provide a qualitative idea on the fundamentals of growing crystals and characterizing the grown samples. This paper will serve as an eye opener for students keen in research activities particularly in experimental physics.

16.Thin film

- To expose the students with knowledge of understanding the basic preparation and to get knowledge about the various properties of thin films. To make the understand the preparation and various necessary techniques used for analyzing the thin films

17.Electronic Structure Calculation

- To introduce knowledge on electronic structure calculation. To make the students to understand basic concepts, various analysis on natural bond Orbitals, normal coordinates and different experimental methods.

18.Nonlinear Dynamics

- To understand the basic concepts of nonlinear dynamics. This course provides knowledge about the effects of nonlinearity on dynamical systems

19. Medical Physics

- To study the basic concepts of medical physics. To make the students to understanding the concepts of Physics in lungs and breathing, sound in medicine, light in medicine, physics of diagnostic X-rays and cardio vascular systems.

20.Radiation Physics

- To teach the students about the basic concepts of radiation physics. To impart knowledge on radiation and interaction, principles of radiation detection and measurement, radiation therapy techniques, diagnostic radiology and radiation protection.

21.Alternative Energy Conversion Devices

- To introduce knowledge on alternative energy sources. To introduce the importance and overview of alternate energy sources. To make the students learn the basics of various energy conversion devices

22.Lasers And Applications

- To facilitates the students with theoretical aspects of laser theory and its applications. To provide the knowledge on laser theory, resonators and switching theory, gas & liquid lasers, solid state & semiconductor lasers and their applications.

23.Project and Viva-voce

- Project and Viva-voce will enable the learners to undergo research aptitude in the areas of his/her specialization with more deep and societal need for Physics development.

PROGRAMME PH.D PHYSICS

Programme Outcomes

- To train the research scholars to use the various techniques of characterization with respective to their problems and various mathematical tools for analysis, which are commonly applied to understand and analyze physics problems.
- To learn robust statistical and mathematical tools and techniques for research analysis.

Programme Specific Outcomes

- Doctoral research is very much essential for any kind of science development, application development, defence development and overall growth of our national development.

1.Materials Science

- To expose the students with theoretical aspects of materials science. To provide the knowledge about phase diagrams, mechanical properties, ceramics, polymers, plastics and crystals.

2.Nanomaterials

- To felicitates the knowledge on nanomaterials. To make the students understanding the fundamental aspects of nanomaterials, synthesis, nanostructures, properties and characterization techniques

3.Space Physics

- To enlighten the students with the concepts of space physics. To make the students understanding the concepts of remote sensing of earth's climate system, space and plasma physics, space weather, introduction to magneto hydrodynamics, x-ray astronomy

4.Crystal Growth

- To introduce the knowledge on crystal growth and characterization. To expose the students with theories of nucleation & crystal growth, crystal growth from various techniques such as, solution, melt and vapour phase and their characterization.

5.Thin film

- To expose the students with knowledge of understanding the basic preparation and to get knowledge about the various properties of thin films. To make the understand the preparation and various necessary techniques used for analyzing the thin films

6.Electronic Structure Calculation

- To introduce knowledge on electronic structure calculation. To make the students to understand basic concepts, various analysis on natural bond Orbitals, normal coordinates and different experimental methods.

7.Nonlinear Dynamics

- To understand the basic concepts of nonlinear dynamics. This course provides knowledge about the effects of nonlinearity on dynamical system

8.Medical Physics

- To study the basic concepts of medical physics. To make the students to understanding the concepts of Physics in lungs and breathing, sound in medicine, light in medicine, physics of diagnostic X-rays and cardio vascular systems.

9.Radiation Physics

- To teach the students about the basic concepts of radiation physics. To impart knowledge on radiation and interaction, principles of radiation detection and measurement, radiation therapy techniques, diagnostic radiology and radiation protection.

10.Alternative Energy Conversion Devices

- To introduce knowledge on alternative energy sources. To introduce the importance and overview of alternate energy sources. To make the students learn the basics of various energy conversion devices.

11.Lasers And Applications

- To facilitates the students with theoretical aspects of laser theory and its applications. To provide the knowledge on laser theory, resonators and switching theory, gas & liquid lasers, solid state & semiconductor lasers and their applications.

Online courses - NPTL

12.Advanced Materials and Processes

- This course provides a fundamental understanding of materials' properties, their processing and classification, which are essential for product commercialization from the concept phase. It also includes the development of new materials and the improvement and application of current materials in new and novel structures.

13.Introduction to Non-linear Optics and its Applications

- To introduce the basic concepts and theory of Nonlinear Optics. To study the basic nonlinear optical effects (like higher harmonic generation, optical Kerr effect, self-phase modulation etc). The course offers the subject matter by giving a rigorous theoretical background and framework for a nonlinear effect, followed by details of how such an effect is implemented in real applications.

14.Non-Conventional Energy Resources

- To study the operating principle of a range of non-conventional energy resources, materials used, characterization, and key performance characteristics. The technologies looked at will include, Solar energy, Wind, Batteries, Fuel cells, and Geothermal conversion. The advantages and limitations of these technologies in comparison to conventional sources of energy will also be examined.

15.Design of Photovoltaic Systems

- To discus about the PV cell electrical characteristics and interconnections. Estimation of insulation and PV sizing is addressed in some detail. Maximum power point tracking and circuits related to it are discussed. Later, applications related to peltier refrigeration, water pumping, grid connection and micro grids are discussed in detail. Lastly a brief discussion on life cycle costing is also discussed in order to bring in a measure of completeness to the course.