St. Albert's College (Autonomous)

An initiative of Archdiocese of Verapoly

Affiliated to Mahatma Gandhi University, Kottayam

(Accredited with "A" Grade by NAAC)

Programme Outcomes
Programme Specific Outcomes
Course Outcomes

Department of Physics

Undergraduate Programme in Physics

2015-16 Onwards

Programme Objectives

Within a few years of earning an undergraduate degree in science, graduates are expected to achieve one or more of the following program educational objectives:

Deep Knowledge in the Discipline: To develop thorough knowledge about the subject and its allied realms by a conscious and continuous process of learning and get informed about the cutting-edge research in the frontier areas of the subject.

Critical Thinking and Problem-Solving Skills: To develop an informed and analytical approach to learning and demonstrate an in-depth knowledge of the subject and to give his/her opinion supported by logical reasoning and problem-solving skills.

Self-Awareness and Emotional Intelligence: To develop a proper idea about one's own capabilities and potentials and to nurture those attributes towards holistic personality development.

Teamwork and Effective Communication: To demonstrate proficiency in communicating competently in groups and organizations, competence in interpersonal communication and to possess skills to effectively deliver formal and informal presentations to a variety of audiences in multiple contexts.

Leadership Qualities: To build essential features of a true leader and to cultivate the character and courage to shoulder responsibilities.

Social Interaction and Ethical Standards: To foster the social skills and developing peer interaction and enabling them to make all people feel valued and to respect their differences by being responsible citizens for creating a socially inclusive society. To recognize values such as justice, trust, equity, fairness, kindness and develop a commitment to meeting and upholding standards of ethical behavior in all walks of life and comprehending the moral dimensions of decisions and actions.

Environmental Consciousness: To discern the issues of environmental contexts and engages in promoting values and attitudes that claim coexistence and sustainable living with reduced, minimal, or no harm upon ecosystems.

Lifelong Learning: To develop a passion to be an independent lifelong learner by imbibing real-time changes in the socio-technological context, promoting continuous development and improvement of the knowledge and skills needed for employment and personal fulfillment.

Programme Specific Objectives

The syllabi are framed in such a way that it bridges the gap between the plus two and post graduate levels of Physics by providing a completer and more logical framework in almost all areas of basic Physics.

By the end of the first year (2nd semester), the students should have attained a common level in basic mechanics, properties of matter, a secure foundation in mathematics and other relevant subjects to complement the core for their future courses and developed their experimental and data analysis skills through a wide range of experiments through practical at laboratories. By the end of the fourth semester, the students should have been introduced to powerful tools for tackling a wide range of topics in Thermodynamics, Statistical Mechanics Electricity, Electrodynamics and Electronics. They should have been familiar with additional relevant mathematical techniques and other relevant subjects to complement the core and developed their experimental skills through a series of experiments which also illustrate major themes of the lecture courses. By the end of the sixth semester, the students should have covered a range of topics in almost all areas of physics including quantum physics, solid state physics, computational physics, electronics etc. and had experience of independent work such as projects; seminars etc. They should have been developed their understanding of core Physics.

Course Outcomes

Core Courses

PHY1CRT01: METHODOLOGY IN PHYSICS

Module I: 12 Hrs.

1. Express the historical perspective of physics, and its methodology.

Module II: 12 Hrs.

1. Recognize different physical units and measuring instruments, and their significance in Physics.
2. Realize the role of vectors and coordinate systems in Physics

Module III: 10 Hrs.

1. Understand the Importance of measurements and error analysis which is central to Physics.

PHY2CRT01: MECHANICS AND PROPERTIES OF MATTER

Module I: 12 Hrs.

1. Define Acceleration due to gravity and summarize the methods for its measurement.
2. Explain the conservation of energy, momentum, angular momentum and ap- ply them to basic problems.
3. Write the expression for the moment of inertia about the given axis of symmetry for different uniform mass distributions.

Module II: 9 Hrs.

1. Express wave motion mathematically and define different terms related to wave motion.
2. Explain the phenomena of simple harmonic motion and the properties of systems executing such motions.

Module III: 16 Hrs.

1. Infer the principles of elasticity through the study of Young Modulus and modulus of rigidity.
2. Understand basic principles of surface tension and its application in real life situations.
3. Learn simple principles of fluid flow and the equations governing fluid dynamics.

PHY3CRT01: ELECTRONICS

Module I: 15 Hrs.

1. Recall N- and P- type semiconductors, Illustrate the fabrication of P-N junctions; Compare forward and reverse biased junctions.
2. Build different types of rectifiers and voltage regulators using P-N junction diodes.

3. Construct wave shaping circuits and measure its parameters.

Module II: 18 Hrs.

1. Classify NPN and PNP transistors and basic configurations namely common base, common emitter and common collector; Define current and voltage gain.
2. Illustrate the biasing of amplifiers and oscillators.
3. Describe Field effect transistors and MOSFET

Module III: 21 Hrs.

1. Illustrate the feedback in amplifiers.
2. Recognize Operational amplifiers and knowledge about different configurations namely inverting and non-inverting; applications of operational amplifiers.
3. Outline basic ideas of Amplitude, Frequency, Pulse, and Phase modulation.

PHY4CRT01: ELECTRICITY AND ELECTRODYNAMICS

Module I: 19 Hrs.

1. Explain the growth and decay of current in an inductive circuit.
2. Illustrate the working of a Ballistic Galvanometer
3. Apply Kirchhoff's rules to analyze AC circuits consisting of parallel and/or series combinations of voltage sources and resistors and to describe the graphical relationship of resistance, capacitor and inductor.
4. Apply various network theorems such as Superposition, Thevenin, Norton, Reciprocity, Maximum Power Transfer, etc. and their applications in electronics, electrical circuit analysis.

Module II: 25 Hrs.

1. Explain Gauss law and Apply Gauss's law of electrostatics to solve a variety of problems
2. Derive Maxwell's equation and apply boundary conditions for free space.

Module III: 10 Hrs.

1. Apply Maxwell's equations to deduce wave equation and electromagnetic field energy.

PHY5CRT01: CLASSICAL AND QUANTUM MECHANICS

Module I: 18 Hrs.

1. Distinguish various types of constraints in a mechanical problem.
2. Understand Lagrangian and Hamiltonian methods and apply them to solve simple practical problems.

Module II: 17 Hrs.

1. Know main aspects of the inadequacies of classical mechanics and under- stand historical development of quantum mechanics and ability to discuss and interpret experiments that reveal the dual nature of matter.
2. Understanding about general formalism of Quantum Mechanics such as linear vector space, operators etc.

Module III: 19 Hrs.

1. Understand the central concepts of quantum mechanics: wave functions, momentum and energy operator, the Schrodinger equation, time dependent and time independent cases, probability density and the normalization techniques, skill development on problem solving e.g. one dimensional rigid box, tunnelling through potential barrier, rectangular barrier.

PHY5CRT02: PHYSICAL OPTICS AND PHOTONICS

Module 1: 22 Hrs.

1. Explain several phenomena we can observe in everyday life that can be explained as wave phenomena.
2. Inspect interference in Thin films and its applications in daily life & Science.
3. Use the principles of wave motion and superposition to explain the Physics of diffraction.
4. Understand the working of selected optical instruments like diffraction grating.

Module II: 10 Hrs.

1. Use the principles of wave motion and superposition to explain the Physics of polarisation.
2. Illustrate the production of polarized light.

Module III: 22 Hrs.

1. Understand the spontaneous and stimulated emission of radiation, optical pumping and population inversion. Three level and four level lasers. Ruby laser and He-Ne laser in details.
2. Describe structure and principle of optic fibres.

PHY5CRT03: THERMAL AND STATISTICAL PHYSICS

Module I: 18 Hrs.

1. Learn the basic concepts of thermodynamics, the first and the second law of thermodynamics, the concept of entropy and the associated theorems, the thermodynamic potentials and their physical interpretations. They are also expected to learn Maxwell's thermodynamic relations.
2. Understand systems such as gases, heat engines and refrigerators etc.

Module II: 18 Hrs.

1. Define Entropy and explain its relation with other thermodynamic quantities. Able to arrive at Maxwell's thermodynamic relations.
2. Understand different methods of Heat transfer and explain different laws associated with thermal radiation.

Module III: 18 Hrs.

Use the statistical physics methods, such as Boltzmann distribution and Gibbs distribution.

1. Apply Fermi-Dirac and Bose-Einstein distributions to solve problems in some physical systems.
2. Apply the concepts and laws of thermodynamics to solve basic problems in thermodynamics.

PHY5CRT04: DIGITAL ELECTRONICS

Module I: 8 Hrs.

1. Describe analog systems and digital systems and their differences, fundamental logic gates, combinational as well as sequential and number systems.

Module II: 20 Hrs.

1. Synthesis of Boolean functions, simplification and construction of digital circuits by employing Boolean algebra.

Module III: 23 Hrs.

1. Construct sequential systems by choosing Flip Flop as a building block-construct multivibrator, counters to provide a basic idea about memory.

PHY5COT01: ENERGY AND ENVIRONMENTAL STUDIES

Module I: 30 Hrs.

1. Understand and be aware of the importance of sustainable energy demonstrate an overview of the main sources of renewable energy.
2. Explain the advantages of solar energy over other energy sources and different methods for harvesting solar energy.

Module II: 20 Hrs.

1. Understand the causes of environmental problems and identify the ways of addressing them.

Module III: 12 Hrs.

1. Define Environment Impact Analysis (EIA) and explain various methods of EIA process.
2. Describe environmental laws and constitutional provisions to control pollutions in India.
3. Explain different waste management methods.

PHY6CRT01: COMPUTATIONAL PHYSICS

Module I: 20 Hrs.

1. Describe the general architecture of a microcomputer system and architecture & organization of 8085 Microprocessor and understand the difference between 8085 and advanced microprocessor.
2. Understand and classify the instruction set of 8085 microprocessor and distinguish the use of different instructions and apply it in assembly language programming.

Module II: 22 Hrs.

1. Identify the names and distinguishing features of different kinds of Input/Output and memory devices.
2. Describe the object-oriented programming approach in connection with C++
3. Apply the concepts of object-oriented programming

Module III: 12 Hrs.

1. Apply Numerical analysis which has enormous application in the field of science and some fields of Engineering.
2. Use numerical integration and differentiation to solve problems related to Physics.

PHY6CRT02: NUCLEAR AND PARTICLE PHYSICS

Module I: 15 Hrs.

1. Understand the properties of nuclei like density, size, binding energy, nuclear forces and structure of atomic nucleus, liquid drop model and nuclear shell model and mass formula.
2. Learn about the detectors of nuclear radiations- the Geiger-Mueller counter, the scintillation counter, the photo-multiplier tube, the solid state and semi- conductor detectors.

Module II: 18 Hrs.

1. Learn about the process of radioactivity, the radioactive decay law, the emission of alpha, beta and gamma rays, the properties of the constituents of these rays and the mechanisms of the emissions of these rays, outlines of tunnel theory of alpha decay and nuclear reactors.

Module III: 21 Hrs.

1. Understand fission and fusion well as nuclear processes to produce nuclear energy in nuclear reactor and stellar energy in stars.
2. Gain knowledge on the basic aspects of particle Physics-the fundamental interactions, elementary and composite particles, the classifications of particles: leptons, hadrons (baryons and mesons), quarks, gauge bosons. The students should know about the quantum numbers of particles.
3. Understand the Physics of stars and sun.
4. Introductory knowledge about cosmic rays and related effects.

PHY6CRT03: CONDENSED MATTER PHYSICS

Module I: 27 Hrs.

1. A brief idea about crystalline and amorphous substances, about lattice, unit cell, miller indices, reciprocal lattice, the concept of Brillouin zones and diffraction of X-rays by crystalline materials.
2. Secured an understanding about the bonding in solids.

3. Describe the free electron theory and band theory of solids and must be able to differentiate insulators, conductors and semiconductors.
4. Distinguish intrinsic and extrinsic semiconductors and their Fermi levels.

Module II: 10 Hrs.

1. Secured an understanding about the dielectric properties of materials.
2. Review different types of magnetism from diamagnetism to ferromagnetism.
3. Outline the theories of different types of magnetism.

Module III: 17 Hrs.

1. Understand the basic idea about superconductors and their classifications.
2. Review the basic theory of superconductors; Distinguish Type I and II super-conductors, their properties and physical concept of BCS theory.
3. Describe liquid crystals, Polymers, and nanomaterials.

PHY6CRT04: RELATIVITY AND SPECTROSCOPY

Module I: 18 Hrs.

1. Understand Special Theory of Relativity.
2. Analyze Lorentz transformation equations.
3. Apply relativistic variations in mass, length and time.

Module II: 18 Hrs.

1. Describe various atom models.
2. Explain the spectra of one electron system on the basis of the vector atom model.
3. Explain electron spin and nuclear magnetic resonance spectroscopy.

Module III: 18 Hrs.

1. Explain rotational, vibrational, electronic and Raman spectra of molecules.

PHY6CBT01: RENEWABLE ENERGY TECHNOLOGY

Module I: 26 Hrs.

1. Explain various energy sources and their availability.
2. Outline the technologies that are used to harvest the solar energy.

Module II: 39 Hrs.

1. Understand different types of wind energy systems.

2. Explain the resources, advantages and disadvantages and applications Geothermal energy.
3. Discuss the methods for obtaining energy from biomass.

Module III: 25 Hrs.

1. Discuss the methods for obtaining energy from tides and ocean waves.
2. Describe energy production from Hydrogen.

Course Outcome

Practical Courses

PHY1CRP01, PHY2CRP01, PHY3CRP01, PHY4CRP01, PHYSCRP01, PHYSCRP02, PHYSCRP03, PHYSCRP04, PHY6CRP01, PHY6CRP02, PHY6CRP03, PHY6CRP04

There is one lab course in each semester up to the fourth semester and four lab courses each in fifth and sixth semesters. In this course, students will be able to apply the theory that they have learned in the theory class to gain hands-on experience. The student shall perform experiments related to mechanics (cantilever. Compound pendulum),Fluid dynamics, electricity, magnetism, etc. By the end of these twelve courses, students should be able to

- Decide which data to collect.
- Decide how to measure data.
- Make predictions about expected measurements, data, and results.
- Evaluate the process and outcomes of an experiment quantitatively and qualitatively.
- Communicate the process and outcomes of an experiment.
- Conduct an experiment collaboratively and ethically.

Course Outcome

Project

PHY6CPR01 – PROJECT

At the end of the project the students are expected to have:

1. The capability to complete projects within the stipulated period and cost.
2. The capability to manage and use scientific knowledge to carry out projects.
3. The capability to think objectively, analytically, and critically in identifying and solving problems in a systematic manner.

4. The capability to deliver or present the project findings in oral and written form.

Course Outcome

Project

COMPLEMENTARY PHYSICS FOR MATHEMATICS

PHY1CMT01: PROPERTIES OF MATTER, MECHANICS AND FOURIER ANALYSIS

Module I 12 Hrs.

1. Understand the principles of elasticity through the study of Young Modulus and modulus of rigidity.

Module II 10 Hrs.

1. Explain the conservation of energy, momentum, angular momentum and apply them to basic problems.
2. Write the expression for the moment of inertia about the given axis of symmetry for different uniform mass distributions.

Module III 14 Hrs.

1. Explain the phenomena of simple harmonic motion and the properties of systems executing such motions.
2. Describe the Fourier analysis of simple wave forms.

PHY2CMT01: ELECTRIC AND MAGNETIC PHENOMENA, THERMODYNAMICS AND SPECIAL THEORY OF RELATIVITY

Module I 14 Hrs.

1. Secured an understanding about the dielectric and ferroelectric properties of materials.
2. Describe different types of magnetism from diamagnetism to ferro magnetism.

Module II 12 Hrs.

1. Comprehend the basic concepts of thermodynamics, the first and the second law of thermodynamics, the concept of entropy and the associated theorems the thermodynamic potentials and their physical interpretations. Learn about Maxwell's thermodynamic relations.

Module III 10 Hrs.

1. Learn the special theory of relativity- postulates of the special theory of relativity, Lorentz transformations, space-time invariant length, length contraction, time dilation and mass-energy relation.

PHY3CMT01: Quantum Mechanics, Spectroscopy, Nuclear Physics, Basic Electronics and Digital Electronics

Module I 24 Hrs.

1. After an exposition of inadequacies of classical mechanics in explaining microscopic phenomena, quantum theory formulation is introduced through Schrodinger equation.
2. Describe various atom models.
3. Explain the spectra of one electron system on the basis of the vector atom model.

Module II 10 Hrs.

1. Explain the properties of nuclear charge, mass, binding energy, nuclear forces and structure of atomic nucleus, liquid drop model and nuclear shell model and mass formula.
2. Learn about the process of radioactivity, the radioactive decay law, the emission of alpha, beta and gamma rays, the properties of the constituents of these rays, the mechanisms of the emissions of these rays and applications.

Module III 20 Hrs.

1. Understand the characteristics of P-N junction diodes, Transistors and their applications.
2. Differentiate between number systems, their interconversions, basic logic gates, Boolean algebra, and combinational circuits to construct half adders and full adders.

PHY4CMT01: Physical Optics, Laser Physics and Astrophysics

Module I 20 Hrs.

1. Use the principles of wave motion and superposition to explain the Physics of interference and diffraction.

Module II 15 Hrs.

1. Use the principles of wave motion and superposition to explain the Physics of polarisation, interference and diffraction.

Module III 10 Hrs.

1. Understand the spontaneous and stimulated emission of radiation, optical pumping and population inversion. Three level and four level lasers. Ruby laser and He-Ne laser in detail.
2. Ability to comprehend astronomical scales and understand basic concepts of positional astronomy like astronomical coordinate system and measurement of distances, time and temperature and radius of star.
3. Understand basic parameters of stars like brightness, radiant flux, luminosity, magnitude, orbits, spectral classification and H-R diagram.

COMPLEMENTARY PHYSICS FOR CHEMISTRY

PHY1 CMT02: Properties of Matter, Mechanics and Particle Physics

Module I 12 Hrs.

1. Understand the principles of elasticity through the study of Young Modulus and modulus of rigidity.

Module II 10 Hrs.

1. Explain the conservation of energy, momentum, angular momentum and apply them to basic problems.
2. Write the expression for the moment of inertia about the given axis of symmetry for different uniform mass distributions.

Module III 14 Hrs.

1. Explain the phenomena of simple harmonic motion and the properties of systems executing such motions.
2. Describe the basic idea of classification of elementary particles.

PHY2CMT01: Electric and Magnetic phenomena, Thermodynamics and Elementary Solid-State Physics

Module I 14 Hrs.

1. Secured an understanding about the dielectric and ferroelectric properties of materials.
2. Describe different types of magnetism from diamagnetism to ferro magnetism.

Module II 12 Hrs.

1. A brief idea about crystalline and amorphous substances, about lattice, unit cell, miller indices, reciprocal lattice, concept of Brillouin zones and diffraction of X-rays by crystalline materials.
2. Learn about Maxwell's thermodynamic relations.

Module III 10 Hrs.

1. Learn the special theory of relativity- postulates of the special theory of relativity, Lorentz transformations, space-time invariant length, length contraction, time dilation and mass-energy relation.

PHY3CMT01: Quantum Mechanics, Spectroscopy, Nuclear Physics, and Electronics

Module I 24 Hrs.

1. After an exposition of inadequacies of classical mechanics in explaining microscopic phenomena, quantum theory formulation is introduced through Schrodinger equation.
2. Describe various atom models.
3. Explain the spectra of one electron system on the basis of the vector atom model.

Module II 10 Hrs.

1. Explain the properties of nuclear charge, mass, binding energy, nuclear forces and structure of atomic nucleus, liquid drop model and nuclear shell model and mass formula.
2. Learn about the process of radioactivity, the radioactive decay law, the emission of alpha, beta and gamma rays, the properties of the constituents of these rays, the mechanisms of the emissions of these rays and applications.

Module III 20 Hrs.

1. Understand the characteristics of P-N junction diodes, Transistors and their applications.
2. Differentiate between different configurations of transistor biasing.

PHY4CMT01: Physical Optics, Laser Physics and Superconductivity

Module I 20 Hrs.

1. Use the principles of wave motion and superposition to explain the Physics of interference and diffraction.

Module II 15 Hrs.

1. Use the principles of wave motion and superposition to explain the Physics of polarisation, interference and diffraction.

Module III 10 Hrs.

1. Understand the spontaneous and stimulated emission of radiation, optical pumping and population inversion. Three level and four level lasers. Ruby laser and He-Ne laser in detail.
2. Learn basic ideas of superconductivity.

COURSE OUTCOME - COMPLEMENTARY PRACTICAL COURSES

PHY1 CMP01, PHY2CMP01, PHY3CMP01, AND PHY4CMP01

There is one lab course in each semester up to the fourth semester. In this course, students will be able to apply the theory that they have learned in the theory class to gain hands-on experience. The student shall perform experiments related to mechanics (cantilever. Compound pendulum), Fluid dynamics, electricity, magnetism, etc. By the end of these four courses, students should be able to

1. Decide which data to collect.
2. Decide how to measure data.
3. Make predictions about expected measurements, data, and results.
4. Evaluate the process and outcomes of an experiment quantitatively and qualitatively.
5. Communicate the process and outcomes of an experiment.
6. Conduct an experiment collaboratively and ethically.