SEMESTER I

PHYS-611 Mathematical Methods in Physics

External: 70 Marks | Internal: 30 marks

Lectures: 40 Lecturers | Tutorials: 10 Lecturers

Additional Contact Hours: 10 (seminars, quiz, assignments, group discussion etc.)

UNIT – I

Coordinate Systems:

Curvilinear coordinat es, differential vector operations, special coordinate systems- rectangular Cartesian, spherical polar and circular cylindrical coordinates, and expressions of gradient, divergence, curl and Laplacian **(4 Lecturers)**

Tensors:

Coordinate transformations, scalars, contra-variant and covariant vectors, definition of contra-variant, mixed and covariant tensor of second rank, Addition, subtraction and contraction of tensors, quotient rule.

(4 Lecturers)

UNIT – II

Matrices:

Orthogonal matrices, Orthogonality conditions- two and three dimensional cases, Hermitian and unitary matrices, Pauli matrices, Dirac matrices, Diagonalization of matrices- Eigen value and Eigen vectors.

(4 Lecturers)

Elementary Group Theory:

Definition of group, Isomorphism and Homomorphism, Matrix representation- reducible and irreducible groups, subgroup-invariant subgroup, Discrete groups-two objects two-fold symmetry axis, three objects-three-fold symmetry axis, Continuous Groups- orthogonal group O_3^+, special unitary group SU(2)

(4 Lecturers)

UNIT – III

Second Order Differential Equations:

Separation of variables-ordinary differential equations, singular points, series solutions – Frobenius method and its limitations, Wronskian-linear independence and linear dependence. **(4 Lecturers)**

Special Functions:

Bessel functions of the first kind, integral representation, Legendre functions-generating function, recurrence relations and orthogonality, Associative Legendre functions, spherical harmonics, Hermite functions. Laguerre functions. **(4 Lecturers)**

UNIT – IV

Complex Variables:

Functions of complex variable, Cauchy- Riemann conditions, Cauchy Integral theorem, Cauchy integral formula, Laurent expansion, Calculus of residues –poles, Essential singularities and branch points, Residue theorem, Jordan's lemma, Singularities on contours of integration, Evaluation of definite integrals.

(8 Lecturers)

UNIT – V

Fourier series and Fourier Transforms:

Fourier series- General properties and uses, Differentiation and integration of Fourier series, Fourier transforms, Fourier integral-exponential form, Fourier transform-inversion theorem. **(4 Lecturers)**

Laplace Transform:

Elementary Laplace transforms, Laplace transform of derivatives**,** substitution properties of Laplace transform.

(4 Lecturers)

Tutorials:

Applications of topics covered in each unit in Physics (based on problems given in the reference books) as given in the detailed lecture schedule will be covered in the tutorial classes. **(10 Hours)**

Recommended Books:

Mathematical methods for Physicists – George B. Arfken & Hans J. Weber

Applied Mathematics for Physicists and Engineers – L. A. Pipes

PHYS-612 Classical Mechanics

External: 70 Marks Internal: 30 marks

Lectures: 40 Lecturers Tutorials : 10 Lecturers

Additional Contact Hours: 10 (seminars, quiz, assignments, group discussion etc.)

UNIT – I

Many particle systems; conservation laws, Constraints; their classification; degrees of freedom, D'Alembert's principle, generalized coordinates, Lagrange's equations from D'Alembert's principle, velocity dependent potentials and dissipative forces. **(8 Lecturers)**

UNIT – II

Jacobi integral, Gauge invariance, generalized momenta, cyclic coordinates, integrals of motion, Symmetries of space and time with conservation laws. **(2 Lecturers)**

Rotating frames:

Transformation equations, pseudo (fictitious) forces, Rigid body dynamics: Angular momentum and Kinetic energy of motion about a point, moment of inertia tensor. **(6 Lecturers)**

UNIT – III

Central force:

Definition and characteristics; properties, closure and stability of circular orbits, Two-body collisions, scattering in laboratory frame, scattering centre-of-mass frame. **(4 Lecturers)**

Variational principles:

Techniques of the calculus of variations, Example of use of the variational principle to find the shortest distance between two points, Hamiltons principle: derivation of Lagrange's equations from Hamilton's principle, equations of motion. **(4 Lecturers)**

UNIT – IV

Canonical transformation:

Generating functions, Hamilton-Jacobi equation; solution: Hamilton's principal function, Solution of harmonic oscillator problem by H-J method. **(4 Lecturers)**

Poisson brackets:

fundamental PB, some properties, Poisson theorems, Angular momentum PBs, Invariance of PB under canonical transformations, relation of PB to quantum mechanics. **(4 Lecturers)**

UNIT – V

Types of equilibria, Periodic motion, small oscillations and normal modes, Free vibrations of a symmetric linear tri-atomic ,Special theory of relativity, Lorentz transformations, Velocity transformations, mass energy equivalence, Four vectors : velocity and acceleration 4 vectors. **(8 Lecturers)**

Tutorials:

Principle of virtual work, problems related to conservation laws, Application of Lagrange equations : Simple pendulum, two connected mass with string over pulley, rolling mass inside or outside a circular ring, Foucault's pendulum, examples of Coriolis force on earth, Example of how energy can be conserved while H need not and vice versa.

Infinitesimal contact transformation, Example of application of canonical transformation for a harmonic oscillator

In addition to the above problems, students are expected to solve examples and problems given in the text as assignments. **(10 Hours)**

Recommended Books:

Herbert Goldstein: Classical Mechanics

Rana and Joag, Classical Mechanics

PHYS-613 Quantum Mechanics-I

External: 70 Marks | Internal: 30 marks

Lectures: 40 Lecturers | Tutorials : 10 Lecturers

Additional Contact Hours: 10 (seminars, quiz, assignments, group discussion etc.)

UNIT – I

Inadequacy of Classical Mechanics:

Black body radiation, Planck' hypothesis, photoelectric effect, Compton effect, Frank-Hertz experiment, Hamilton's principle. Schrödinger equation, Normalization, probability interpretation of ψ, Admissible wave functions. **(3 Lecturers)**

Linear Vectors Space:

Vectors: Definition and properties, Examples of linear vector spaces, norm of a vector, orthonormality and linear independence, Basis and dimensions, Completeness (Closure property), Hilbert space, subspace, Inequalities and Ehrenfest theorem.

Operators: Equality, product, sum, power, function, inverse of operators, eigenvalues and eigenvectors of an operator, Positive definite, continuous and bounded operators, Linear operators, Hermitian operators, Unitary operators, Projection operators. **(5 Lecturers)**

UNIT – II

Dirac Space and Representation Theory:

Completeness of eigenfunctions, Bra and Ket notation for vectors, Dirac-Delta function, Matrix elements of change of basis, unitary transformation. Representation theory, Coordinate and momentum representations. **(3 Lecturers)**

Postulates of Quantum Mechanics & Uncertainty Relations:

Postulates of Quantum mechanics, Uncertainty relations**,** States with minimum uncertainty product, Commutators, Theorem of simultaneous eigenfunctions. **(5 Lecturers)**

UNIT – III

Quantum Dynamics:

The equations of motion, Schrodinger picture, Heisenberg picture, Interaction Picture, Linear Harmonic Oscillator: Solutions from Schrodinger and Heisenberg Pictures, the method of second quantization. **(5 Lecturers)**

The Hydrogen Atom:

Two body equation, Separation of variables for spherically symmetric potential, radial wave equation, radial wave functions and energy states. **(3 Lecturers)**

UNIT – IV

Quantization of Angular Momentum:

Definition, angular momentum of a system of particles, matrix representation, Pauli matrices, the spin eigenvectors. Orbital angular momentum: Solutions, Spherical harmonics and properties, addition theorem (no proof). **(5 Lecturers)**

Addition of angular momenta:

Clebsch-Gordan coefficients, the selection rules, properties of CG coefficients (without proof): symmetry, orthogonality and recursion relations. **(3 Lecturers)**

UNIT – V

Perturbation Theory (Non-degenerate case):

Basic formulation of the method and applications: Anharmonic oscillator (x^4), linear harmonic oscillator, infinite square well. **(5 Lecturers)**

Degenerate case:

Formulation and applications: Stark and Zeeman effects in H, Infinite cube well.

(3 Lecturers)

Tutorials:

Applications of topics covered in each unit in Physics (based on problems given in the reference books) as given in the detailed lecture schedule will be covered in the tutorial classes. **(10 Hours)**

Recommended Books:

Quantum Mechanics, V.K. Thankappan, Wiley Eastern Ltd. (1986).

Introduction to Quantum Mechanics, D.J. Griffiths, Pearson Education Inc. (2005)

Principles of Quantum Mechanics, R. Shankar, Plenum Press, New York (1994)

Modern Quantum Mechanics, J.J. Sakurai, Addison and Wesley (1994).

PHYS-614 Electronics

External: 70 Marks Internal: 30 marks

Lectures: 40 Lecturers Tutorials : 10 Lecturers

Additional Contact Hours: 10 (seminars, quiz, assignments, group discussion etc.)

UNIT – I

Amplification: Operational Amplifiers-I:

Differential amplifier: circuit configurations, dual input, balanced output differential amplifier, DC analysis

and AC analysis, inverting and non inverting inputs, block diagram of typical OP-Amplifier, constant current-bias level translator. Open loop configuration, inverting and non-inverting amplifiers, and Frequency- response

OP-Amp Parameters: input offset voltage, bias currents, input offset current, output offset voltage, CMRR, frequency response, Slew rate. OP-Amp with negative feedback, voltage series feedback, effect of feed-back on closed loop gain, input and output resistance, band width. **(8 Lecturers)**

UNIT – II

Operational Amplifiers based Instrumentations and their applications:

DC and AC amplifier, voltage follower, adder, subtractor, multiplier, phase changer, active filters, active integrator and active differentiator. **(3 Lecturers)**

Oscillators and wave shaping Circuits:

Oscillator Principle - Oscillator types, frequency stability response, the phase shift oscillator, Wien bridge oscillator, LC tunable oscillators, multivibrators: monostable and astable, comparators, square and triangle wave form generators. **(5 Lecturers)**

UNIT – III

Voltage regulators:

Block diagram of Power supply, fixed voltage regulators, adjustable voltage regulators, switching regulators. Clipping and clamping circuits. **(3 Lecturers)**

Boolean algebra and logic gates:

Canonical and standard forms, IC logic families, Simplification of Boolean functions: Karnaugh map of up to 4 variables, don't care conditions, NAND and NOR implementation. **(3 Lecturers)**

Combinational logic:

Adders, subtractors, binary parallel adder, magnitude comparator, decoders/de-multiplexers encoders/multiplexers. **(2 Lecturers)**

UNIT – IV

Sequential Logic:

Basic flip-flop, clocked RS flip-flop, T flip-flop, D flip-flop, J-K flip flop, triggering of flip-flops, JK master slave flip-flops; Synchronous and asynchronous counters: Binary counters, Decade counters, Registers. **(5 Lecturers)**

Microprocessors:

Organization of a Micro computer based system, Microprocessor architecture and its operations, Memory, memory map. The 8085 microprocessor unit; Functional block diagram. **(3 Lecturers)**

UNIT – V

Assembly Language Programming of 8085:

Instruction set of 8085: Data transfer operations, Arithmetic operations, Logic operations, Branch operations, Addressing modes of 8085 instructions, Assembly language programmes involving data transfer, arithmetic logic operations and looping, counting and indexing - counters and timing delays. **(8 Lecturers)**

Tutorials:

Review of basic electronics: Currents in a transistor, Design of CE and CC Amplifier, Design of two stage amplifier. In addition to the above, problems from the reference books can be given as assignments to the students. **(10 Hours)**

Recommended Books:

- Integrated Electronics by J. Millman and C.C. Halkias, TMH, New Delhi
- OP-AMP and Linear Integrated Circuits by Ramakanth, A. Gayakwad, PHI, New Delhi
- Electronic Devices and Circuit Theory by Robert Boylestead and Louis Nashelsky, PHI, New Delhi – 110001
- Digital Logic and Computer design by Electronics by Morris Mano
- Digital Principle and Applications by A.P. Malvino and Donald P. Leach, TMH, New Delhi.
- Microprocessors Architecture, Programming and Applications with 8085/8086, Ramesh S Gaonkar, Wiley - Eastern Ltd.

PHYS-615 General Physics Practical

External: 70 Marks Internal: 30 marks

External Assessment:

Experiments: 50 marks

Viva-Voce: 20 marks

NOTE:

- Students are required to complete at least five experiments allotted to them.
- Students are expected carry out the practical after understanding theoretical principle behind each experiment, design of experiments, working principle of the equipments/instruments, sources of errors in experiments etc.
- Experimental errors must be estimated in all experiments.

LIST OF EXPERIMENTS

1. Measurement of arc spectra by constant deviation spectrometer.
2. Determination of elastic constants of glass by method of Cornu's fringes.
3. Determination of coefficient of thermal conductivity of metal by Ångstrom's method.
4. To study variation in internal resistance of a material with temperature.

5. To study the Hall effect in a given semiconductor probe and to find the Hall Voltage and Hall Coefficient, Charge Carriers, Hall angle and Mobility.
6. To study the characteristic of given Solar Cell Panel.
7. Determination of λ, $d\lambda$, and thickness using Michelson's interferometer.
8. Determination of wavelength of light emitted by He-Ne laser and to verify the law governing Interference from a Young's double slit experiment.
9. Measurement of wavelength of He-Ne laser light using ruler.
10. Measurements of thickness of thin wire with laser.
11. Investigation of Faraday's effect and to determine Verdt's constant.
12. To plot the polar curve of a filament lamp and to determine its mean spherical intensity.
13. To study the dissociation limit of iodine.
14. Jamin's Interferometer's method for refractive index of air using He-Ne Laser.
15. Beam characteristics of a He-Ne laser beam.

Any other experiments designed and setup by the teacher on the availability of laboratory.

PHYS-616 Electronics Laboratory

External: 70 Marks Internal: 30 marks

External Assessment:

Experiments: 50 marks

Viva-Voce: 20 marks

NOTE:

- Students are required to complete at all experiments allotted to them from Section-A and section-B.
- Students are expected carry out the practical after understanding theoretical principle behind each experiment, design of experiments, working principle of the equipments/instruments, sources of errors in experiments etc.
- Experimental errors must be estimated in all experiments.

LIST OF EXPERIMENTS

SECTION-A: Analog Electronics

1. Measurement of operational amplifier parameters.
2. Study of Clipping and clamping circuits.
3. Study of active filter circuits
4. Study of active integrator and differentiator circuits
5. Study of Wien Bridge Oscillator
6. Study of wave form generators: (a) Square wave generator (astable multivibrator), (b) Pulse generator (monostable multivibrator) and triangular wave generator.

7. Study of Schmitt Trigger and comparators
8. Study of UJT parameters and Relaxation Oscillator
9. Design of a Regulated power supply: (a) Study of series voltage regulated power supply and (b) study of IC regulated power supply.

SECTION-B: Digital Electronics

1. Study of two bit and four bit adder
2. Study of subtractor
3. Study of decoder and 7- segment display
4. Study of multiplexer
5. Study of demultiplexer
6. Study of Flips Flops : RS, JK, JKMS, D &T flip-slops
7. Study of Shift Registers
8. Study of Counters : 4-bit Ripple counter, 4-bit Synchronous Counter, BCD Counter

Any other experiments designed and setup by the teacher on the availability of laboratory.

Reference Books:

- Integrated Electronics by Millman and Halkias, TMH, New Delhi
- OP-AMP and Linear Integrated Circuits by Ramakanth, A. Gayakwad, PHI, New Delhi
- Electronic Devices and Circuit Theory by Robert Boylestead and Louis Nashelsky, PHI, New Delhi - 110001, 1991.
- Digital Logic and Computer design by Electronics by Morris Mano
- Digital Principle and Applications by A.P. Malvino and Donald P. Leach, TMH, New Delhi.
- Lab manuals

SEMESTER II

PHYS-621 Computational Methods in Physics

External: 70 Marks | Internal: 30 marks

Lectures: 40 Lecturers | Tutorials: 10 Lecturers

Additional Contact Hours: 10 (seminars, quiz, assignments, group discussion etc.)

(Topics must be taught through Algorithmic approach. Detailed derivations of the equations are not required.)

UNIT – I

Computers and Numerical Analysis:

IEEE 64 bit Floating point number representation, arithmetic operations, consequences of floating Point representation, computing errors, Error propagation, Introduction to parallel and distributed computing, Measuring efficiencies of Numerical procedures **(3 Lecturers)**

System of Linear Equations:

Solving a system of Linear equations using Gauss Elimination, Gauss Jordan methods, Inverse of a matrix, Iterative methods to solve Equations: Gauss Seidel iterations, comparison of Iterative and Direct Methods.

(6 Lecturers)

UNIT – II

Non-linear equations:

Bisection and Newton Raphson method, Solution of Polynomial Equations, Newton methods for a system of nonlinear equation. **(4 Lecturers)**

Interpolation:

Lagrange Interpolation, Difference tables, Truncation error, Spline Interpolation **(3 Lecturers)**

Curve fitting:

Straight line fit, fitting using polynomial function of higher degree, Exponential Curve Fit cubic spline fitting

(3 Lecturers)

UNIT – III

Fourier Transform:

Fourier analysis and orthogonal functions, Discrte Fourier Transform, Power Spectrum of driven pendulum. **(3 Lecturers)**

Numerical Integration:

Simpson and Gauss quadrature method. **(2 Lecturers)**

Numerical Differentiation:

Difference approximation of first derivative. **(1 Lecturers)**

UNIT – IV

Differential equations:

Euler and Taylor Series methods, Runge-Kutta Methods, Predictor-corrector Method, Comparison of different methods. **(5 Lecturers)**

Elementary ideas of solutions of Partial Differential Equations. **(1 Lecturers)**

Montecarlo simulations:

Sampling and Integration, Metropolis Algorithm, Applications in Statistical physics. **(3 Lecturers)**

UNIT – V

Matrices and Eigen values:

Eigen values and Eigen vectors, Similarity transformation to and Diagonalization power method find eigen values, physical meaning of eigen values and eigen vectors. **(6 Lecturers)**

Recommended Books:

- V. Rajaraman, Computer Oriented Numerical methods, Third Edition, PHI, 2013
- Curtis F Gerald and Patrick Wheatley: Applied Numerical Analysis, Seventh Edition, Pearson Education Inc. 2004
- Won Young Yang, Wenwu Cao, Tae-Sang Chung and John Morris: Applied Numerical Methods Using MATLAB, Wiley 2005
- Tao Pang: An Introduction to Computational Physics, Cambridge Press

PHYS-622 Quantum Mechanics II

External: 70 Marks Internal: 30 marks

Lectures: 40 Lecturers Tutorials : 10 Lecturers

Additional Contact Hours: 10 (seminars, quiz, assignments, group discussion etc.)

UNIT – I

Approximation methods

The WKB approximation:

Introduction of the method, The Classical region, Tunneling, The WKB wave function and connection formulae, Criterion for validity of approximation, Applications to potential well with a vertical wall and no vertical walls, Energy of one dimensional bound system. **(5 Lecturers)**

The Variational method:

Basic formulation and principle of the method, bound state (Ritz method), Applications to linear harmonic oscillator, Ground state energy under delta potential, Helium atom. **(3 Lecturers)**

UNIT – II

Theory of scattering:

The scattering experiment, Classical and quantum mechanical scattering, Relationship of scattering cross-section to the wave function, Scattering amplitude, Method of partial waves, Expansion of a plane wave into partial waves. **(5 Lecturers)**

Scattering by a central potential V(r):

Dependence of phase shift on V(**r**), angular momentum and energy, Zero energy scattering, Scattering length, Scattering by a square well potential, effective range. **(3 Lecturers)**

UNIT – III

Born approximation and Integral equation of scattering:

Born approximation, Green Function, The integral equation for scattering, The Born series, Criterion for the validity of the Born approximation, Low energy soft-sphere scattering, Yukawa Scattering, Scattering of electrons by atoms, Rutherford scattering. **(5 Lecturers)**

Variational principles:

Techniques of the calculus of variations, Example of use of the variational principle to find the shortest distance between two points, Hamiltons principle: derivation of Lagrange's equations from Hamilton's principle, equations of motion. **(4 Lecturers)**

Identical particles:

The identity of particles, the indistinguishability principle, symmetry of wave functions, spin and statistics, Pauli exclusion principle, Illustrative example: scattering of identical particles, case of spin half and spin zero particles. **(4 Lecturers)**

UNIT – IV

Time dependent perturbation theory:

Basic principle and formulation of time dependent perturbation theory, constant perturbation, Continuum, Transition to continuum, Fermi¨s golden rule, scattering cross section in the Born approximation, Harmonic perturbation. **(5 Lecturers)**

Radiative transitions in atoms:

Theory of radiative transitions in atoms, The dipole transitions, Selection rules involving m and ℓ.
(3 Lecturers)

UNIT – V

Relativistic wave equations:

The Klein Gordan equation:

Introduction, The Klein-Gordan equation, Interpretation of probability and the equation of continuity.

(6 Lecturers)

Dirac equation:

The first order wave equations, Weyl equation, The Dirac equation, Properties of Dirac matrices, Covariant form of Dirac equation, Existence of intrinsic angular momentum of Dirac particle, Solutions of Dirac equation, The non-relativistic limit of Dirac equation, spin-orbit coupling, Hole theory.

(6 Lecturers)

Recommended Books:

- Quantum Mechanics, V.K. Thankappan, Wiley Eastern Ltd. (1986).
- Introduction to Quantum Mechanics, D.J. Griffiths, Pearson Education Inc. (2005).
- Principles of Quantum Mechanics, R. Shankar, Plenum Press, New York (1994).
- Modern Quantum Mechanics, J.J. Sakurai, Addison and Wesley (1994).

PHYS-623 Statistical Mechanics

External: 70 Marks | Internal: 30 marks

Lectures: 40 Lecturers | Tutorials : 10 Lecturers

Additional Contact Hours: 10 (seminars, quiz, assignments, group discussion etc.)

UNIT – I

Classical Statistical Mechanics:

The Postulate of Classical Statistical Mechanics, Microcanonical Ensemble,, Derivation of Thermodynamics, Equipartition theorem, classical ideal gas, Gibbs Paradox. **(4 Lecturers)**

Canonical Ensemble and Grand canonical Ensemble:

Canonical Ensemble, Energy fluctuations, Grand Canonical ensemble, Density fluctuations in the Grand Canonical Ensemble, The Chemical potential, Equivalence of the canonical ensemble and grand canonical ensemble. **(4 Lecturers)**

UNIT – II

Quantum Statistical Mechanics:

The postulates of Quantum Statistical mechanics, Density Matrix, Ensembles, Third law of Thermodynamics, The Ideal Gases: Micro canonical and Grand Canonical Ensemble, Foundations of Statistical Mechanics.

(8 Lecturers)

UNIT – III

The General Properties of Partition function, Classical Limit of Partition functions, Singularities and Phase transitions.

Classical cluster expansion, quantum cluster expansion, Virial coefficient, variational Principles, imperfect gases at Low temperatures.

Identical particles and symmetry requirement, difficulties with Maxwell-Boltzmann statistics, quantum distribution functions, Bose Einstein and Fermi-Dirac statistics and Planck's formula. **(8 Lecturers)**

UNIT – IV

Bose Einstein condensation, liquid He4 as a Boson system, quantization of harmonic oscillator and creation and annihilation of phonon operators, quantization of fermion operators

The Ising Model:

Definition of Ising model, Spontaneous Magnetization, The Bragg-Williams Approximation, The One dimensional Ising Model. **(8 Lecturers)**

UNIT – V

Landau theory of free energy, mathematical digression, derivation in simple models, mean field theory, the Vander-Waal equation of state, Gaussian model, Ginzburg criterion. **(8 Lecturers)**

Degenerate case:

Formulation and applications: Stark and Zeeman effects in H, Infinite cube well.

(3 Lecturers)

Tutorials: **(10 Lecturers)**

- Calculation of number of states and density of states 1D free particles in a Box
- Linear harmonic and harmonic oscillators
- Statistics of Occupation number calculation of thermodynamic quantities
- Black body radiation and photon statistics
- Evaluation of second virial coefficient
- Fluctuations in thermodynamic variables

Recommended Books:

- Huag : Statistical Mechanics
- Reif: Fundamentals of Statistical and Thermodynamical Physics.
- Rice: Statistical mechanics and Thermal Physics.
- Kubo: Statistical Mechanics
- Landau and Lifshitz: Statistical mechanics
- S. N. Biswas: Statistical mechanics

PHYS-624 Electrodynamics

External: 70 Marks | Internal: 30 marks

Lectures: 40 Lecturers | Tutorials : 10 Lecturers

Additional Contact Hours: 10 (seminars, quiz, assignments, group discussion etc.)

UNIT – I

Coordinate systems and transformation: **(2 Lecturers)**

Electrostatics: Field lines, flux and Gauss law and applications, Laplace and Poisson equations, electrostatic boundary conditions. **(4 Lecturers)**

Magnetostatics: Biot-Savart law, Ampere's theorem, electromagnetic induction. **(2 Lecturers)**

UNIT – II

Maxwell's equations in free space and linear isotropic media, boundary conditions on fields at interfaces. **(3 Lecturers)**

Scalar and vector potentials, Gauge invariance. **(2 Lecturers)**

Electromagnetic waves in free space, dielectrics and conductors, reflection and refraction. **(3 Lecturers)**

UNIT – III

Electromagnetic waves in dielectrics and conductors: polarization, Fresnel's law, coherence, interference and diffraction. **(2 Lecturers)**

Dispersion relations in plasma, Lorentz invariance of Maxwell‟s equations, classification of waves (TEM, TE, TM), Transmission lines: lossless line, terminated transmission line and general lossy line. **(4 Lecturers)**

Rectangular wave guide, Electromagnetic cavities: time average electric and magnetic energies. **(2 Lecturers)**

UNIT – IV

Electromagnetic cavities: damping constant, quality factor (no derivation), Dipole radiation: Retarded potential. **(2 Lecturers)**

Liénard-Wiechert potential, dynamics of charged particle in static and electromagnetic field, electric and magnetic fields due to a uniformly moving charge and an accelerated charge. **(4 Lecturers)**

Radiation from moving charges, Qualitative discussion of Bremsstrahlung, synchrotron radiation (no derivations), Radiation reaction: The Abraham-Lorentz formula, radiation damping. **(2 Lecturers)**

UNIT – V

Basic properties and occurrence: definition of plasma, natural occurence of plasma, Astrophysical plasmas. **(2 Lecturers)**

Criteria for plasma behaviour, plasma oscillation, quasineutrality and Debye shielding, plasma parameter and plasma production, thermal ionization, Saha equation (No derivation) **(4 Lecturers)**

Brief discussion of methods of laboratory plasma production, steady stage glow discharge, microwave breakdown and induction discharge. **(4 Lecturers)**

Tutorials:

10 hrs Additional Contact Hours : 10 (Problems based upon coordinate systems and transformation, electrostatic and magnetostatic boundary conditions, Maxwell's equations, rectangular waveguide and electromagnetic cavities).

Recommended Books:

- DJG – David J. Griffiths, Introduction to Electrodynamics, 2nd
- Edition JDJ – J.D. Jackson, Classical Electrodynamics, 3rd Edition
- MS- M. Sadiku – Elements of Electromagnetics, 3rd "Digital Logic and Computer design" by Electronics by Morris Mano
- Edition Chen: Plasma Physics, 2nd Edition
- P & C – Robert Plonsey and R.E Collins : Principles and applications of electromagnetic fields.

PHYS-625 Electronics Projects

External: 70 Marks Internal: 30 marks

External Assessment:

Experiments: 50 marks

Viva-Voce: 20 marks

NOTE:

- Students are required to submit a project report and working model of the project for evaluation in Section A.
- Students will write and execute one program based on microprocessor.
- External assessments will be on presentation and viva-voce.

SECTION-A: Design and fabrication of one Experimental Kit

1. Design the operational amplifier parameters circuit.
2. Design Clipping and clamping circuits.
3. Design the active filter circuits.
4. Design the active integrator and differentiator circuits
5. Design the wave form generators like square wave generator, pulse generator or triangular wave generator.
6. Design the Schmitt Trigger circuit.
7. Design the series voltage regulated power supply.
8. Design the metal oxide field effect transistor (MOSFET) circuit or field effect transistor (FET) circuit.

9. Design the push-pull amplifier circuit.
10. Design and study a two stage RC coupled amplifier.
11. Design the two bit and four bit adder or a subtractor.
12. Design the decoder and encoder.
13. Design the multiplexer or de-multiplexer.
14. Design RS, JK, JKMS, D &T flip-flops.
15. Design of Shift Registers.

SECTION-B: Microprocessor 8085

1. One's compliment and two's complements of a number.
2. Mask off most significant and least significant 4-bits of an 8-bit data.
3. Addition of 8-bit hexadecimal data.
4. Subtraction of two 8-bit data.
5. Addition of 16-bit data.
6. Multiplication of two numbers.
7. Division of two 8-bit data and the quotient and the remainder are stored in two successive memory locations.

Note: Any other experiment suggested by teacher

Recommended Books:

- Morris Mano, Digital Logic and Computer design by Electronics
- Malvino and Leach, Digital Principle and Applications
- Ramakanth and Gayakwad, OP-AMP and Linear Integrated Circuits
- Boylestead and Nashelsky, Electronic Devices and Circuit Theory
- Millman and Halkias, Integrated Electronics
- Ramesh S Gaonkar, Microprocessor Architecture, Programming and Applications with 8085/8086.

PHYS-626 Computational Physics Laboratory

External: 70 Marks Internal: 30 marks

External Assessment:

Experiments: 30 marks + 20 marks

Viva-Voce: 20 marks

NOTE:

SECTION-A: Fortran Language

In this section students are required to carry out practical by implementing algorithm taught in the theory paper computational methods in physics.

SECTION-B: Matlab Programming

In this section programming should be done by the students using matlab for numerical analysis.

PHYS-627 Information and Communication Technology skill (ICT)

External: 70 Marks Internal: 30 marks

Practical training on following topics and to acquire the skill mentioned must be provided to the participants of the course

Use of video and online recourses: 10 Hrs.

Assignment/Self study/Practical: 60 Hrs.

Skill test and presentations: 10 Hrs.

Identification of various components of a computer system: Identify mother board, CPU, Memory, various ports and connectors, drives, keyboards, mouse, types of monitors and its connection to computer, hardware specifications.

Skill: Identification of various components of a PC and writing specification of a computer.

Operating a computer system: Desktop, using help, My computer, folders and files, word pad, copy, save and print.

Skill: Operation of a PC

Word Processing: Creating new documents, entering text, saving, closing and opening files, editing & formatting, cut, copy and paste, search and replace, insert page number, date, picture, page layout, spell and grammer check, headers and footer, footnoting, table of contents, table, mail merge, mailing labels using Menu items etc.

Skill: Preparation of a given document.

Spreadsheet: Creating and editing a workbook, using charts, managing workbook. Candidate should be trained to create, enter and edit data, save and close workbook, change column width, moving, entering and merging cells, using formulae, using functions, formatting worksheet, creating chart, printing.

Skill: Preparation of invoice, balance sheet, plotting selected columns of a table etc.

Database Management System: Creating a database, modifying table, creating forms, queries and reports. Candidates should be trained in creating data entry, close and open table and database, customizing and inserting fields, sorting, form wizard, adding records, using queries, creating and printing reports.

Skill: Prepare telephone directory, catalogue and making queries and required reports.

Presentation Graphics: Creating modifying and refining presentation, using advanced presentation features.

Skill: Prepare a good presentation on given topic.

Insert and Personal Information Management: Internet and intranet, browsers and finding information, URL's, search services, e-mail, checking internet connection.

Using calendar for appointment, creating and managing task, address book and its management.

Skill: Creating of mailing list, preparing appointment and tasks.

Web Authoring and IT work: Creating a web page using HTML editor, modifying and refining web page, inserting hyperlink, changing theme and layout, inserting images, publishing web page.

Skill: Creating and Publishing a web page.

Installation of Software including antivirus software, printer and other devices. Installing and using PDF files, using ftp, using google drive.

Skill: Preparing a PC for office by installing necessary software.