Semester III

Astrophysics - I

Course No: **PHY15304DCE**	Max. Marks:	75
	External Examination:	60
No. of credits: **03**	Internal Assessment:	15

UNIT – I

Equation of stellar structure; equation of conservation of mass, hydrostatic equilibrium, thermal equilibrium and energy transport, Equation of State, Stellar Opacity, Stellar Energy Sources. Application of virial theorem to isothermal spheres, Jean's criteria for stability. Polytropic model, Lane-emden's equation, Central temperature and pressure,

UNIT – II

Evolution of stars, interstellar dust and gas, Jean's criteria for stability, formation of stars, Evolution of stars on the basis of HR-diagram, Binary stars, masses of binary stars, Fate of massive stars, Supernovae, White dwarfs, Chandershker limit, neutron stars, Pulsars, black holes.

UNIT – III

The Milky way Galaxy, size and shape, Rotation curves of the Galaxy, Implication of dark matter, Radio-observation and spiral structure, star counts, interstellar extinction, Implications of Dark matter, Hubble's classification of galaxies.
External galaxies: Methods of extra galactic distance, Properties of Seyfersts, radio galaxies, quasars.

Text books

1. Steller Structure by Chanderskher
2. Modern Astrophysics by B.W.Carroll and D.A.Ostlie Addison-Weslet Publishing

Reference Books:

1. Astronomy by R. H. Baker

2. Structure of Universe by J.V.Narlikar
3. Cosmology by J.V.Narliker
4. Introductory Astronomy & Astrophysics by M.Zelik & S.A.Gregory, 4th Edition Saunders College Publishing
5. Theoretical astrophysics, Vol. II: Stars and Stellar Systems, T.Padmanabhan, Cambridge University Press.
6. Stellar dynamics by Chanderskher

Semester III

Electrodynamics - II

Course No: **PHY15305DCE**	Max. Marks:	75
	External Examination:	60
No. of credits: **03**	Internal Assessment:	15

UNIT – I

CovCovariance of electrodynamics, Transformation of electromagnetic fields, Covariance of the force equation, Conservation laws, Momentum and energy of a particle, Kinematics of decay of an unstable particle, Transformation of momenta from center of momentum frame to the laboratory, Thomas precession

La Lagrangian and Hamiltonian, Relativistic corrections to the Lagrangian for interacting charged particles, Motion in uniform static, magnetic field, Motion in combined uniform, static, electric and magnetic fields, Particle drifts in non-uniform magnetic fields, Adiabatic invariance of flux through an orbit

UNIT – II

LieLienard-Wiechert potentials and fields, Larmor's radiated power formula and its relativistic generation, Angular distribution of radiation, Radiation by an extremely relativistic charged particle, General angular and frequency distributions of radiation from accelerated charges, Frequency spectrum from relativistic charged particle in an instantaneously circular orbit, synchrotron radiation, Thomsonscattering, Cherenkov radiation

FielFields and radiation of localized source, Oscillating electric dipole, Magnetic dipole and quaqdruple fields, centre-fed linear antenna, Radiation emitted during collisions, Bremsstrahlung in non-relativistic coulomb collision, relativistic radiative energy loss, Radiation emitted during beta decay, Radiation emitted in orbital-electron capture

UNIT – III

Energy transfer in coulomb collision, Energy transfer to a harmonically bound charges, Classical and quantum mechanical energy loss, Density effects in collision energy loss, Energy loss in an electronic plasma, elastic scattering of fast particles by atoms.

Magnetohydrodynamic equations, Magnetic diffusion, Viscosity, and pressure, Magnetohydrodynamic flow, Pinch effect, Dynamic model of the pinch effect, Instabilities, Magnetohydrodynamic waves, High-frequency plasma oscillations, Short-wavelength limit, Debye screening distance

Text Book:

1. Classical Electrodynamics, by John David Jackson, John Wiley & Sons Inc

Reference Books:

1. The Classical Theory of Fields, L. D. Landau and E. M. Lifshitz, Butterworth Heinmann
2. Introduction to Electrodynamics, David J. Griffiths, Pearson Education

Semester III

Field Theory - I

Course No: **PHY15306DCE**	Max. Marks:	75
	External Examination:	60
No. of credits: **03**	Internal Assessment:	15

UNIT – I

Euler-Lagrange equations in field theory. Noether's theorem. Quantization of scalar field: Equation of motion. The field and its canonical quantization, Fourier decomposition of the field. Ground state of the Hamiltonian and normal ordering. Fock space. Complex scalar field . Propagator for scalar fields.

UNIT – II

Quantization of Dirac fields : Dirac Hamiltonian, Dirac equation: Lorentz Covariance, Plane wave solutions of Dirac equation. Projection operators. Lagrangian for a Dirac field. Fourier decomposition of the field. Propagator for Dirac Field.
The S -matrix expansion: Examples of interactions , Evolution operator, S-matrix. Wick's theorem.

UNIT – III

Feynman diagrams: Yukawa interaction: decay of a scalar. Normalized states. Sample calculation of a matrix element. Feynman amplitude, Feynman rules , Virtual particles, Amplitudes which are not S-matrix elements . Cross sections and decay rates, Examples of decay rate calculation. Decay of a scalar into a fermion-anti fermion pair , Muon decay with 4-fermion interaction. Scattering cross section , Generalities of 2-to-2 scattering. Mandelstam variables.

Text Book:

A First book of quantum field theory: Lahiri and Pal (Narosa Publishing House)

Reference Books:

Bjorken & Drell, Relativistic Quantum Mechanics.
Bjorken & Drell, Relativistic Quantum Fields.
Itzkyson & Zuber: Quantum Field Theory.
Bogoliubov & Shirkov: Introduction to the theory of Quantized Fields.

Semester III

Seminars/Oral Presentation/Demonstration

Course No: **PHY15307DCE**	Max. Marks:	50
	External Examination:	25
No. of credits: **02**	Internal Assessment:	25

Description

The curriculum of this course shall consist of two seminar lectures/oral presentations/demonstrations by a student during the whole 3rd semester. The topics for the same shall be decided by the student in consultation with a faculty member who shall be responsible for the internal assessment part of the course. The external part shall be evaluated by a committee of faculty members in presence of which the student shall make the necessary presentation.

There shall be two such seminar lectures/oral presentations/demonstrations by each student with each carrying a total of 25 marks (13 external: to be evaluated by the committee + 12 internal to be assigned by the concerned teacher).

Semester III

Superconductivity

Course No: **PHY15310GE**	Max. Marks:	50
	External Examination:	40
No. of credits: **02**	Internal Assessment:	10

UNIT – I

The superconducting state, Basic properties of the superconducting state: Zero resistance, Critical temperature, The Meissner effect (Perfect diamagnetism), Flux quantization, Isotope effect, Critical magnetic fields, Type-I and Type-II superconductors, Critical Current, Penetration depth, Coherence length, Thermodynamics of transition, First and Second order transitions, Entropy, specific heat, Energy gap, The Josephson effects.

UNIT – II

Models and theories: Two fluid model, London equations, Ginzburg-Landau theory, main results of Bardeen Cooper and Schrieffer (BCS) theory: Instability of the Fermi Surface in the presence of attractive Interaction between electrons, Electron distribution in the ground state of a Superconductor, Critical temperature, Energy gap, Origin of the attractive interaction. Introduction to Hi T_C superconductivity.

Applications: SQUIDS, Magnetic Shielding, Power Transmission, Energy Storage devices, and Medical Applications.

Text Book:

1. A. C. Rose-Innes, Introduction to Superconductivity (Pregamon Press)

References Books:

1. C. P. Poole, Handbook of superconductivity (Academic Press 2000)
2. Andrei Mourachkine, Room Temperature Superconductivity (Cambridge 2004)
3. Jeffrey W. Lynn (Ed.), High Temperature Superconductivity (Springer-Verlag 1990)
4. T. V. Ramakrishnan and C. N. R. Rao, Superconductivity Today (Wiley 1992)
5. M. Tinkham Introduction to Superconductivity (Mc Graw Hill, 2004)

Semester IV

High Energy Physics

Course No: **PHY15404DCE**	Max. Marks:	50
	External Examination:	40
No. of credits: **02**	Internal Assessment:	10

UNIT – I

Quarks and leptons:

Particle Classification: femions and bosons, Standard model of Particle Physics, Particles and antiparticles, Free particle wave equation, Lepton flavours , Quark flavours.

Interactions and fields: Classical and quantum picture of Interactions, Yukawa theory of quantum exchange, Feynman diagrams, Electromagnetic Interaction, Weak Interaction, Strong Interaction.

Invariance Principles, Conservation laws and Quarks in Hadrons:

Parity Operation, Test of Parity conservation, Charge conjugation Invariance, Baryon and Lepton conservation, Isospin in pion-nucleon systems, The baryon decuplet, The baryon octet, Light vector mesons, Mesons built of light and heavy quarks.

UNIT – II

Quark Interactions and QCD:

Elastic lepton-nucleon scattering, Deep Inelastic scattering, QCD potential at short distances, QCD potential at large distances.

Experimental Methods: Accelerators, Colliding beam accelerators, Accelerator complexes, Secondary particle spectators, Interaction of charged particle and radiations with matter, Shower detectors and calorimeters.

Quark Gluon Plasma and Signatures of Quark Gluon Plasma:

Quarks and Gluons, Bag model of hadrons, Quark Gluon Plasma, Quark Gluon Plasma at High Temperature, Quark Gluon Plasma with High Baryon Density, J/Psi suppression and production in Quark Gluon Plasma, Dilepton production in QGP, Photon production on Quark Gluon Plasma, Experimental information on J/Psi production and suppression, Experimental information on photon production.

Text Books:

1. Introduction to High Energy Heavy Ion Collisions by CHeuk-Yin Wong.

Reference Books:

1. Introduction to High Energy Physics by D. H. Perkins

Semester IV

Astrophysics - II

Course No: **PHY15405DCE**	Max. Marks:	75
	External Examination:	60
No. of credits: **03**	Internal Assessment:	15

UNIT – I

Stellar dynamics, types of forces on a star in the stellar system, Tidal radii, star star encounter, time of relaxation determination of time of relaxation, application to Galaxy & star cluster. Masses of double galaxies, Masses of cluster of galaxies by virial theorem observational determination of masses, clusters of galaxies, Missing mass problem.

UNIT – II

Cosmology, cosmological principle, Newtonian cosmology, deceleration parameters critical density, Robertson walker equation and its properties, solution of Robertson-Walker equations. Einstein field equation in cosmology, Energy tensor of Universe, solution of Friedman's equation, Einstein de-sitter model, open model, particle horizon, Event horizon.

UNIT – III

Thermal History of the Universe, Temperature red shift relation, distribution in the early Universe, relativistic and non-relativistic limits, decoupling of matter and radiation, Cosmic microwave background radiation (CMBR), isotropy and an-isotropy of CMBR.

UNIT – IV

Thermal History of the Universe, Temperature red shift relation, distribution in the early Universe, relativistic and non-relativistic limits, decoupling of matter and radiation, Cosmic microwave background radiation (CMBR), isotropy and an-isotropy of CMBR.

The formation of structures in the Universe: Jean's equation derivation from fluid dynamics and General relativity; evolution of Jean mass, Growth in the Post recombination era

Text Books:

1. Introduction to Cosmology By J.V.Narliker

2. Modern Astrophysics by B.W.Carroll and D.A.Ostlie, Addison-Wesley Publishing Co.

Reference Books:

1. Structure Formation in the Universe by T. Padmanabhan, vambridge University
2. Stellar Dynamics by S.Chandersakher
3. Stellar Evolution by Kippenhahn
4. Quassars and Active Galactic Nuclei by A.K.Kembehavia & G.V.Narliker, Cambridge University Press

Semester IV

Field Theory - II

Course No: **PHY15406DCE**	Max. Marks:	75
	External Examination:	60
No. of credits: **03**	Internal Assessment:	15

UNIT – I

Quantization of the electromagnetic field : Classical theory of electromagnetic fields. Problems with quantization. Propagator. Fourier decomposition of the field. Physical states. Feynman rules for photons. Quantum electrodynamics, Local gauge invariance. Interaction Hamiltonian, Lowest order processes. Electron-electron scattering, Electron-positron scattering . Consequence of gauge invariance. Compton scattering , Scattering by an external field. Bremsstrahlung.

UNIT – II

P, T, C and their combinations : Motivations from classical physics . Parity, Charge conjugation and Time reversal for free and interacting fields. CP and CPT.

Symmetries and symmetry breaking : Classification of symmetries, Groups and symmetries , Symmetry group. Examples of continuous symmetry groups , Generators of continuous groups, Representations , Approximate symmetries. Spontaneous breaking of symmetries , Discrete symmetry . U(I) symmetry, Non-Abelian symmetry, Goldstone's theorem. Higgs mechanism .

UNIT – III

Electromagnetic form factors: General electromagnetic vertex, Physical interpretation of form factors . Anomalous magnetic moment of the electron , Charge form factor. Electron- proton scattering . Renormalization : Degree of divergence of a diagram , Vertex function. Regularization of self-energy diagrams , Counterterms . Vertex function, Full Lagrangian. Specific examples in QED , Ward-Takahashi identity . Observable effects of renormalization , Running coupling constant. Cancellation of infra-red

divergences.

Text Book:

1. A First book of quantum field theory: Lahiri and Pal (Narosa Publishing House)

Reference Books:

1.Bjorken & Drell, Relativistic Quantum Fields.

2. Itzkyson & Zuber: Quantum Field Theory.

3.Bogoliubov & Shirkov: Introduction to the theory of Quantized Fields.

4. Weinberg, S. : The Quantum Theory of Fields, Vol. I

5. Schroeder & Peskin: Quantum Field Theory

Semester IV

Project

Course No: **PHY15407DCE**	Max. Marks:	100
	External Examination:	50
No. of credits: **04**	Internal Assessment:	50

Description

The students will work intensively on a topic of her/his choice, while interacting on regular basis with the project supervisor. The project should consist of any innovative topic in Physics which, in principle, should lead to some training for further research on the topic. The student should present the most recent and novel research happenings in the field.

The curriculum shall consist of the preparation and submission of a project report and then oral presentation and viva-voce before a committee consisting of internal and external examiners. The distribution of marks for the various component of this curriculum shall be as follows;

Total Marks:	100
Internal assessment (by the project supervisor):	20
Marks for the content of the Project Report:	30
Marks for oral presentation and viva-voce (external examiner):	50

Semester IV

Neutrino Physics

Semester IV

Project

Course No: **PHY15407DCE**	Max. Marks:	100
	External Examination:	50
No. of credits: **04**	Internal Assessment:	50

Description

The students will work intensively on a topic of her/his choice, while interacting on regular basis with the project supervisor. The project should consist of any innovative topic in Physics which, in principle, should lead to some training for further research on the topic. The student should present the most recent and novel research happenings in the field.

The curriculum shall consist of the preparation and submission of a project report and then oral presentation and viva-voce before a committee consisting of internal and external examiners. The distribution of marks for the various component of this curriculum shall be as follows;

Total Marks:	100
Internal assessment (by the project supervisor):	20
Marks for the content of the Project Report:	30
Marks for oral presentation and viva-voce (external examiner):	50

Semester IV

Neutrino Physics

Course No: **PHY15408DCE**	Max. Marks:	50
	External Examination:	40
No. of credits: **02**	Internal Assessment:	10

UNIT – I

Introduction and Historical Overview, motivation for proposing the neutrino, first discovery by Reines and Cowan and subsequent discoveries, the number of neutrinos, neutrino properties and interactions, neutrino electron elastic scattering, neutrino-nucleon quasi-elastic scattering, neutrino-nucleon deep inelastic scattering, solar neutrinos, atmospheric neutrinos, terrestrial neutrino sources

UNIT – II

Neutrino mass, neutrino oscillations, flavour oscillations in vacuum and matter, solution of the solar and atmospheric problems, limitations of oscillation experiments, direct mass searches, kinematic mass determination, double beta decay, summary of understanding now, outstanding questions and the future of experimental neutrino physics

Text Books:

1. Neutrino Physics by Kai Zubair (CRC Press).
2. Current aspects of neutrino physics. Ed. by David O. Codwell (Springer)

Reference Books:

1. Fundamental of neutrino physics and astrophysics by Carlo Giunti and Chung W. Kim

Semester I

Classical Mechanics

Course No: **PHY15104DCE**	Max. Marks:	100
	External Examination:	80
No. of credits: **04**	Internal Assessment:	20

UNIT – I

The Lagrangian Approach to Mechanics: degrees of freedom, constraints and generalized coordinates, virtual displacement, virtual work and generalized force, d'Alembert's principle and the generalized equation of motion, the Lagrangian and the Euler Lagrange equation of motion, the Hamiltonian, cyclic coordinates and canonical momenta, applications; double pendulum, spherical pendulum, particle in electromagnetic field.

UNIT – II

Variational calculus and Hamiltonian dynamics: the variational calculus and the Euler equation, the principle of least action and the Euler Lagrange equation, constraints in variational dynamics.

Hamiltonian dynamics: Legendre transformations, Hamilton's equations, conservation laws, phase space and Liouville's theorem.

UNIT – III

Theoretical Mechanics: canonical transformations and generating functions, symplectic notation, Poisson Brackets (PB); the angular momentum PB relations, invariance of PBs under canonical transformations, action-angle variables and adiabatic invariance, the Hamilton Jacobi (HJ) Equation; HJ equation for Hamilton's characteristic function, separation of variables, particle motion under central force.

UNIT – IV

Oscillations: the simple harmonic oscillator; the damped harmonic oscillator, the damped simple and damped harmonic oscillator, coupled simple harmonic oscillators; couple pendulum, general method of solution.
Lagrangian and Hamiltonian of continuous systems: transition from discrete to continuous systems, the Hamiltonian formulation, Noether's theorem

Text Books:

1. Classical Mechanics by Goldstein, Poole and Safko (Pearson Education).
2. Mechanics by Landau and Lifshitz

Reference Books:

1. Analytical Mechanics by L. N. Hand and J. D. Finch (Cambridge University Press)

Semester I

Antenna and Wave Propagation

Course No: **PHY15105DCE**	Max. Marks:	100
	External Examination:	80
No. of credits: **04**	Internal Assessment:	20

UNIT – I

Antenna Fundamentals and Definitions: Radiation mechanism - over view, Electromagnetic Fundamentals, Solution of Maxwell's Equations for Radiation Problems, Ideal Dipole, Radiation Patterns, Directivity and Gain, Antenna Impedance, Radiation Efficiency. Antenna Polarization Resonant Antennas: Wires and Patches, Dipole antennas, Yagi - Uda Antennas, Micro strip Antenna

UNIT – II

Arrays: Array factor for linear arrays, uniformly excited, equally spaced Linear arrays, pattern multiplication, directivity of linear arrays, non- uniformly excited -equally spaced linear arrays, Mutual coupling, multidimensional arrays, phased arrays, feeding techniques, perspective on arrays. Broad band Antennas: Traveling-wave antennas, Helical antennas, Biconical antennas; Principles of frequency - independent Antennas, spiral antennas, and Log - Periodic Antennas

UNIT – III

Aperture Antennas: Techniques for evaluating Gain, reflector antennas - Parabolic reflector antenna principles, Axi -symmetric parabolic reflector antenna, offset parabolic reflectors, dual reflector antennas, Gain calculations for reflector antennas, feed antennas for reflectors, field representations, matching the feed to the reflector, general feed model, feed antennas used in practice

UNIT – IV

INTELSAT Series, INSAT, VSAT, Remote sensing, Mobile satellite service: GSM. GPS, INMARSAT, Satellite Navigation System, Direct to Home service (DTH), Special services, E-mail, Video conferencing and Internet connectivity

Text Books:

1. Antenna Hand book by J. D. Kraus

Reference Books:

1. Bruce R. Elbert," The Satellite Communication Applications Hand Book, Artech House Boston, 1997

2. Stutzman and Thiele, "Antenna Theory and Design", 2ndEd, John Wiley and Sons nc
3. C. A. Balanis: "Antenna Theory Analysis and Design", John Wiley, 2nd Edition, 1997

Semester I

Electronics – I

Course No: **PHY15106DCE**	Max. Marks:	50
	External Examination:	40
No. of credits: **02**	Internal Assessment:	10

UNIT – I

Review of PN junction diode and characteristics, ideal diode and diode approximations representations. Block diagram of a Regulated Power Supply, center tapped and bridge full wave rectifier Circuit diagrams, working and waveforms, ripple factor & efficiency(no derivations). . Zener diode regulator– circuit diagram and explanation for load and line regulation, . LED– circuit symbol, operation and applications (mention only) Bipolar Junction Transistor: Construction, principle & working of NPN transistor, terminology. Configuration – CE, CB, CC (mention only). Definition of α, β and γ and their interrelations

UNIT – II

Junction Field Effect Transistor (JFET) – types (mention only), construction and working of N channel FET, characteristics, FET parameters and their relationships, comparison of FET with BJT Field Effect Transistors: MOSFET circuits, working of Depletion and Enhancement types, MOSFET as a variable voltage resistor Feedback in amplifiers, Advantages of negative feedback Oscillators, Principle of oscillation, classification of oscillators, Condition for self sustained oscillation: Barkhausen criterion .

Text Books

1 Electronic Devices and circuits by R.L.boylestad louis Nashkly

2. Basic electronics- B.L. Theraja - S. Chand and Co. 3rd edition -2012.

3. Electronic Instrumentation and Measurements, David A Bell, PHI / Pearson Education, 2006.

4. Electronics and Linear circuits, N.N. Bhargava, D.C. Kulshresta and D.C Gupta-TMH.

5. Principles of Electronics By V.K. Mehta, S.Chand& Co.

6. Digital computer Electronics: Malvino

Reference books:

1. Electronic Devices and circuit theory, Robert Boylstead and Louis Nashelsky, 9th Edition. Edition, 2013, PHI
2. Instrumentation Devices & Systems - C. S. Rangan, G. R. Sarma, V. S. V. Mani

Semester I

Physics Education

Course No: **PHY15107GE**		Max. Marks:	50
		External Examination:	40
No. of credits:	**02**	Internal Assessment:	10

UNIT – I

Basic aim of Physics Education,

Physics Education through master texts: ideas of communicating physics.

Physics Education through Experimentation: understanding physics through our day-to-day observations.

Physics Education through Problem Solving: physics understanding through curiosity.

UNIT – II

Semester I

Mathematical Physics - I

Course No: **PHY15101CR**	Max. Marks:	100
	External Examination:	80
No. of credits: **04**	Internal Assessment:	20

UNIT – I

Complex functions, Analytic functions, Cauchy - Riemann conditions, Cauchy's Integral Theorem, Multiply connected regions, Singularities, Cauchy's Integral formula, Derivatives, Taylor and Laurent expansion, Analytic continuation, Poles and Branch Points, Calculus of Residues, Residue theorem, Cauchy principal value, Evaluation of Definite Integral using Cauchy's residues.

UNIT – II

The Gamma Function: Definitions, Simple Properties, Factorial and Double factorial, Digamma and Polygamma Functions, Stirling's Series; The Beta Function, Legendre duplication formula.

Partial Differential Equations, Classes and Characteristics, Boundary Conditions, First-order, Separable variables, Solution of linear first-order ODEs; Seperation of variables in cartesian, Spherical Polar and Cylindrical Coordinates.

UNIT – III

Singular points, Solution of Second order Differential Equations using Frobenius Method, Limitations of series approach; Second solution, Linear independence of solutions.

Orthogonal Functions, Self-Adjoint ODEs, Hermitian Operators, Gram–Schmidt Orthogonalization, Orthogonal Polynomials, Completeness of Eigenfunctions.

UNIT – IV

Bessel Functions of First kind, Orthogonality, Neuman Functions, Henkel

Functions, Modified Bessel Functions, Spherical Bessel Function; Legendre Function, Orthogonality, Associated Legendre Function, Spherical Harmonics, Hermite Functions; Laguerre Functions.

Text Book:

1. Mathematical Methods for Physicists (6th Ed.), G. B. Arfken and H. J. Weber, Academic Press

Reference Books:

1. Mathematical Methods For Students of Physics and Related Fields, Sadri Hassani, Springer (2009)
2. Mathematical Physics: A Modern Introduction to Its Foundations, Sadri Hassani, Springer (2002)
3. Advanced Engineering Mathematics by Michel D, Greenberg
4. Mathematical Methods for Physics and Engineering (3rd Ed.), Riley, Hobson and Bence, Cambridge
5. Advanced Engineering Mathematics, E Kreyzig (8th Ed.), Wiley
6. Complex Analysis by E. C. Tichmersh
7. Differential Equations by H. J. H. Piagin

Semester II

Quantum Mechanics – II

Course No: **PHY15205DCE**	Max. Marks:	100
	External Examination:	80
No. of credits: **04**	Internal Assessment:	20

UNIT – I

Time-independent perturbation theory, Non-degenerate & degenerate cases, Applications such as linear harmonic oscillator, Zeeman effect, Stark effect, Perturbation of the type X^2, X^3, X^4.

Variational method and its applications, WKB approximation, Solution of bound state problems, Time -dependent perturbation theory, Harmonic perturbation, Fermi's golden rule, Adiabatic and sudden approximation.

UNIT – II

Collision in 3-D and scattering, Laboratory and CM reference frames, Scattering amplitude, differential scattering cross and total scattering cross, Scattering by spherically symmetric potentials, Partial waves and phase shifts, Scattering by a perfectly rigid sphere and by square well potential, Complex potential and absorption.

UNIT – III

Identical particles, Symmetric and antisymmetric wave functions, Spin and Statistics, The Exclusion Principle, Distinguishability of Identical Particles, Collision of identical particles; Spin angular momentum, Spin functions for a many-electron system.

Semi classical theory of radiation, Transition probability for absorption and induced emission, Electric dipole and forbidden transitions.

UNIT – IV

Relativistic QM: The Klein-Gordon equation, Free particle solutions, probability density & probability current density, interpretation of negative energy solutions of the K-G equation. The Dirac equation, Free particle solutions, Probability density and probability density current for the free particle Dirac equation, Spin of an electron, Interpretation of negative energy

states.

Text Book:

1. L. l. Schiff, Quantum Mechanics (McGraw-Hill), New York Toronto London, Kogakusha Company, Ltd. Tokyo

Reference Books:

1. Cohen, Diu and Laloe Quantum Mechanics
2. A. P. Messiah, Quantum Mechanics
3. J. J. Sakurai, Modern Quantum Mechanics
4. Mathews and Venkatesan, Quantum Mechanics
5. Bjorken & Drell, Relativistic Quantum Mechanics
6. J. R. Aitchson, Relativistic Quantum Mechanics
7. W. Greiner, Relativistic Quantum Mechanics

Semester II

Advanced Digital Systems

Course No: **PHY15206DCE**	Max. Marks:	50
	External Examination:	40
No. of credits: **02**	Internal Assessment:	10

UNIT – I

Review of Basic Digital Concepts and logical gates,Brief introduction of VLSI Design and Implementation, Traditional vs. Hardware Description Languages, Digital System Design Flow, The Role of Hardware Description, VHDL, Levels of Abstraction, Scope of VHDL, Benefits of using VHDL, VHDL Examples.

UNIT – II

Intro to FPGA, Xilinx ISE , FPGA Prototyping by VHDL Examples: ISE/Spartan 3 FPGA Implementation Walkthrough , Xilinx Spartan-3, Design Examples with Xilinx ISE and Spartan 3**E,** Programming the FPGA, Project.

References :

Digital Integrated Circuits second edition by John M Rabaey, Anantha Chandrakasan

Text

VHDL Starters Guide Sudhakar Yalamanchili Publisher: Prentice Hall , ISBN: 0-13-145735-7

Forms of examination

The student's knowledge will be tested by a written exam in combination with written and/or oral presentations of the Projects.

Aims: To familiarize students with the basic principles of digital systems design and the use of a hardware description language, VHDL, and xilinx software in the

design process..

Semester II

Tensor Analysis

Course No: **PHY15207GE**	Max. Marks:	50
	External Examination:	40
No. of credits: **02**	Internal Assessment:	10

UNIT – I

Transformation of coordinates, properties of admissible transformation of coordinates, transformation by invariance, transformation by covariance and contravariance. Tensor concept, contranvariant and covariant tensors. Algebra of tensors, quotient laws, symmetric and anti-symmetric tensors, relative tensors, metric tensor . Fundamental and associated tensors. Christoffel symbols and transformation.

UNIT – II

Covariant differentiation of tensors, formulas for covaraiant differentiation of tensors. Tensor form of differential operators. Ricci Theorem, Riemann-Christoffel tensor and its properties. Ricci Tensor, Bianchi identities, Einstein tensor. Existence theorem. Some applications to analytical mechanics.

Text Book:

1. I. S. Sokolnikoff: Tensor Analysis.

Semester III

Advanced Lab. Methods

Course No: **PHY15309GE**	Max. Marks:	50
Duration of Examination: 1:30 Hrs.	External Examination:	25
No. of credits: **02**	Internal Assessment:	25

UNIT – I

Types of Radiation, Radiation Detector, General Detector Properties, Geiger Counters ,Scintillator Detectors , Solid State (Semiconductor) Detectors , Specific Models: Binomial Distribution, Poisson Distribution Gaussian (Normal) Distribution. Properties of the Binomial Distribution, Poisson Distribution and Gaussian (Normal) Distribution. Examples. Error Propagation Formula, Sums or Differences of Counts, Multiplication or Division of Counts, Limits of Detection.

UNIT – II

Lab Procedures

Existence of Radiation:Become familiar with different sources of radiation around us, and measure the level of radiation emitted from them.

Gamma-Ray Spectroscopy using NAI(Tl):Basic techniques used for measuring gamma rays, based on the use of a sodium iodide (NaI) detector that is thallium-activated (Tl). Spectrum Analysis of ^{60}CO and ^{137}CS explain some of the features other than the photopeaks, that are usually present in a pulse-height spectrum. These are the Compton edge, backscatter peak, and x-rays.

Mass Absorption Coefficient :To measure experimentally the mass absorption

coefficient in lead and other materials like iron Aluminum with sources Na-22, Cs.

References Books:

1. Radiation Detection and Measurement by Glenn F. Knoll
2. Radiation detection - W. H. Tait

Text Books:

1. Physics and Engineering of Radiation Detection by Syed Naeem Ahmed
2. Practical Gamma-ray Spectroscopy By Gordon Gilmore
3. The Design and Construction of a NaI(T1) Scintillation Detector by Samuel Strit

Forms of examination

The student's knowledge will be tested by a written and/or oral exam in combination with written and/or oral presentations of the laboratory exercises.

Aims and Objectives:

The theory part treats statistical methods for data analysis and introduces students to .Radiation ,detection of Radiation and radiation detection systems.

In the experimental part the student gets training in planning and performing experiments, in analyzing experimental data with statistical, computer based methods estimating statistical and systematic uncertainties.

Semester IV

Atmospheric Physics

Course No: **PHY15410GE**	Max. Marks:	100
	External Examination:	80
No. of credits: **04**	Internal Assessment:	20

UNIT – I

Origin, Composition and Mean Structure of the Atmosphere, Vertical profiles of pressure and density, Variable constituents, The vertical temperature structure, General Circulation of the Atmosphere, Energy Balance of the Earth, Global Patterns of Insolation , Heating Imbalances, Earth's Energy Budget, Surface Energy Budget
Modeling Energy Balance, Global Heat Balance, Atmosphere's Energy Budget, Natural Greenhouse Effect, Effect on Surface Temperature

UNIT – II

Gas law and its application to dry air, water vapour, and moist air, Virtual Temperature, Hydrostatic Equation ,Geopotential, Scale Height, hypsometric equation, Reduction of Pressure to Sea Level, specific heat, adiabatic and isothermal processes, concept of air parcel, dry adiabatic lapse rate, potential temperature, first law thermodynamic applied to atmosphere, Moisture Parameters, potential temperature, Claussius Clapeyron equation, latent Heats, Saturated Adiabatic and Pseudoadiabatic Processes, The Saturated Adiabatic Lapse Rate, Equivalent Potential Temperature and Wet-Bulb Potential Temperature, Stability and instability

UNIT – III

Earth coordinate system (latitude, longitude, depth),Dynamic and thermodynamic variables (u,v,w,T,P,density).Forces felt by an air parcel, mathematical development of apparent forces, momentum equations,scale analysis momentum equations, the Rossby Number and geostrophic, Cyclostrophic and gradient Balance, Continuity equation, Energy equation ,Governing equations for synoptic scale.The Thermal Wind, Vertical motion, pressure coordinates,Basic equations in pressure coordinates.

UNIT – IV

Weather and climate, weather forecasting, Numerical weather prediction

models, Global climate models, Working principle, application and circuit descriptions in blocks of the system: Ionosonde, Rdiosonde, Ozonesonde, LIDARS, DIAL, SODARS, AWS, weather Satellites, Doppler Radar, ST Radar and MST radar

Text Books:

1. McIlveen, R., Fundamentals of Weather and Climate, Chapman-Hall, 1992
2. An Introduction to Dynamic Meteorology (3rd edition), J.R. Holton
3. Atmospheric Science: An Introductory Survey by J.M. Wallace and P.V. Hobbs, Academic,
4. 1977, Hargrave Library 551.5 W191A.

Reference Books

1. The Physics of Atmospheres by J.T. Houghton, 1986,
2. Theory of Satellite Orbit in the Atmosphere by King Hele
3. Numerical Analysis by Shastri
4. Weather Satellite by L.F. Hubert
5. Meteorological Satellite by W.K. Widger
6. A guide to Earth Satellite by D. Fishlock

Text Books

1 Electronic Devices and circuits by R.L.boylestad louis Nashkly

2. Basic electronics- B.L. Theraja - S. Chand and Co. 3rd edition -2012.

3. Electronic Instrumentation and Measurements, David A Bell, PHI / Pearson Education, 2006.

4. Electronics and Linear circuits, N.N. Bhargava, D.C. Kulshresta and D.C Gupta-TMH.

5. Principles of Electronics By V.K. Mehta, S.Chand& Co.

6. Digital computer Electronics: Malvino

Reference books:

1. Electronic Devices and circuit theory, Robert Boylstead and Louis Nashelsky, 9th Edition. Edition, 2013, PHI
2. Instrumentation Devices & Systems - C. S. Rangan, G. R. Sarma, V. S. V. Mani

Semester I

Physics Education

Course No: **PHY15107GE**		Max. Marks:	50
		External Examination:	40
No. of credits:	**02**	Internal Assessment:	10

UNIT – I

Basic aim of Physics Education,

Physics Education through master texts: ideas of communicating physics.

Physics Education through Experimentation: understanding physics through our day-to-day observations.

Physics Education through Problem Solving: physics understanding through curiosity.

UNIT – II

Physics Education through master awareness and misconceptions: Going through daily life physics and its interpretation.

Physics Education through proto-research: solving problems of physics related to human life.

Physics Education through Qualitative Overview:

Reference Book.

1. A cultural history of physics by Karoli Simonyi, CRC Press.

design process..

Semester II

Tensor Analysis

Course No: **PHY15207GE**	Max. Marks:	50
	External Examination:	40
No. of credits: **02**	Internal Assessment:	10

UNIT – I

Transformation of coordinates, properties of admissible transformation of coordinates, transformation by invariance, transformation by covariance and contravariance. Tensor concept, contranvariant and covariant tensors. Algebra of tensors, quotient laws, symmetric and anti-symmetric tensors, relative tensors, metric tensor . Fundamental and associated tensors. Christoffel symbols and transformation.

UNIT – II

Covariant differentiation of tensors, formulas for covaraiant differentiation of tensors. Tensor form of differential operators. Ricci Theorem, Riemann-Christoffel tensor and its properties. Ricci Tensor, Bianchi identities, Einstein tensor. Existence theorem. Some applications to analytical mechanics.

Text Book:

1. I. S. Sokolnikoff: Tensor Analysis.

Semester I

Introduction to Astronomy

Course No: **PHY15108GE**	Max. Marks:	50
	External Examination:	40
No. of credits: **02**	Internal Assessment:	10

UNIT – I

Celestial Sphere and Time; Constellations and nomenclature of stars. The cardinal points and circles on the celestial sphere. Equatorial, ecliptic and galactic system of co-ordinates. Spherical triangle and related problems. Aspects of sky from different places on the earth. Twilight, Seasons, Sidereal. Apparent and Mean solar time and their relations. Equation of time. Ephemeris and Atomic Times. Calendar. Julian date and heliocentric correction.

UNIT – II

Stellar Distances and Magnitudes; Distances of stars from the trigonometric, statistical and moving cluster parallax. Stellar motions. Magnitude scale and magnitude systems. Atmospheric extinction. Absolute magnitudes and distance modulus. Stellar Classification, H-R Diagram, Black-body approximation to the continuous radiation and temperatures of stars. Variable stars as distance indicators.

Text Books.

2. W.M.Smart: Text book of Spherical Astronomy
3. K.D.Abhyankar: Astrophysics: Stars and Galaxies.Tata McGraw Hill Publication

Reference Books:

1. A.E.Roy: Orbital Motion.
2. McCusky: Introduction to Celestial Mechanics
3. G.Abell: Exploration of the Universe.
4. A. Unsold: New Cosmos. Baidyanath Basu: Introduction to Astrophysics.

Semester II

Crystallography

Course No: **PHY15208GE**	Max. Marks:	50
	External Examination:	40
No. of credits: **02**	Internal Assessment:	10

UNIT – I

Crystalline solids and their growth methods. Crystal lattice; two and three dimensional lattices, crystal planes and directions. Crystal symmetry, crystallographic point groups and their applications. Space groups, graphical representation of space groups, building crystal structure from space groups, crystal structure of some simple compounds. Direct and reciprocal lattice. Reciprocal lattice of simple, body centered and face centered cubic lattices.

UNIT – II

Diffraction of Waves by Crystals, Scattered Wave Amplitude, Fourier Analysis of a crystal structure. Reciprocal Lattice and its applications to diffraction techniques, Diffraction Conditions, Brillouin Zones, Crystal structure factor and intensity of diffraction maxima, atomic scattering factor. Extinctions due to lattice centering. Powder X-ray diffraction, Single crystal X-ray diffraction. Structure determination using X-ray diffraction.

Text Books :

1. Crystal and crystal structure by Richard Tilley , Willey Pub.
2. Introduction to Solid State Physics by Charles Kittel, Willey Publication.

Reference Books :

1. An Introduction to Crystallography by M.M. Woolfson, Cambridge University Press.
2. Structure and Bonding in Crystalline Materials by G.S. Rohrer, Cambridge University Press.

Semester III

Microwave Devices and Circuits

Course No: **PHY15308GE**	Max. Marks:	50
	External Examination:	40
No. of credits: **02**	Internal Assessment:	10

UNIT – I

Introduction to microwaves and applications, advantages of microwaves, EM spectrum domain, electric and magnetic fields static electric and magnetic fields, time varying electric and magnetic fields, Microwave Tubes: Limitation of conventional tubes, microwave tubes, velocity modulation, method of producing the velocity modulation, principle of operation of two cavity klystron, reflex klystron principle of operation, velocity modulation in reflex klystron

UNIT – II

Microwave Semiconductor Devices: Microwave bipolar transistor, FET, Principle of Operation and application of tunnel diode, Principle of operation of gunn diode, application of gunn diode advantages of gunn diode, principle of operation of PIN diode and applications, Tunnel diode, IMPATT, TRAPATT Diodes

Text Books:

1. Microwave Devices and Circuits, S.Y. Liao

Reference Books:

1. Microwave Engineering by Prof. G. S. N. Raju, IK International Publishers, 2007
2. Microwave Engineering, by P. A. Rizzi, PHI, 1999.
3. Microwave Engineering, Non-reciprocal active and passive circuits" by Joseph Helszajin, McGraw Hill, 1992.

5. Baidyanath Basic: Introduction to Physics

Semester I

Philosophical foundations of Quantum Mechanics

Course No: **PHY15109GE**	Max. Marks:	50
	External Examination:	40
No. of credits: **02**	Internal Assessment:	10

UNIT – I

Formalism and Interpretations , Early Semiclassical Interpretations , The conceptual situation in 1926/ 1927 . Schrodinger's electromagnetic interpretation , Hydrodynamic interpretations ,Born's original probabilistic interpretation ,De Broglie's double-solution interpretation ,Later semiclassical interpretations , The Indeterminacy Relations , The early history of the indeterminacy relations , Heisenberg's reasoning , Subsequent derivations of the indeterminacy relations , Philosophical implications , Later developments , Early Versions of the Complementarity Interpretation , Bohr's Como lecture , Critical remarks , "Parallel" and "circular" complementarity , Historical precedents

UNIT – II

The Bohr-Einstein Debate , The Fifth Solvay Congress , Early discussions between Bohr and Einstein

The Sixth Solvay Congress , Later discussions on the photon-box experiment , and the time-energy relation , Some evaluations of the Bohr-Einstein debate ,The Incompleteness Objection and Later Versions of the Complementarity Interpretation, The interactionality conception of microphysical attributes , The prehistory of the EPR argument , The EPR incompleteness argument ,Early reactions to the EPR argument , The relational conception of quantum states , Mathematical elaborations , Further reactions to the EPR argument , The acceptance of the complementarity interpretation , Hidden-Variable Theories .

Text Books.

4. Max Jammer: The Philosophy of Quantum Mechanics; The interpretation of Quantum Mechanics in historical perspective.

Reference Books:

6. Michael Redhead: *Incompleteness, Nonlocality, and Realism: A Prolegomenon to the Philosophy of Quantum Mechanics*
7. A. Patrick., S. J Heelan: *Quantum Mechanics and Objectivity: A Study of the Physical Philosophy of Werner Heisenberg*

   Michel Bitbol: *Schrödinger's Philosophy of Quantum Mechanics*

Semester I

Biophysics

Course No: **PHY15110OE**	Max. Marks:	50
	External Examination:	40
No. of credits: **02**	Internal Assessment:	10

UNIT – I

Radiological Physics

Properties of Electromagnetic Radiation, Radiation Units, Exposure and Dose, Dose equivalent Unit, Particle flux, X Rays and Gamma Rays, their interaction with matter, Photoelectric and Compton effect, Ion pair production, Principles of Radiation detection and measurements, General requirement of dosimeters, Telegamma Unit (Cobalt Unit), Radio Isotopes in Biology, Agriculture plant breeding, soil plant relationship and plant physiology, Medicine and diagnosis.

UNIT – II

Radiation Safety measures

Natural and manmade Radiation exposure or principle of Dose Equivalent limit (DEL), Maximum permissible Dose (MPD), Evaluation of External and internal Radiation hazards, Radiation protection measures in Industrial establishment, Radio Isotope labs, Diagnostics and therapeutic installations during transportation of Radioactive substances, Disposal of Radioactive waste, Administrative and Legislative aspect of Radiation protection

Text Books:

1. Casarett A.P. (1968), Radiation Biology, Prentice-hall Inc.

Semester II

Electronics – II

Course No: **PHY15209GE** Max. Marks: 75

External Examination: 60

No. of credits: **03** Internal Assessment: 15

UNIT – I

Logic gates,Sequential and Combinational circuits, Commonly used gates, Boolean Algebra , DeMorgan's Theorem and Examples, DeMorgan's in Gates.Logic Minimisation, Truth Tables, , Karnaugh Maps, K-maps examples, POS Simplification, POS Example, Number Representation,combinational logic ciruits and their implementation.

UNIT – II

Basic overiew of logic functions, Halfadder, Full adder, Half Subtracter, Full Subtracter, Multiplexers, Demultiplexers, Encoder , Decoders Latches,Edge triggered flip flops, Master slave flip flops, Flip flop operating characteristics and applications Asynchronous, Synchronous operations up/down counters .CMOS and TTL circuits and their comparison.ECL circuits

UNIT – III

Multivibrators and clock circuits, up and down shift registers, ALU design, Finite state machines, Control unit designs, Digital system design concepts, approaches, PLD, Memories, A/D and D/A converters.

Texts Books

1. Tokhiem digital systems and principles and applications
2. R.J. Tocci., N.S.Widmer, G.L. Moss. Digital Systems, Principles and Applications, Pearson/Prentice Hall.
3. T.L.Floyd and Jain Digital Fundamentals, 8th Ed. Prentice Hall.
4. N.P. Cook. Practical Digital Electronics, Pearson/Prentice Hall.
5. W. Kleitz. Digital Electronics. A Practical Approach. Prentice Hall.

6. Wakerly: Digital System Design and Principles
7. M. M. Mano: Digital Design
8. C. E. Strangio: Digital Electronics: Fundamental Concepts and Applications.
9. W. Kleitz. Digital Electronics with VHDL, Pearson/Prentice Hall.
10.

4. Max Jammer: The Philosophy of Quantum Mechanics; The interpretation of Quantum Mechanics in historical perspective.

Reference Books:

6. Michael Redhead: *Incompleteness, Nonlocality, and Realism: A Prolegomenon to the Philosophy of Quantum Mechanics*
7. A. Patrick., S. J Heelan: *Quantum Mechanics and Objectivity: A Study of the Physical Philosophy of Werner Heisenberg*

   Michel Bitbol: *Schrödinger's Philosophy of Quantum Mechanics*

Semester I

Biophysics

Course No: **PHY15110OE**	Max. Marks:	50
	External Examination:	40
No. of credits: **02**	Internal Assessment:	10

UNIT – I

Radiological Physics

Properties of Electromagnetic Radiation, Radiation Units, Exposure and Dose, Dose equivalent Unit, Particle flux, X Rays and Gamma Rays, their interaction with matter, Photoelectric and Compton effect, Ion pair production, Principles of Radiation detection and measurements, General requirement of dosimeters, Telegamma Unit (Cobalt Unit), Radio Isotopes in Biology, Agriculture plant breeding, soil plant relationship and plant physiology, Medicine and diagnosis.

UNIT – II

Radiation Safety measures

Natural and manmade Radiation exposure or principle of Dose Equivalent limit (DEL), Maximum permissible Dose (MPD), Evaluation of External and internal Radiation hazards, Radiation protection measures in Industrial establishment, Radio Isotope labs, Diagnostics and therapeutic installations during transportation of Radioactive substances, Disposal of Radioactive waste, Administrative and Legislative aspect of Radiation protection

Text Books:

1. Casarett A.P. (1968), Radiation Biology, Prentice-hall Inc.

2. Clause W.D. (1958), Radiation Biology and Medicine, Addison- Wesley.
3. Grosch D.S. (1979), Biological effects of Radiation, Academic Press.
4. Howard L. A. (1974), Radiation Biophysics, Prentice Hall Inc.

References Books:

1. Knoll G.E.(1979), Radiation detection and measurement, John Wiley and sons.

Semester II		
Renewable Energy Resources		
Course No: **PHY15210OE**	Max. Marks:	50
	External Examination:	40
No. of credits: **02**	Internal Assessment:	10

UNIT – I

Energy Senerio:

Global Energy Scenario, Energy & GDP, energy consumption and Projected future demands,

Non Renewable Energy Resources: Coal, Oil, Natural Gas, Nuclear Power.

Renewable Energy Resources : Hydroelectricity. Solar Energy:

Sun as Source of Energy, Nature of Solar Radiation, Photo thermal Systems, Photovoltaic systems. Geothermel Energy

UNIT – II

Wind Energy:

Wind Energy Fundamentals, Wind Measurements, Analysis and Energy Estimates , Aerodynamics Theory, Wind Turbines Technology, Issues and challenges in the wind energy sector.

Biomass Energy:

Biomass: Generation and utilization, Properties of biomass, Agriculture Crop & Forestry residues used as fuels. Biomass gasifiers Concept of Bio-energy: Photosynthesis process, Bio-fuels, Biomass resources Bio based chemicals and materials , Thermo-chemical Conversion: Pyrolysis, Combustion, Bio-fuels: Importance, Production and applications.

Hydrogen:

Hydrogen and energy source, Potential advantages, Hydrogen economy and its components, Hydrogen fuel cell. Global renewable energy trends.

Text Books:

1. Energy Economics: Concepts, Issues, Markets and Governance Subhes C. Bhattachary

2. Methane Production Guide - how to make biogas. Three simple anaerobic digesters for home construction by Richard Jemmett
3. Free Renewable Energy Book by The Clearlight Foundation
4. Energy systems and sustainability by Godfrey Boyle

References Books:

1. Energy Systems and Sustainability by Godfrey Boyle
2. Energy Systems and Sustainability: Power …Bob Everett
3. Sustainable Energy - David J.C. MacKay
4. Energy Science: Principles, John Andrews
5. Environmental Law Stuart Bell

Forms of examination

The student's knowledge will be tested by a written examination.

Aims and Objective: Course details

The course aims to develop an understanding of the existing and emerging renewable energy technologies. It covers basics of different sources and forms of renewable energy, status of these sources in India .

Semester III

Lasers

Course No: **PHY15311OE**	Max. Marks:	50
	External Examination:	40
No. of credits: **02**	Internal Assessment:	10

UNIT – I

Absorption, spontaneous and stimulated emission. Einstein coefficients, Trasition propability and lifetime of an atom in an excited state. Population inversion. Laser rate equations: The three level and four levelsystems. Line broadening mechanism. Shape and width of spectral lines. Optical resonators: Qualityfactor. Losses inside the cavity. Threshold conditions. Schawlow-Townes condition. Transverse and longitudinal mode selection.

UNIT – II

Laser Systems He-Ne laser. CO_2 laser. Four level solid state lasers. Dye lasers. Ar+ laser. Excimer lasers. Properties of laser beam: directionality, mono chromacity, intensity, coherence (temporal and Spatial). Applications oflasers: Laser induced fusion. Isotope separation.

Textbooks:

1) Thyagarayan, K. and Ghatak, A.K. : LASERS: Theory & Application
2) Laud, B.B. : Laser and Non-linear Optics (Wetey-Eastern)

Semester II

Philosophical Foundations of Physics

Course No: **PHY15211OE**	Max. Marks:	50
	External Examination:	40
No. of credits: **02**	Internal Assessment:	10

UNIT – I

Galileo's perspective; background, basic issues, natural philosophy, Newtonian framework; a revolution, broad coherence, Newton's absolute space, physics through determinism, coordinates, manifolds and Metrics; the building blocks , Aristotelian & Newtonian space-time, Galilean space The Leibniz-Clarke debate, handedness' and space.

UNIT – II

Special Relativity: Albert Einstein and his skeptiscism about classical physics, the postulates, Minkowski space-time, time topology and twin paradox, the most famous equation $E=mc^2$. what does it really mean? General Relativity: curved spaces and curved space-time, a conventional world, relationism versus substantivalism, the geometry of time, time travel as a technical problem, the direction of time.

Textbooks:

1. Philosophical Concepts in Physics: The Historical Relation between Philosophy and Scientific Theories by James T. Cushing
2. From Paradox to Reality: Our Basic Concepts of the Physical World by Fritz Rohrlich

Semester III

Radioactivity and Environmental Radon

Course No: **PHY15312OE**	Max. Marks:	50
	External Examination:	40
No. of credits: **02**	Internal Assessment:	10

UNIT – I

Radioactivity -A Basic Description, Types of radioactivity, Distribution of the Radioactive Elements in nature, Half Life and Units of Radon Disintegration Exposure, Quality Factor, Working Level, Working Level Month (WLM), Introduction to Environmental radon, History of Radon Spas, Radon Exposure and background Radiation Dose (humans), Radon Exposure mechanism, Radon in residential buildings, Sources of Radon inside residential Places

UNIT – II

Carcinogenic Nature of Radon, Studies on Carcinogenic Profile of Radon, Lung cancer risks in radon-exposed miners, Lung Cancer from indoor radon, Extrapolation, of miner lung cancer prevalence data, Ecological Studies, Case Control Studies, Summary of findings of measure pooling studies, Radon and diseases other than lung cancer, Prevalence of Lung cancer in Jammu and Kashmir, environmental radon as earthquick precurser. Radon mitigation techniques (residential places), use of radon as tracer in environmental sciences.

Text books:

1) Radon in the Environment, M. Wilkening, Elsevier Publishing Company (1990)
2) Radon Prevalence, Measurements, Health Risks and Control, Niren Laxmichand, Nagda Astm Manual Series, Mnl 5 (1994

Semester IV

Modern Communication Systems

Course No: **PHY15412OE**	Max. Marks:	50
	External Examination:	40
No. of credits: **02**	Internal Assessment:	10

UNIT – I

Introduction to wireless communications, example of wireless communication system, the Cellular concept and system design fundamentals, frequency reuse, Channel assignment strategies, Handoff strategies, Interference and system capacity, trunk and grade services, Methods for improving coverage and capacity in cellular system,
Multiple access techniques for wireless communications FDMA, TDMA, Spread spectrum techniques, SDMA, Packet Radio, CSMA, Capacity of cellular CDMA with multiple cells and capacity of SDMA

UNIT – II

Wireless systems and standards, AMPS, IS-94, GSM traffic, Examples of GSM cell, frame structure of GSM cello, details of forward and reverse CDMA channels
Personal access communication systems, Personal Mobile satellite communication, Integrating GEO, LEO, MEO Satellite and terrestrial mobile systems, Rake receiver and Advanced Rake receiver

Reference Book:

1. Wireless Communication Principles and Practice: 2nd Edition, Theodore S. Reppaport.
2. Wireless Digital Communication, Dr. Kamilo Feher

Text Books:

1. Electronic Communication System, Wayne Tomasi

Semester IV

Astronomical Techniques

Course No: **PHY15413OE**	Max. Marks:	50
	External Examination:	40
No. of credits: **02**	Internal Assessment:	10

UNIT – I

Telescopes; Types of telescopes. Design and construction of a simple Optical telescopes. Schmidt telescopes. Sky charts and their importance. Solar telescopes. Detectors for optical and infrared regions. Application of CCD's to stellar imaging.

UNIT – II

Astronomical photometry; Simple design of an astronomical photometer. Observing technique with a photometer Correction for atmospheric extinction. Tansformation to a standard photometric system. Astronomical spectroscopy; Spectral classification. Simple design of astronomical spectrograph. Radial velocity measurements.

Text Books:

1. C.R.Kitchin: Astrophysical Techniques
2. Henden and Kaitchuck: Astronomical Photometry.

Reference Books:

1. Gordon Walker: Astronomical Observations - an Optical Perspective (Cambridge University press).
2. Astrophysics-Stars and galaxies by K.D.Abhyankar.
3. C.R.Miczaika and W.M.Sinton: Tools of the Astronomers
4. W.A.Hiltner (Ed): Astronomical Techniques.
5. Carleton: Methods of Experimental Physics. Vol.XIIA.

Semester III

Condensed Matter Physics

Course No: **PHY15302CR**	Max. Marks: 100
	External Examination: 80
No. of credits: **04**	Internal Assessment: 20

UNIT – I

Electrons in a periodic lattice, origin of energy gaps. Bloch functions, Schrodinger wave equation in a reciprocal space; Bloch theorem. Tight binding approximation, pseudo-potential methods for energy band calculations.

Fermi surface of solids; experimental methods, De Hass-van Alfen effect, Cyclotron resonance, Electron motion in a magnetic field and Landau Levels.

UNIT – II

Low dimensional electron systems: Electronic structure of a two dimensional electron gas, density of states (DOS). Integral quantum Hall effect. One dimensional systems; DOS, 1D sub-bands, Van Hove singularities and their applications. Conductance quantization and the Landauer formula. Resonant tunneling, two potential barriers in series. Zero dimensional systems: quantized energy levels of semiconductor nanocrystals, DOS, Metallic dots, discrete charge states, Coulomb Blockade, Single Electron devices.

UNIT – III

Superconductivity: Critical temperature, heat capacity, energy gap, isotope effect, Meissner effect, Types of superconductors, London equations, BCS theory (Qualitative), Josephson effect.

Point defects and line defects; the role of dislocations in plastic deformation and in crystal growth.

UNIT – IV

Ferromagnetism: Weiss theory of ferromagnetism, Curie-Weiss law for susceptibility Heisenberg model and molecular field theory. Spin waves and Magnons, Bloch $T^{3/2}$ law. Formation of Domains, Bloch-wall energy

Ferroelectricity: Classification of Ferroelectric Crystals, applications. Landau theory of the ferroelectric phase transition.

Text Books:

1. Introduction to Solid State Physics by Charles Kittel, John Wiley & Sons.
2. The Physics of Low dimensional Semiconductors, An Introduction, by John H. Davies, Cambridge University Press.

Reference Book:

1. Solid State Physics by J. S. Blakemore, Cambridge University Press.
2. Solid State Physics by Neil W Ashcroft, N. David Mermin, BlackWell Pub.

Semester IV

Particle Physics

Course No: **PHY15401CR**	Max. Marks:	100
	External Examination:	80
No. of credits: **04**	Internal Assessment:	20

UNIT – I

Overview of Elementary particles: Overview of particle discoveries, particle classification schemes, the Gellmann-Nishijima scheme, the eight fold way, the quark model.

Invariance principles and conservation laws: the parity operation, parity of particles and antiparticles, tests of parity conservation, charge conjugation invariance, charge conservation and gauge invariance, baryon and lepton conservation, CPT invariance, CP violation.

UNIT – II

Weak Interactions: V-A theory, coupling constant, neutron decay, muon decay, pion decay, CP invariance and violation, Charged weak interactions, neutral weak interactions, Cabibo mixing, CP violation; the neutral kaon system.

Electroweak Interactions: prediction and discovery of W /Z , weak isospin and hypercharge, the basic electroweak interaction, the effective current-current interaction, Feynman rules for electroweak interaction, Electron-positron annihilation

UNIT – III

Quark structure of hadrons: the baryon decouplet, quark spin and colour, the baryon octet, magnetic moment of baryons, the light pseudoscalar mesons, the light vector mesons, mesons built of heavy quarks.

Lepton and quark scattering: electron positron annihilation to hadrons. electron-muon scattering, neutrino-electron scattering, lepton-nucleon scattering, deep inelastic scattering and quarks.

UNIT – IV

Strong Interactions: the evidence for quarks and colour charge, strange particles, strongly decaying resonances.

Standard model: particle content of the Standard Model, nature of fundamental interactions, Inadequacies of SM, unification of electroweak and strong interactions

Text Books:

1. Introduction to Elementary Particles by David Griffiths (John Wiley & Sons).
2. Quarks and Leptons by Francis Halzen and Alan D. Martin (John Wiley & Sons).

Reference Books:

1. Introduction to High Energy Physics by D. H. Perkins

Semester IV

Computational Methods in Physics

Course No: **PHY15403CR**	Max. Marks:	100
	External Examination:	50
No. of credits: **04**	Internal Assessment:	50

UNIT – I

Computers, Interpreters and Operating system, Types of programming languages, C programming, Programme Characteristics, C character set, identifiers and key words, Data types, Constants, Variables and Arrays Declaration, Expressions, Statements, Symbolic constants, Operators and Expressions, Library functions, Data input and output, Error Diagnostics, Debugging Techniques, Control statements, Case studies, Programming exercises

UNIT – II

Arrays, Character Arrays and Strings, User defined functions, Function properties, Recurrsion, Programme Structure, Structure and Unions, Pointers, Pointer Declaration, Operation on pointers, Pointers and one dimensional arrays, Arrays of pointers, User defined data types, File management in C, Preprocessor, Guidelines for developing a C programme, Case studies, Programming exercises

UNIT – III

Developing algorithms and Computer programs in C-Language to solve following problems:

(1) Linear Equations
(2) Non-Linear Equations
(3) Matrix Inversion
(4) Eigen-Values and Eigen-Vectors

UNIT – IV

Developing algorithms and Computers programs in C-Language to solve following problems:

(1) Interpolation with equally spaced and unequally spaced points
(2) Cubic Spline fitting
(3) Numerical Differentiation and Integration
(4) Second order differential equation by Runge-Kutta method and

other methods

Text Books:

1. Sastry: Introductory Methods of Numerical Analysis
2. Rajaraman: Numerical Analysis
3. Press, Teukolsky Vetterming and Flannery: Numerical Recipes
4. Balagurusamy: Programming in ANSI C

Reference Books:

1. Rajaraman: Numerical Analysis

Semester I

Lab. Course

Course No: **PHY15103CR**	Max. Marks:	100
	External Examination:	50
No. of credits: **04**	Internal Assessment:	50

Description

There shall be about 20 experiments available in the lab out of which the student shall have to complete at least 06 experiments in this semester.
The list of experiments presently available is as follows:

- To determine the wave length of a laser with a diffraction grating.
- To determine the energy gap of a semiconductor using Four probe method.
- To determine the curie temperature of an electrical material BaTio3
- To determine the dead time and absorption Co-efficient using G.M. Counter.
- ESR: Electron Spin Resonance.
- To determine the velocity of ultrasound in a given liquid medium (kerosene)
- To determine the Hall coefficient for a semiconductor sample.
- Designing and studying RC filters Active and Passive.
- To Determination of e/m ratio of electron by J.J. Thomson's method.
- To Determination of e/m ratio of electron by Helical method
- To determine the velocity of sound using Lissajous figures.
- Determination of Plank's constant using Photoelectric Effect.
- Antenna measurements
- Michelson Interferometer
- Fabry-Perot Interferometer
- Study of Regulated Power Supply
- Study sinusoidal steady-state response of a resonant circuit in the phasor domain.
- To determine the characteristics of a Solar Cell.
- Study Digital Fiber Optical Transmitter and Receiver.
- Fast Fourier Transform (FFT) in Excel

Semester II

Electrodynamics – I

Course No: **PHY15202CR**	Max. Marks:	100
	External Examination:	80
No. of credits: **04**	Internal Assessment:	20

UNIT – I

Review of: Coulomb's Law, Electrostatic field, Gauss's law and Differential form of Gauss's law, Scalar potential, Surface distributions of charges and dipoles, Poisson's and Laplace's equation, Green's theorem, Uniqueness theorem, Formal solution of boundary-value problem, Green's functions, Electrostatic potential energy

Method of images, Point charge and grounded conducting sphere, Point charge and conducting sphere in uniform field, Method of inversion, Green's function for sphere, Conducting sphere with hemi-spheres at different potentials, Orthogonal functions and expansions, Separation of variables in rectangular co-ordinates

UNIT – II

Boundary value problems in cylindrical co-ordinates, Expansion of Green's function in spherical co-ordinates, Eigen function expansion of Green's functions, Mixed boundary conditions, charged conducting disc

Multiple expansion, Multiple expansion of the energy of a charge distribution in external field, Macroscopic electrostatics, Simple dielectrics and boundary conditions, Molecular polarizability and electric susceptibility, Modes of Molecular polarizability, Electrostatic energy in dielectric media

UNIT – III

Review of: Biot and Savart law, Differential equations of magnetostatics and Amperes law, Vector potential, Magnetic induction of a circular loop of current, Localized current distribution, Magnetic moment, Force and torque on localized currents in the external field, Macroscopic equation, Boundary conditions, Uniformly Magnetized sphere, Magnetized sphere in an external field, Permanent magnets

Faraday's law of Induction, Energy in Magnetic field, Maxwell's Displacement

current, Maxwell's equations, Vector and scalar potentials, wave equations, Guage transformation, Green's function for time-dependent wave equation, Initial value problem, Kirchhoff's integral representation, pointing theorem, conservation laws, Macroscopic equations

UNIT – IV

Plane waves in non-conducting media, linear and circular polarization, Superposition of waves, group velocity, propagation of pulse in dispersive medium, reflection and refraction, polarization by reflection, total internal reflection, Waves in conduction media. Simple model for conductivity, transverse waves in tenuous plasma

Field at the surface of and within the conductor, cylindrical cavities and wave guides, Wave Guides, modes in a rectangular wave guide, Energy flow and attenuation in a wave guides, resonant cavities, power losses in cavity, Dielectric wave guides

Text Book:

1. Classical Electrodynamics, by John David Jackson, John Wiley & Sons Inc

Reference Books:

1. he Classical Theory of Fields, L. D. Landau and E. M. Lifshitz, Butterworth Heinman
2. Introduction to Electrodynamics, David J. Griffiths, Pearson Education