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**VIJAYANAGARA COLLEGE, HOSAPETE**  
**POST GRADUATION DEPARTMENT OF PHYSICS**



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**Program Outcome, Course Outcome and Program specific outcome**  
**for the Academic year -2021-22**

**Program outcome:**

- 1) To understand the importance and application of physics in day-to-day life.
- 2) Students will develop quantitative and Qualitative knowledge of physics.
- 3) To Possess theoretical and Experimental Knowledge of physics concepts
- 4) Development of experimental techniques among the students.
- 5) Cultivating the instrumental skills among the students.

At the successful completion of this program, students get skilled in logical thinking in steps, formulating model systems, and solving problems. With a satisfactory number of Presentations and group discussions, the students become good communicators. Students get lessons on research and development during their Project work, Assignments, and Seminars.

During project work, group discussion, and laboratory class students get nurtured to become team members and to stand beside others with fellow feeling in need. Their creative skills get nourished by inspiring them to manage and organize different events; e.g. Science Day Observation, Lecture Competition, Celebration of Scientists' birth Day, etc. being honest and ethical in higher education and research, awareness is inculcated amongst the students by obeying the intellectual property.

**Program specific outcome:**

With successful completion of this program the students become enable to teach secondary, higher secondary levels. They can be absorbed in international schools also. Completing this program one can appear as data analyst, material analyst also. They get ample opportunity of pursuing their higher education (e.g. M.Tech, MS, M.Phil, Ph.D). Students coming out with flying colours in M.Sc Physics get professional options in any interdisciplinary area related to Physics.

## M.Sc- First semester

### PHHCT110: Mathematical Physics:

**Course Objectives:** To make students understand the use of mathematical tools in Physics and developing them to apply technique / methods to solve physical system problems.

#### **Course outcome:**

Quantitative Understanding of physical process and parameters require various mathematical methods to solve the given problem subjected to known boundary conditions. The Prescribed course runs through various topics which include Differential Equations, special functions, Fourier series, Integral and Laplace transformations, Matrices, complex and Vector analysis, Tensors and Group Theory. The special functions unit is useful in understand and solving transfer of heat in different geometries, Integral Transformation unit helps the students in studying Gaussian probability functions. Students will be able to solve charge on capacitor and electric circuit related problems through Laplace transformations. physical observations like Force on a charged particle, circular motion of a particles, Laplace and Poisson equations can be studied through vector analysis unit. Study of Pauli spins, electric circuits can be done through Matrices unit. And in Tensors unit students can understand and solve physical properties problem like Elasticity and Rigid bodies. After completing the course, student is expected to solve the Problems of Physical system and get insight of the solution.

### PHHCT 120: Quantum Mechanics:

**Course objectives:** To understand the modern day Physics, present technology in the field of Particle Physics to Nano-materials students require adequate knowledge in Quantum Mechanics. The basics of the subject are designed here to grow the concept amongst the students.

#### **Course outcome:**

This course provides understanding and knowledge to realize the basics of molecular, atomic and sub-atomic physics.

Concept of wave function and wave packet is introduced. Students get their critical thinking ability developed by studying uncertainty principle. Study of probability, expectation value and Ehrenfest's theorem assist students to be enriched with mathematical calculation The concept of Schrodinger equation creates analytical power of students. The knowledge of quantization is clarified by studying energy levels. The study of different potentials nourish them to think about system and its function with the help of mathematical tools. Students get skilled by studying the formalism of quantum mechanics in describing the systems mathematically and this knowledge becomes very useful for their study of particle physics, spectroscopy and research.

## **PHHCT130: Atomic, Molecular and Optical Physics**

**Course Objective:** This course is needed to have clear concept of Atomic, Molecular Physics and Modern Optics and their applications and current technologies amongst students.

### **Course Outcome:**

Study of basic atomic models helps to understand the process of developments in this field, thus the logical understanding and comprehensive skills are developed. In first unit concepts of atomic spectra are cleared and study of Hydrogen atom with fine structure correction makes the knowledge strong. In unit 2 The concept of fine structure and the hyperfine structure provides the understanding of spectral lines in details also study of Zeeman effect, Paschen Back effect grows the nature of cultivating mathematical and analytical stuff in students, study of LS and JJ coupling studies helps to develop the analytical skills and thinking ability. In third unit the problem solving skill is developed by the mathematical concept of rotational spectra. In unit 4 skill of empirical model developing is created by studying the Born- Oppenheimer approximation and critical thinking ability is developed by studying the Franck Condon Principle. In unit 5 the Basics of Laser, 3D mapping of images, Holography, Fibre optics assists students to know and learn present day applications and use them in current technologies.

## **PHHCT140: Electronics**

**Course Objective:** This course is designed to make students well-equipped with present day knowledge in electronics.

### **Course Outcome:**

This helps students to gain knowledge of some basic electronic components and circuits, and to learn the semiconductor devices, PN junction diodes characteristics and their applications in different areas. In unit 2 students will study the basics of transistor and its working and implementations also identifies and review the various configuration like CC,CB,CE and different biasing techniques to operate transistor, FET,MOSFET etc. In unit 3 the students will learn the concept of operational amplifiers where students can examine the CMRR like common mode gain and difference mode gain, and design of phase and frequency response of low pass and band pass filters also outline the various operations of amplifiers, inverting and non inverting configuration. In unit four students understand the basic of logic gates and its applications also they learns to evaluate and plot karnaugh maps. In unit five students will be familiar with the binary digits, different flipflops, counters, digital to analogue vice versa converters topics also gains skill to handle them and their applications in current technologies through this course.

## **PHHCP150: Atomic, Molecular and Optical Physics Lab**

**Course objective:** students should carry enough knowledge and expertise in the general experiments so that they can be fit for teaching job as well as to design the experiments in research purpose.

### **Course outcome:**

In this course the experiments are designed to give glimpse of heat, magnetism, electricity and optics experiments. Measurement of refractive index of a liquid by shift assists the students to understand uses of laser, refractive index and grating. Designing Experiments to study atomic spectra of different sources like mercury, sodium and hydrogen atom source by using spectrometer gives the atomic spectral lines and students can have the knowledge about atomic structure and properties by analysing the spectra. Using laser light as a source Diffraction and interference properties of light can be studied and by conducting experiment where laser light passing through different medium Properties shape, size of the molecule and atomic structure can be studied. Ultrasonic velocity of different liquids gives brief idea about translational and vibrational waves produced by applying frequency gives vast idea about waves and frequency and applications of it in students and these experiments also develops the techniques and skills in conducting Experiments.

## **PHHCP160: Electronics Lab**

**Course objective:** Students should have expertise in the basic experiments of electronics in the present day demand and hence this course is designed.

### **Course outcome:**

The basic filters will help the student to identify how the frequency depend on resistance and how the signals behave with the frequencies. They can explore how to filter these signals with resistors and capacitors. The students can analyse and compare the effect of frequency to the output voltage. They are exposed to the usage of semi-log graph and how to plot with respect to the given values. The experiments related to operational amplifier makes the students to analyse and working of IC 741 and its characteristics and finding the solution for linear and nonlinear applications using OP-Amp. The study of basic logic gates will help the student to have thorough understanding of the fundamental concept and the various techniques in digital electronics. To understand the Boolean algebra and the basic properties of Boolean algebra and will be able to simplify the simple Boolean expression using the properties. They should be able to relate Boolean Expression to the truth table and logic diagrams. They will be able to compute arithmetic operation like addition and subtraction using gates.

## M.Sc- Second semester

### PH HCT 210 : Mathematical physics II

**Course Objectives:** To make students expert in the subjects like Complex analysis ,Vector analysis Group Theory and Numerical Techniques and C Programming this course in designed.

#### **Course Outcome:**

Mathematical Methods of Physics-II deals with Complex analysis ,Vector analysis Group Theory and Numerical Techniques and C Programming this course in designed. Students learn about Properties of analytic functions, Cauchy's integral theorem, singularities, Cauchy's residue theorem, evaluation of definite integrals. The prescribed course runs through various topics which include Vector integration, Gauss and Stoke's theorem, etc. some physical applications of this Studying Group theory, the concept of arrangement and representation of real physical properties by mathematics is developed. Learning Numerical techniques and C programming analytical power is grown within the students. As well as the students get practiced to find accurate and precise values.

### PHHCT 220: Quantum Mechanics II:

**Course objectives:** To learn how to apply Perturbation Theory (Time Independent) in non-degenerate and degenerate situations. To learn the basics of relativistic quantum Mechanics.

#### **Course outcome:**

Students Will be able to solve and analyses various quantum mechanical problem related to Time Independent Perturbation Theory. Will be able to treat molecules quantum mechanically. Will be able to apply semi-classical method to treat atom field interactions. Will be able to treat Two-Level System Quantum Mechanically. Will be able to understand the central concept and principles of relativistic Quantum Mechanics. To apply approximate method in Quantum Mechanics to treat molecules. To learn how to apply semi-classical method to treat the interaction of atoms with field. To learn how to treat Two-level systems Quantum Mechanically.

## **PH SCT 230: Elements Of Solid State Physics**

**Course Objective:** This course introduces students to the physical properties of crystalline solids and to explore the electronic properties of various solids around us.

### **Course Outcome:**

The first module of the course gives the fundamental understanding of crystalline solids to students by introducing them to the basics of geometrical crystallography like crystal systems, their classifications, symmetries, concepts of reciprocal lattices and also the physical principle behind X-ray diffraction studies which is a great tool to determine the crystal structures. The second module discusses the Types of binding. Van der Waals-London interaction, repulsive interaction. Modelung constant. Born's theory for lattice energy in ionic crystals and comparison with experimental results. Ideas of metallic binding, Hydrogen bonded crystals.

Vibrations of monoatomic and diatomic lattices. Optical and acoustical branches, Quantization of lattice vibration-Concept of phonon, phonon momentum. Specific heat of lattice.. Research in solid state physics has given rise to enormous technological applications which we witness in our daily life. The fundamental knowledge of solid state physics is very much essential and plays a major role in other research areas like material science, nanomaterial science, functional materials. This course helps the students to gain essential knowledge required to enhance their basic understanding in these research areas. By the end of this course, students will be able to analyses different types of matter depending on nature of chemical bonds and their electronic properties. They will be able to analyses the crystal structures by applying crystallographic parameters and also to determine the crystal structure by analysis of XRD data.

## **PH SCT 240:Elements of Nuclear physics**

**Course Objective:** Basic nuclear structure and its representation is understood by studying this course. Students get comprehensive knowledge regarding interaction of charged particles and their behavior in detail.

### **Course Outcome:**

Interaction gamma rays with particles introduces the clarity to the concepts of Compton scattering, pair production and the photo electric effect. Study of nuclear forces and characteristics assists to develop inclusive knowledge of the students in the nuclear structure.

The concept of technical thinking using physical phenomena is cultivated by studying the topics on nuclear detector and the nuclear electronics. Study of liquid drop model provides skill of preparing empirical models. Analytical understanding is developed by studying the shell model.

Concept of experimental results and its representation in theory is developed by studying Fermi theory of beta decay, curie plot. Students get equipped with understanding of experimental plots.

A comprehensive knowledge is gathered after going through the basic particle physics. Particles and their properties are well understood by this topic. Students get skilled by understanding of different symmetry.

## **PH HCP 260:Optics lab**

**Course Objective:** Optics lab deals with experiments from optics and they are aimed to grow the knowledge of students in that area.

### **Course Outcome:**

Students learn about Constant Deviation Spectrometer (CDS), one of the modern spectroscopy tools when they experiments with CDS. Using optical method, the size determination of lycopodium powder teaches the students of application of diffraction as well as the limitation of measuring the length by the direct method. Minute analytical observation power is developed by studying the rotatory dispersion. Performing the experiments with Michelson interferometer students get clarity of happening of interference. This develops their concept on the measurement of wavelength of the used light, measurement of temporal and spatial coherence. Study of interference and diffraction with laser light develops the concept of the mentioned optical phenomena as well as the use of laser. Studying Hartman's constant determination, one gets practised with lamp-scale arrangement and analytical observation of the Hartman's constants. Concept of polarization of light is developed by doing study of elliptically polarized light.

## **PH HCP 270 : General and computational lab II**

**Course objective: Course Objective:** For modern day technology students need to learn the programming and C++ is a very useful one for Physics students.

### **Course Outcome:**

In this laboratory course students get the lessons in computer programming using C++. Studying Bisection method, Newton-Raphson method students learn to find the roots of a quadratic equation. Students learn to solve differential equations by learning Euler method. By studying the Simpson's 1/3rd rule, Simpson's 3/8th rule students learn to do integrations numerically.

## M.Sc- Third semester

### PHHCT310: Classical Mechanics

**Course objectives:** This subject Provides an in depth knowledgr of mechanical systems and an analysis of the constraints present within them.

#### **Course outcome:**

Students will be able to Understand the law's of Motions, and Develops the Understanding of Kinetic energy and Potential Energies of systems and able to solve the problems of motion of Particle in a central force field. In second unit The Behavior of micro and macro molecules under the effect of central forces will be analysed by studying rigid body mechanics. In unit 3 student develop the knowledge of Lagrangian of systems, which will be set up in order to arrive and Organize the importance of equations of motion. In unit 4 students understands the variational Principle, Hamilton equation of motion of a different system and Poisson brackets. In unit 5 Motion in non – inertial frame of references will also be studied in order to understand the effect of forces acting on rotating particles, also it gives the idea of ekastic and inelastic scattering of small particles also students will understand the concept of small oscillations of particles. This course Develops the quantitative and Qualitative knowledge for understanding moving coordinate systems and motion of a rigid body system.

### PHHCT320: Electrodynamics and Plasma Physics

**Course Objective:** A clear concept regarding electrostatics, magnetostatics and electrodynamics is in need to shape the understanding of the students.

#### **Course Outcome:**

As the paper deals with mathematical detail, the ability of approaching and solving the problems is also nurtured. As this paper is full of vector, tensor and differential equations, the understanding of mathematical methods can be completed with applications of those topics in electrodynamics. The concept of dielectric and the field in material medium are also grown within the students in this course. Analytical skill and the realization of the regular electromagnetic phenomena are developed studying the electromagnetic waves. Understanding of Maxwell's equations help students for a complete grip over the subject. The perception regarding dipole is shaped in this course and that assists the students to understand Nuclear Physics with clarity. The idea of retarded potential and the point charge makes the thinking ability of the students stronger.



### **PHSCT330: Solid State physics I**

**Course Objective:** This course introduces students to the physical properties of crystalline solids and to explore the electronic properties of various solids around us.

#### **Course Outcome:**

The first module of the course gives the fundamental understanding of crystalline solids to students by introducing them to the basics of geometrical crystallography like crystal systems, their classifications, symmetries, concepts of reciprocal lattices and also the physical principle behind X-ray diffraction studies which is a great tool to determine the crystal structures. This course helps the students to gain essential knowledge required to enhance their basic understanding in these research areas. Studying Crystal Physics students get in-depth concept about crystal and lattice. Studying energy bands in solids, Kronnig Penny model, Brillouin Zone etc. students get thorough knowledge of energy bands. Informative and analytic concept about ferroelectric is clarified with general properties and classification of ferroelectrics. Students get technical and chemical concept after studying about films and surfaces. By the end of this course, students will be able to analyse different types of matter depending on nature of chemical bonds and their electronic properties.

### **PHSCT340: Solid State physics II**

**Course Objective:** This course introduces students to the physical properties of Metallic solids and to explore the electronic properties of various solids around us.

#### **Course Outcome:**

The second module discusses the free electron theory of metals, where this theory successfully accounts for a wide range of metallic properties like thermal conductivity, specific heat capacities, electrical conductivity of metals and their temperature dependence etc. Followed by this module, the course introduces the other classes of solids like semiconductors and superconductors where it discusses their electronic properties and explains their origin. Final module of the course describes the dielectric properties of insulators, internal fields in dielectrics and also various types of magnetic phenomena like diamagnetism, para-magnetism, ferromagnetism, anti-ferromagnetism and ferrimagnetism exhibited by different solids. It also introduces the students to the theories which explain the origin of these magnetic properties in solids. This course aims to establish the fundamental concepts of condensed matter physics to students and also provides the knowledge to apply other concepts of physics which have been previously learned by the students particularly in quantum mechanics, classical mechanics, electromagnetism and statistical mechanics.

### **PHHCP350: Solid state physics lab I**

**Course Objective:** This laboratory course focuses on the advanced physics experiments chosen from Solid state Physics and Condensed matter physics giving brief idea about solid material properties through Experimentation.

#### **Course Outcome:**

This course provides practical knowledge to students as they perform experiments and correlate it to theory. In Magnetic susceptibility by Quincke's method student learns to calibrate electromagnet and determine the magnetic susceptibility of magnetic salts ( $MnSO_4$ ,  $MnCl_2$ ) using Quincke's method. Electrical resistivity of semiconducting Ge sample using four probe method gives idea of Using four probes set up students learn the variation of resistivity of the Ge sample with temperature and determine the energy gap of the Ge crystal. At the end of the course, students learn to apply the various procedures and techniques for the experiments. They will be able to perform experiments with different measuring devices and meters, software and record the data with precision. By applying the mathematical concepts/equations one can arrive at quantitative results. They also develop basic communication skills through working in groups in performing the laboratory experiments. Students can learn and understand related physics concepts by performing experiments, applying analytical techniques and interpreting the results with the help of graph.

### **PHHCP360: Solid state physics lab II**

**Course Objective:** This course deals with the study crystal Physics, Energy bands in solid, Ferroelectrics, Films and surfaces through Instrumentation and analyzing the Results.

#### **Course Outcome:**

Determination of Curie temperature for a ferroelectric material, By performing experiment using four probe method, students study the temperature variation of dielectric constant of a ferroelectric material and determine its Curie point. Hall effect Experiment helps students to Understand the theoretical approach and Experimental approach and helps in measuring the conductivity of the Probe material. Studying the elastic material properties through Experiments called study of Creep where student will be able to observe the creep behavior of the solid material with respect to time this experiment helps students to analyse creep behavior for different solid materials and application to research level. Magnetic Susceptibility by Gouy's method helps students to Understand the phenomena of dipole orientation in solid material when magnetic field is applied and the theory of this can be easily understood by students through this experimental Demonstration.

## M.sc- Fourth Semester

### PHHCT 410: Statistical Mechanics

**Course Objective:** This Course is needed to have in-depth knowledge in thermodynamics and quantum statistics etc.

#### **Course Outcome:**

In this course the statistical description, quantum statistics of ideal gases, irreversible processes and fluctuations are dealt with. Studying the statistical description students get in-depth knowledge and concept about thermodynamics and its applications. Applications of statistical mechanics clarify the understanding of the students regarding number of breakthroughs in modern physics; e.g. Einstein's theory, partition function, theory of equi-partition, specific heat of solids, entropy, Gibb's paradox etc. Identical particles and their statistics are the key of the description of the quantum mechanical particles. Studying the Maxwell-Boltzmann statistics, Fermi-Dirac statistics and Bose-Einstein statistics the analytical and mathematical concept of the students regarding the statistical Behaviour of the tiny bodies are developed thoroughly. Finally the introduction of the irreversible processes and fluctuations help students to be ready for present day statistical physics.

### PHHCT420:Analytic Techniques and Instrumentations:

**Course Objective:** Students should have the knowledge of this course as basic techniques and different instruments are discussed here in-depth.

#### **Course Outcome:**

It deals with different experimental techniques in Physics. Studying different temperature and electrical measurements the concept of measurements for regular equipment is grown within the students. Studying the vacuum techniques and the vacuum systems students get their knowledge in that type of systems. This course provides practical knowledge to students as they perform experiments and correlate it to theory. Raman spectrum of a molecule experiment aims at determining the rotational constant and the bond length of nitrogen molecule by analyzing rotational Raman spectrum. ESR spectrometer. Students will use the lab apparatus and measure the Lande-g factor of electron for standard ESR sample (DPPH) using portable ESR spectrometer. Analysis of X-ray powder Diffraction ( NaCl , KCl).This experiment demonstrates the concept of x-ray diffraction by crystals. At the end of the course, students learn to apply the various procedures and techniques for the experiments. Students can learn and understand related physics concepts by performing experiments, applying analytical techniques and interpreting the results with the help of graph and by estimating the errors due to discrepancies in the experimental data and theoretical predictions. It enables them to explain the basic physical principle behind the experiment.

### **PHHCT430: Solid State Physics III**

#### **Course objective:**

This course introduces students to the physical properties of Different solids and to explore the electronic, Optical, Elastic properties of various solids around us.

#### **Course Outcome:**

In this Course students will able to study the Different Properties of various solids around us and their respective applications in different areas. In this Course Unit one Magnetic resonance of a solid materials is studied where spin resonance, paramagnetic resonance, spin resonance Relaxation time concepts are deeply understood by students. In second unit students will be able to understand optical properties of solid materials like absorption of amorphous, luminescence, photoconductivity which gives broad knowledge about optical properties of solid materials and their applications in current research and technologies. In third unit Elastic Properties of various solid materials has been understand and these theoretical knowledge of the solid materials helps students in learning concepts and also exposure to the recent researches going on based on this properties and gives them opportunity to find application of solid materials out of it. In this course unit ferrites is the topic where students not only studies about the theoretical concepts it gives them wide vision of industrial use of ferrites and its applications and also the recent researches going on this builds interest in students towards industrial research.

### **PHHCT440: Solid State Physics III**

**Course objective:** This course introduces students to the Different solid Materials and to explore the wide range of applications in different areas.

#### **Course Outcome:**

Research in solid state physics has given rise to enormous technological applications which we witness in our daily life. The fundamental knowledge of solid state physics is very much essential and plays a major role in other research areas like material science, nanomaterial science, functional materials, quantum computing, bio physics, low dimensional semiconductors, etc. This course helps the students to gain essential knowledge required to enhance their basic understanding in these research areas. In first unit of this course student swill be able to learn about the applications solid materials and their properties and usage of such solids in electronic devices. In this course students will understand the conversion of solar energy through photovoltaic converters also they gain knowledge about the characterestics of it and their applications. The course discusses types of nano systems such as quantum wire, quantum well etc and its key differences with respect to its counter part of the bulk system. Different methods for synthesis of nano materials which include Top down and Bottom up approaches are discussed at length.

## **Project Work:**

**Course Objective:** This course provides the primary window of research to each and every student. Students get acquainted with basics of research. Ethics and methodology of research are also taught to students.

### **Course Outcome:**

In a particular subject-area students become very expert during exploring their project related to basic research. The analytical, mathematical and experimental concept of the students in the corresponding topic gets very strong and leads them to choose research or higher education as their career.