M.Sc. (Physics) Program

Program Outcomes, Program Specific Outcomes, Course Outcomes

Program Outcomes	**M.Sc. (Physics) Program**
PO1.	**Scientific knowledge:** Apply the knowledge of physics fundamentals with the help of mathematics to the solution of physical problems.
PO2.	**Problem analysis:** Identify, formulate, research literature, and analyze physical problems using basic principles of physics.
PO3.	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO4.	**Individual and team work:** function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO5.	**Communication:** Communicate effectively on complex activities with the scientific community and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO6.	**Modern tool usage:** Apply appropriate techniques, resources, and modern scientific & engineering techniques to complex physical activities with an understanding of the limitations.
PO7.	**Research Proficiency:** Apply various modern techniques for research specific activities/experiments and analysis purpose
PO8.	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
Program Specific Outcomes	**PSOs of M.Sc. (Physics) Program**
PO1.	Understand the advanced concepts Mathematical Physics, Classical Mechanics, Statistical Mechanics, Quantum Mechanics, Electronics Nuclear & Particle Physics, Atomic and Molecular Physics, Quantum Field Theory, Classical Electrodynamics, Condensed Matter Physics, General Theory of Relativity, Material Science, Renewable Energy Sources, Nano Physics
PO2.	Perform procedures/experiments as per laboratory standards
PO3.	Understand the complex applications of physics in real world problems

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Program Outcomes, Program Specific Outcomes, Course Outcome

Course Outcomes	COs of the course “**PHY-511- Mathematical Physics I**” Describe general understanding of various mathematical tools used for solving various Physical problems. CO1: Describe the vector algebra &vector calculus and solve related problems. CO2: Explain delta, beta and gamma functions and solve related problems. CO3: Describe Integral transforms and solve related problems. CO4: Describe Fourier series and its properties and solve related problems. CO5: Explain matrices and solve related problems. CO6: Describes tensors and solve related problems.
Credits	03 Theory periods of one hour per week over a semester

Course Outcomes	COs of the course “**PHY-512- Classical Mechanics**” Describe general understanding of Lagrangian and Hamiltonian Formulation, Canonical Transformations, Rigid Body Motion. CO1: Describe the Mechanics of a system of particles, constraints of motion, generalized coordinates. CO3: Describe Hamilton's principle, Legendre Transformation CO2: Explain D'Alemberts Principle, applications of Lagrangian formulation. CO4: Describe Canonical Transformation and Hamilton-Jacobi Theory CO5: Explain orthogonal transformations, Euler's theorem CO6: Describe inertia tensor, Small Oscillations
Credits	03 Theory periods of one hour per week over a semester

Course Outcomes	COs of the course **“PHY-513- Condensed Matter Physics – I”** Describe general understanding of lattice dynamics, thermal properties, energy band theory, transport theory and liquid crystals. CO1: Develop an understanding of elastic properties in solids. CO2: Explain thermal properties, lattice vibrations, normal modes. CO3: Enumerate and explain Electrons in a periodic potential, Bloch theorem, Semiconductor Crystals, superlattices. CO4: Define thetransport theory, Boltzmann transport equation, Hall effect, Magnetoresistance. CO5: Develop an understanding of liquid crystals and physics of liquid crystal devices.
Credits	03 Theory periods of one hour per week over a semester

M.Sc. (Physics) Program

Program Outcomes, Program Specific Outcomes, Course Outcome

Course Outcomes	COs of the course "**PHY-514- Quantum Mechanics**" Describe general understanding of Basic Quantum Mechanics and related physical problems. CO1: Develop an understanding of the mathematical tools and basic concepts of quantum mechanics. CO2: Develop an understanding of angular momentum and related problems. CO3: Understand stationary state approximation methods and their applications. CO4: Understand time dependent perturbation theory and its applications. CO5: Develop an understanding of various problems related to scattering theory
Credits	03 Theory periods of one hour per week over a semester

Course Outcomes	COs of the course "**ETE-515- Electronics-I**" Describe general understanding of Circuit Analysis, Semiconductor Devices and applications, Communication systems and related problems. CO1: Develop an understanding of circuit analysis such as Thevenin and Norton theorems, Mesh and Node analysis. CO2: Enumerate and explain the Direct and indirect semiconductors, diodes, Solar cell, UJT, Gunn diode, IMPATT devices, Liquid crystal displays, FET. CO3: Enumerate and explain the Differential amplifiers, Analogue computation, oscillator, filters CO4: Clearly define the communication systems in broad aspects such as review of analog modulation techniques, analog pulse modulation techniques, Pulse code modulation, satellite communication and cellular mobile communication.
Credits	03 Theory periods of one hour per week over a semester

M.Sc. (Physics) Program

Program Outcomes, Program Specific Outcomes, Course Outcome

Course Outcomes	COs of the course “**PHY-516- Physics Laboratory-I**” Describe general understanding physics practical and related problems. CO1: Understanding and determine the coefficient of self-inductance of a coil by Anderson bridge. CO2: Study of Cathode Ray Oscilloscope and its various applications. CO3: Study of characteristics of semi-conductor devices (UJT, FET). CO4: Study of tunnel diode and Zener diode characteristics. CO5: Designing and study of Op-Amp: Characteristics and parameter measurements. CO6: Study of multi vibrators (a) a stable (b) bi-stable (c) mono-stable. CO7: To study Op-Amp as an active filter, its frequency response and basic mathematical operations. CO8: Determination of thickness of mica sheet using Michelson Interferometer. CO9: To determine the velocity of ultrasonic waves in a given liquid.
Credits	03 Theory periods of one hour per week over a semester

Course Outcomes	COs of the course “**PHY-517- Computational Physics Laboratory-I**” Describe general understanding of MATLAB and its application in mathematical and physical problems. CO1: Develop an understanding of basic commands used for programming in MATLAB. CO2: Develop an understanding of programming in MATLAB for various mathematical problems. CO3: Develop an understanding of programming in MATLAB for various physics problems. CO4: Enumerate and explain programming in MATLAB for various material science problems.
Credits	03 Theory periods of one hour per week over a semester

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Program Outcomes, Program Specific Outcomes, Course Outcome

Course Outcomes	COs of the course "PHY-521-Mathematical Physics II" Describe general understanding of Group Theory, Tensors, Fourier Series and Integral Transforms, integral Equations and related physical problems. CO1: Develop an understanding of a group, Multiplication table, subgroups, Isomorphism and Homomorphism, Reducible and irreducible representations, special unitary groups SU(2) and SU(3). CO2: Enumerate and explain tensors, contraction, Levi-Civita symbol, Noncartesian tensors, metric tensor, covariant differentiation. CO3: Enumerate and explain the Fourier series, Fourier transforms, Fourier transforms of derivatives; Momentum representation. Laplace transforms, Laplace transforms of derivatives CO4: Clearly define the Integral Equations, integral transforms and generating functions. Hilbert-Schmidt theory, Green's functions, Numerical Techniques
Credits	03 Theory periods of one hour per week over a semester

Course Outcomes	COs of the course "PHY-522- Condensed Matter Physics - II" Describe general understanding of optical properties and related theories, magnetism, principal of magnetic resonance, superconductivity and disordered materials and related problems. CO1: Develop an understanding of Macroscopic theory - generalized susceptibility, Kramers- Kronig relations, Brillouin scattering, Raman effect and interband transitions. CO2: Enumerate and explain Dia- and para-magnetism in materials, Ferro-, ferri- and antiferromagnetism, Pauli paramagnetism, Heisenberg Hamiltonian mean field theory; spin waves. CO3: Explain and understand ESR and NMR - equations of motion, line width, motional narrowing, and Knight shift. CO4: Develop a basic understanding about superconductors: BCS pairing mechanism and nature of BCS ground state; Flux quantization. CO5: Explain and understand the basic concepts of defects and dislocations; noncrystalline solids such as glasses, Quasi-crystals, amorphous semiconductors and ferromagnets.
Credits	03 Theory periods of one hour per week over a semester

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Program Outcomes, Program Specific Outcomes, Course Outcome

Course Outcomes	COs of the course "PHY-523-Relativistic Quantum Mechanics & Quantum Field Theory" Describe general understanding of Relativistic Klein- Gordon Equation, Relativistic Dirac Equation, Quantization of wave fields, Quantum Field Theory and related problems CO1: Develop an understanding of Klein-Gordon equation, interaction with electromagnetic fields CO2: Enumerate and explain Dirac Equation, Covariance of Dirac equation and bilinear covariance CO3: Enumerate and explain quantization of wave fields CO4: Clearly define the Covariant perturbation theory, Feynman diagrams and their applications, Wick's Theorem. Scattering matrix.
Credits	03 Theory periods of one hour per week over a semester

Course Outcomes	COs of the course "PHY-524-Classical Electrodynamics" Describe general understanding of Electrostatics, Magnetostatics, Boundary value problems, Electromagnetic Waves and related problems CO1: Develop an understanding of Laplace and Poisson's equations, Electrostatic potential, vector potential CO2: Enumerate and explain Dirichlet and Neumann Boundary conditions, Boundary value problems CO3: Enumerate and explain Time varying fields and Maxwell equations CO4: Define the wave equation, plane waves in free space and isotropic dielectrics CO5: Define Radiation from Localized Time varying sources & Charged Particle Dynamics
Credits	03 Theory periods of one hour per week over a semester

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Program Outcomes, Program Specific Outcomes, Course Outcome

Course Outcomes	COs of the course "PHY-525- Statistical Mechanics" Describe general understanding of Statistical Basis of Thermodynamics, Ensembles and related physical problems. CO1: Explain the Statistical Mechanics of physics. CO2: Explain the Quantum statistics. CO3: Explain the effect Phase Transition. CO4: Explain the concept of Thermodynamics fluctuation.
Credits	03 Theory periods of one hour per week over a semester

Course Outcomes	COs of the course "ETE-526- Electronics II" Describe general understanding of Digital circuits, A/D Converters, Digital logic families, Microprocessor, Semiconductor Memories. CO1: Develop an understanding of Flip-Flops, A/D & D/A Converters CO2: Enumerate and explain RTL, DTL, TTL, ECL, CMOS, CMOS CO3: Enumerate and explain Microprocessor 8085 Architecture, memory interfacing, Assembly language programming CO4: Define the ROM, PROM and EPROM, RAM, Static and Dynamic Random Access Memories
Credits	03 Theory periods of one hour per week over a semester

Course Outcomes	COs of the course "**PHY-527- Physics Laboratory-II**" General understanding of Physics lab experiments and physical problems. CO1: To study temperature-dependence of conductivity of a given semiconductor crystal using four probe method. CO2: To determine the band gap of a semiconductor by Four Probe Method. CO3: To study the temperature dependence of a ceramic capacitor: Verification of Curie-Weiss law for the electrical susceptibility of a ferroelectric material. CO4: To determine the Hall voltage, Hall coefficient and the carrier concentration of a given semi-conductor. CO5: To study the modulation & demodulation of AM wave. CO6: To study the modulation& demodulation of FM wave. CO7: To determine the dielectric constant of a liquid by dipole meter.
Credits	03 Practical periods of two hour per week over a semester

M.Sc. (Physics) Program

Program Outcomes, Program Specific Outcomes, Course Outcome

Course Outcomes	COs of the course "**PHY-528- Computational Physics Laboratory-II**" Describe general understanding of MATLAB and its application in mathematical and physical problems.. CO1: Develop an understanding of programming in MATLAB for various mathematical physics problems. CO2: Develop an understanding of programming in MATLAB for various quantum physics problems. CO3: Develop an understanding of programming in MATLAB for various nuclear physics problems. CO4: Develop an understanding of programming in MATLAB for various material science problems.
Credits	02Practical periods of two hour per week over a semester

Course Outcomes	COs of the course "PHY-531-Nuclear and Particle Physics" Describe general understanding of Nuclear Masses and Nucleon-Nucleon Interaction, Nuclear Structure, Nuclear Models, nuclear reactions, Classification of fundamental forces CO1: Develop an understanding of nuclear masses, nuclear mass formula, stability of nuclei, beta decay and double beta decay, deuteron problem, nuclear potential. CO2: Enumerate and explain Shell Model Potential and Magic Numbers CO3: Enumerate and explain the Nuclear Collective Vibrations, Nuclear Collective Rotation CO4: Clearly define the Types of nuclear reactions, cross-sections, Berit-Wigner formula CO5: Classification of Elementary particles and their quantum numbers, Gellmann-Nishijima formula. Quark model, Standard Model of Particle Physics
Credits	03 Theory periods of one hour per week over a semester

M.Sc. (Physics) Program

Program Outcomes, Program Specific Outcomes, Course Outcome

Course Outcomes	COs of the course "**PHY-532-Atomic and Molecular Physics**" Describe general understanding of many electron atoms and molecular quantum mechanics, various atomic and molecular spectroscopy, interactions of atoms with radiation CO1: Develop an understanding of spectrum of Hydrogen, Helium and alkali atom. quantum virial theorem Hartree and Hartree-Fock method, periodic table and atomic properties: ionization potential, electron affinity, Hund's rule. CO2: Enumerate and explain Molecular Quantum Mechanics: Electron spin. Hydrogen molecular ion, hydrogen molecule, Relativistic corrections Hyperfine structure and isotope shift, width of spectrum lines, LS and JJ couplings. CO3: Develop an understanding offine and hyperfine structure of atoms, electronic, vibrational and rotational spectra for diatomic molecules, role of symmetry, selection rules, term schemes, and applications to electronic and vibrational problems. CO4: Develop an understanding Zeeman, Pashchen-Bach-Oppenheimer approximation. Electronic, rotational, vibrational and Raman spectra of diatomic molecules, selection rules. CO5: Explain and understand the basic concepts ofatoms in an electromagnetic field, induced absorption and emission, spontaneous emission and line-width, Einstein A and B coefficients, density matrix formalism, two-level atoms in a radiation field, Lasers.
Credits	03 Theory periods of one hour per week over a semester

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Program Outcomes, Program Specific Outcomes, Course Outcome

Course Outcomes	COs of the course "PHY-533- Material Science" Describe general understanding of various type of materials, structural properties of materials, materials preparation and characterization techniques and related topics. CO1: Develop an understanding of material noncrystalline and semi crystalline states, crystal systems, indices of lattice directions and planes, symmetry classes and point groups, space groups, phase transition in materials etc. CO2: Enumerate and explain Crystalline & amorphous materials, high T_c superconductors, alloys & composites, semiconductors, solar energy materials, luminescent and optoelectronic materials, Polymer, Liquid crystals and quasi crystals, Ceramics. CO3: Develop an understanding of preparation of materials by different techniques (e.g. zone refining, epitaxial growth. Melt-spinning and quenching methods, sol-gel), Top down and bottom up approaches of synthesis of nano-structured materials. Fullereness and tubules, Single wall and multiwall nanotubes. CO4: Develop an understanding of various Materials Characterization Techniques (e.g. XPS, STM, AFM, TEM, SEM, IR, Ultraviolet (UV) and visible spectroscopy)
Credits	03 Theory periods of one hour per week over a semester

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Program Outcomes, Program Specific Outcomes, Course Outcome

Course Outcomes	COs of the course "PHY-534(I)-Opto-Electronics" Describe general understanding of Injection luminescence, the basic principles of laser actions, optical detectors, junction detectors and related problems. CO1: Develop an understanding of recombination processes, the spectrum of recombination radiations, direct and indirect band gap semiconductors, internal quantum efficiency, and external quantum efficiency. CO2: Enumerate and explain spontaneous and stimulated emission and absorption, the condition for the laser action, theory of Laser action in semiconductors, condition for gain, Semiconductor Injection Laser: efficiency, stripe geometry LED materials. CO3: Explain and understand optical detection, quantum efficiency, responsivity, photoconductive detectors, characteristics of particular photoconductive materials, solar cell, holography, liquid crystal displays, optical fibers, free space optics and their applications CO4: Develop an understanding of detectors performance parameters, semiconductors p-i-n diodes, materials and design for p-i-n photodiodes. Avalanche photodiodes detectors (APD), Avalanche photodiodes design, phototransistors.
Credits	03 Theory periods of one hour per week over a semester

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Program Outcomes, Program Specific Outcomes, Course Outcome

Course Outcomes	COs of the course "PHY-534(II)-Nonlinear Dynamics" Describe general understanding of phenomenology of chaos, dynamics in state space, hamiltonian system, quantifying chaos, quantum chaosand related problems. CO1: Develop an understanding of linear and nonlinear systems, A nonlinear electrical system, biological population growth model, lorenz model; unpredictability and divergence of trajectories, feigenbaum numbers and size scaling, models and universality of chaos. CO2: Enumerate and explain state space, autonomous and non-autonomous systems, dissipative systems, one dimensional state space, linearization near fixed points, two dimensional state spaces, dissipation and divergence theorem, bifurcation theory, Heuristics, three-dimensional dynamical systems etc. CO3: Explain and understand non- integrable systems, KAM theorem and period doubling, standard map, applications of Hamiltonian dynamics, chaos and stochasticity. CO4: Develop an understanding of time series, lyapunov exponents. Invariant measure, kolmogorov -Sinai entropy. Fractal dimension, Statistical mechanics and thermodynamic formalism. CO5: Explain and understand quantum mechanical analogies of chaotic behaviour, distribution of energy eigenvalue spacing, chaos and semi-classical approach to quantum mechanics.
Credits	03 Theory periods of one hour per week over a semester

M.Sc. (Physics) Program

Program Outcomes, Program Specific Outcomes, Course Outcome

Course Outcomes	COs of the course "PHY-534(III)-Particle Accelerator Physics" Describe general understanding of charged particle dynamics, radiofrequency accelerators, electrostatic and heavy ion accelerators, synchrotron radiation sources, radioactive ion beams and related problems. CO1: Develop an understanding of linear and nonlinear systems, A nonlinear electrical system, biological population growth model, lorenz model; determinism, unpredictability and divergence of trajectories etc. CO2: Enumerate and explain state space, autonomous and non-autonomous systems, dissipative systems, one dimensional state space, linearization near fixed points, two dimensional state spaces, dissipation and divergence theorem, Three-dimensional dynamical systems etc. CO3: Explain and understandnon-integrable systems, KAM theorem and period doubling, standard map. applications of Hamiltonian dynamics, chaos and stochasticity. CO4: Develop an understanding of time series, lyapunov exponents. Invariant measure, kolmogorov -Sinai entropy. Fractal dimension, Statistical mechanics and thermodynamic formalism. CO5: Explain and understand quantum mechanical analogies of chaotic behaviour, distribution of energy eigenvalue spacing, chaos and semi-classical approach to quantum mechanics.
Credits	03 Theory periods of one hour per week over a semester

M.Sc. (Physics) Program

Program Outcomes, Program Specific Outcomes, Course Outcome

Course Outcomes	COs of the course "PHY-534(IV)-Astrophysics" Describe basic concepts of celestial sphere, interstellar medium and molecular clouds, stellar evolution and nucleo-synthesis, cosmology and related topics. CO1: Develop an understanding of right ascension, ecliptic, basic stellar properties; luminosity, estimation of distance using parallax method and cepheid variables, origin of emission and absorption spectra, Doppler effect and its applications etc. CO2: Explain the structure of our galaxy, globular clusters, velocity distribution of stars, fine structure of carbon, origin of spiral arms and its basic features, Interstellar dust and theory of extinction of stellar light etc. CO3: Explain and understand pre-main sequence collapse, origin of the solar system, Jean's criteria, late stage evolution of stars, red giant phase, white dwarf, supernova, neutron star, black hole, stellar nucleo-synthesis etc. CO4: Develop an understanding of simple extragalactic observations, Olber's paradox, Hubble's constant and its implications, the steady state universe, Evolution of the Big Bang, time evolution of the future universe etc.
Credits	03 Theory periods of one hour per week over a semester

Course Outcomes	COs of the course "PHY-534(V) -Science of Renewable Energy Sources" Describe general understanding of energy sources, solar energy, hydrogen energy, wind energy, wave energy and oceanic thermal energy conversion and related topics. CO1: Explain and enumerate production alternatives and reserves of energy sources in the world and in India; need of renewable energy sources, energy security and energy conservation, energy and its environmental impacts, distributed generation. CO2: Develop an understanding of solar thermal and solar photovoltaic technologies and their applications. CO3: Explain and understand the hydrogen production techniques, importance of hydrogen energy as per environmental concern, storage techniques and safty issues. CO4: Develop an understanding of wind energy, wave energy and OTEC and their implementation criteria.

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Program Outcomes, Program Specific Outcomes, Course Outcome

Credits	03 Theory periods of one hour per week over a semester

Course Outcomes	COs of the course "PHY-535(I)-Nano Physics" Describe general understanding regarding types of Nanomaterials and their Properties, Nanomagnetism, Quantum Wells, Quantum Wells, Synthesis of Nanomaterials(Bottom up Approach, some special nanomaterials and related topics. CO1: Develop an understanding of nanomaterials and their properties: clusters, metal nanocluster, magic number, theoretical modelling of nanoparticles, geometric structures. excitons, effective mass approximation, optical properties of semiconductor nanoparticles and plasmonic materials etc. CO2: Enumerate and explain effect of bulk nanostructuring of Magnetic properties, Dynamics of nanomagnets; Nanopore Containment of magnetic particles, Nanocarbon ferromagnets, Giant and colossal Magnetoresistance, Ferrofluids, spintronics etc. CO3: Explain and understand quantum wells, wires, and dots, Preparation of quantum nanostructures; fermi gas and density of states, potential wells, Partial confinement, properties dependent and density of states. CO4: Develop an understanding the synthesis of Nanomaterials(Bottom up Approach): Synthesis of Nanomaterials (Top down Approach): Ball milling, Lithography. CO5: Explain and understand Some special Nanomaterials: Carbon Nanomaterials, Multiferroics, and Nanostructured Multilayers.
Credits	03 Theory periods of one hour per week over a semester

M.Sc. (Physics) Program

Program Outcomes, Program Specific Outcomes, Course Outcome

Course Outcomes	COs of the course **"PHY-535(II)-Fibre optics and Non-linear Optics"** Describe general understanding of Optical fibre and its properties, Fiber fabrication and cable design, Optics of anisotropic media, Electro-optic and acousto-otpic effects and modulation of light beams, and Non-linear optics/processes. CO1: Develop an understanding of Optical fibre and its properties. CO2: Enumerate and explain Fiber fabrication and cable design. CO3: Explain and understand Optics of anisotropic media. CO4: Develop an understanding of Electro-optic and acousto-otpic effects and modulation of light beams, and Non-linear optics/processes. CO5: Explain and understand Non-linear optics/processes.
Credits	03 Theory periods of one hour per week over a semester

Course Outcomes	COs of the course **"PHY-535(III)-Nuclear Technology"** Describe general understanding of interaction of radiation with matter: Detectors and Instrumentation: Industrial and Analytical Applications: Nuclear Energy Power from Fission: CO1: Develop an understanding of interaction of radiation with matter. CO2: Enumerate and explain Detectors and Instrumentation. CO3: Explain and understand Industrial and Analytical Applications. CO4: Develop an understanding of Nuclear Energy Power from Fission.
Credits	03 Theory periods of one hour per week over a semester

M.Sc. (Physics) Program

Program Outcomes, Program Specific Outcomes, Course Outcome

Course Outcomes	COs of the course **"PHY-535(IV)-Advanced Nuclear & Particle Astrophysics"** describe general understanding of the observational basis of nuclear astrophysics, thermonuclear and nuclear reactions in stellar interiors, supernovae, nucleo synthesis of light elements. CO1: Develop an understanding of the observational basis of nuclear astrophysics, the importance of the four fundamental interactions, evolution of stars; the Abundances of Elements in the Universe. CO2: Enumerate and explain Thermonuclear and Nuclear Reactions in Stellar Interiors; Nuclear Reactions: Generalities; Nuclear Reaction Rates. CO3: Explain and understand the Fe photodisintegration mechanism, the C detonation mechanism, the neutrino transport mechanism, deceleration of the central pulsar, the helium flashes, the novae outbursts explosions of super massive stars. CO4: Develop an understanding of nucleo synthesis of light elements, abundances of light elements, spattation reaction. CO5: Explain and understand the basic assumptions, the standard model of the universe, cosmological principle and the expansion of the universe.
Credits	03 Theory periods of one hour per week over a semester

Course Outcomes	COs of the course **"PHY-535(V)-Advanced Computational Physics"** describe general understanding of various advances developed in Computational Physics. CO1: Develop an understanding of concepts of deterministic and stochastic simulation methods, limitations of simulational physics. CO2: Enumerate and explain Monte Carlo Method, Random walk on one, two and three dimensional lattices, self-avoiding walk, micro-canonical ensemble, canonical ensemble, classical ideal gas, ising model, grand canonical ensemble. CO3: Explain and understand Molecular Dynamics. CO4: Develop an understanding of symbolic computing systems. CO5: Explain and understand computing hardware basics: memory and CPU, components.
Credits	03 Theory periods of one hour per week over a semester

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Program Outcomes, Program Specific Outcomes, Course Outcome

Course Outcomes	COs of the course "PHY-536-Physics Laboratory - III" Describe general understanding Physics lab experiment and related problems. CO1: To study temperature-dependence of conductivity of a given semiconductor crystal using four probe method. CO2: To determine the band gap of a semiconductor by Four Probe Method. CO3: To study the temperature dependence of a ceramic capacitor: Verification of Curie-Weiss law for the electrical susceptibility of a ferroelectric material. CO4: To determine the Hall voltage, Hall coefficient and the carrier concentration of a given semi-conductor. CO5: To determine the dielectric constant of a liquid by dipole meter. CO6: To study the modulation & demodulation of AM wave. CO7: To study the modulation& demodulation of FM wave.
Credits	03 Theory periods of one hour per week over a semester

Course Outcomes	COs of the course "PHY-599- Research Methodology" Describe general understanding of some basic concepts of research and its methodologies. CO1: Develop an understanding of need, importance and impact of research, types of research, research process. CO2: Learn about synopsis writing, Selecting research problem; formulation of research projects; survey of literature. CO3: Develop an understanding of formulation and types of hypothesis; collection, maintenance, storage and analysis of data. CO4: Understand compilation and presentation of results, writing of manuscripts; research reports and thesis. CO5: Know about various funding agencies provides financial support for research and writing research proposal for external funding. CO6: Develop an understanding of computer and informatics including word processing, excel, power point presentation etc. CO7: Explain and understand principal and working procedure of various lab instruments.
Credits	03 Theory periods of one hour per week over a semester