Phy-301 Semester-III Mathematical Physics III

Max. Marks : 40
Internal Assessment : 10
Time : 3 Hrs.

NOTE :

1. The syllabus is divided into 2 units. Eight questions will be set up. Four questions from each unit. Student will have to attempt at least two questions from each unit. A student has to attempt five questions in all.
2. 20% numerical problems are to be set.
3. Use of Scientific (non-programmable) calculator is allowed.

Unit I: Complex Variables:

Importance of complex numbers and their graphical representation. De Moivre's theorem. Roots of complex numbers. Euler's formula. Functions of complex variables. Examples. Cauchy-Riemann conditions. Analytic functions. Singularities. Differentiation and integration of a function of a complex variable. Cauchy's theorem Cauchy's integral formula. Morera's theorem. Cauchy's inequality. Liouville's theorem. Fundamental theorem of algebra. Multiple valued functions, simple ideas of branch points and Riemann surface. Power series of a complex variable, Taylor and Laurent series, Residue and residue theorem. Multiple valued functions.

Unit II

Contour integration and its application to evaluation of integrals. Series Solution of Linear Second order Ordinary Differential Equations: Singular points of second order differential equations and their importance. Series methods (Frobenius) Legendre. Bessel, Hermite and Laguerre differential equations.

Phy-302 Semester-III Thermal Physics-I

Max. Marks : 40
Internal Assessment : 10
Time : 3 Hrs.

NOTE :

1. The syllabus is divided into 2 units. Eight questions will be set up. Four questionsfrom each unit. Student will have to attempt at least two questions from each unit. A student has to attempt five questions in all.
2. 20% numerical problems are to be set.
3. Use of Scientific (non-programmable) calculator is allowed.

Unit I : Kinetic Theory of Gases:

Derivation of Maxwell law of distribution of velocities and its experimental verification. Mean free path. Transport phenomena, viscosity, conduction and diffusion. Brownian motion. The theories of Langevin and Einstein and experimental determination of Avogadro's number. Examples of Brownian motion in physics (galvanometer mirror, sedimentation, Johnson's noise).

Unit II

Ideal gases: Equation of state, internal energy, specific heats, entropy, Isothormal and adiabatic processes. Compressibility and expansion coefficient. Adiabatic lapse rate. Real gases: Deviations from the ideal gas equation. The virial equation, Andrew's experiments on CO_2 gas, continuity of liquid and gaseous state. Van der Wall's equation. Critical constants and law of corresponding states. Free expansion, Joule-Thomson effect.

Phy-303 Semester-III Vibrations and Wave Optics-I

Max. Marks : 40
Internal Assessment : 10
Time : 3 Hrs.

NOTE:

1. The syllabus is divided into 2 units. Eight questions will be set up. Four questions from each unit. Student will have to attempt at least two questions from each unit. A student has to attempt five questions in all.
2. 20% numerical problems are to be set.
3. Use of Scientific (non-programmable) calculator is allowed.

Unit I : Vibrations

Free oscillations of system with one degree of freedom; Linearity and superposition principle. Superposition of (i) two and (ii) N collinear harmonic oscillations; beats System with two degrees of freedom (coupled oscillators). Normal coordinates and normal modes. Energy relation and energy transfer. Normal modes of N coupled oscillators. Normal modes of stretched string, Energy of vibrating string. Plucked and struck strings waves.

Wave equation. Traveling waves, Plane and spherical waves. Superposition of two harmonic waves. Standing waves on a string. Superposition of N harmonic waves.
Pulses and wave packets.

Unit II : Wave Optics

Introduction to different models, light waves, electromagnetic nature of light waves. Coherence and Interference: Interaction of independent light sources. Classification in terms of division of amplitude and division of wave front. Young's double slit experiment, Lloyd's mirror and Fresnel's biprism. Interference in thin films parallel and wedge-shaped films.
Fringes of equal inclination (Haidinger fringes) and fringes of equal thickness (Fizeau fringes).

Michelson's interferometer: Theory, form of fringes (mention only), applications, visibility of fringes.
Theory of partial coherence. Coherence time and coherence length, i.e. temporal and spatial coherence. Fabry-Perot interferometer: Theory, Airy's formula, sharpness of fringes, finesse, visibility of fringes

Phy-304 Semester-III Quantum Mechanics

Max. Marks : 40
Internal Assessment : 10
Time : 3 Hrs.

NOTE:

1. The syllabus is divided into 2 units. Eight questions will be set up. Four questions from each unit. Student will have to attempt at least two questions from each unit. A student has to attempt five questions in all.
2. 20% numerical problems are to be set.
3. Use of Scientific (non-programmable) calculator is allowed.

Unit I

Photoelectric effect. Compton effect. Reduced mass correction. De Broglie hypothesis. Wave particle duality. Davisson-Germer experiment. Wave packets. Two Slit experiment with electrons. Wave amplitude and wave functions, Probability. Uncertainty principle.

Basic postulates and formalism: Schrodinger equation, wave function, eigenvalues, probabilistic interpretation, conditions for physical acceptability of wave functions. Free particle. Time independent Schrodinger equation, stationary states. Particle in one-dimensional box, quantization of energy. Franck-Hertz experiment.

Unit II

Scattering problem in one dimension : Reflection and transmission by a finite potential step. Stationary solutions, Attractive and repulsive potential barriers. Gamow theory of alpha decay. Quantum phenomenon of tunneling. Tunnel diode-qualitative description. Spectrum for a square well (mention upper bound-no calculation).

Bound state problems: General features of a bound particle system. One-dimensional simple harmonic oscillator. Particle in a spherically symmetric potential rigid rotator. Orbital angular momentum and azimuthal quantum numbers and space quantization. Physical significance. Radial solutions and principal quantum number. Hydrogen atom.

Phy-305 Semester-III Mathematics III

Max. Marks : 40
Internal Assessment : 10
Time : 3 Hrs.

NOTE:

1. The syllabus is divided into 2 units. Eight questions will be set up. Four questions from each unit. Student will have to attempt at least two questions from each unit. A student has to attempt five questions in all.
2. 20% numerical problems are to be set.
3. Use of Scientific (non-programmable) calculator is allowed.

Unit-I : Analysis

Sequences and series of functions of real variable. Point wise and uniform convergence. Welerstrass M-test Uniform convergence and continuity. Uniform convergence and differentiation. Uniform convergence and integration. Weterstrass approximation theorem. Power series and their convergence and uniform convergence. Definition of exponential, logarithmic and trigonometric functions by means of power series. mproper
integrants and their convergence comparison, Abel's and Dirichlet's tests. Beta and Gamma functions and their properties. Differentiation under the sign of integration.

Unit-II : Statistics:

Probability Classical, relative frequency and axiomatic approaches to probability. Theorems of total and compound probability. Conditional probability. Independent events. Bayes theorem. Random variables. Discrete and continuous random variables distinction function. Expectation of a random variable. Moments, moment generating function and probability generating function.

Phy-306 Semester-III Computer Fundamentals and Programming-I

Max. Marks : 40
Internal Assessment : 10
Time : 3 Hrs.

NOTE:

1. The syllabus is divided into 2 units. Eight questions will be set up. Four questions from each unit. Student will have to attempt at least two questions from each unit. A student has to attempt five questions in all.
2. 20% numerical problems are to be set.
3. Use of Scientific (non-programmable) calculator is allowed.

Unit I

Basic components of computer system, their function and inter-types of computersystems. Brief idea of data storage and input/output devices Hexadecimal number system and arithmetic.

Microprocessor architecture and operations (Intel 8085/8086) Basic concepts, functional block diagram, memory, memory organization and addressing, memory interfacing, input/output instruction cycle (timing diagram) Microprocessor programming algorithm and flowcharts, assembly language, 8085 instruction set and format: data transfer, arithmetic, logical and control operations, RIM and SIM Addressing modes (register, immediate, direct and indirect). Simple programming exercises (addition and multiplication, both 8 and 16 bit etc.)

Unit II : Introduction of Fortran, Problem solving using Fortran

Data types: Integer and Floating point arithmetic; Fortran variables; Real and Integer variables; Input and Output statements; Formats; Expressions; Built in functions; Executable and non-executable statements; Control statements; Go To statement; Arithmetic IF and logical IF statements; Flow charts; Truncation errors, Round off errors; Propagation of errors.

Block IF statement; Do statement; Character DATA management; Arrays and subscripted variables; Subprogrammes: Function and SUBROUTINE; Double precision; Complex numbers; Common statement.

Phy-307 Semester-III Physics Laboratory I

The distribution of marks in laboratory papers will be as follows:

Written test (45 minutes duration)	15	
Internal assessment including laboratory report	20	
Experiment and viva (35+5)	40	
Total (each paper)		75

Unit I: Familiarisation with Devices

1. Measurement of focal length of a lens; combination of lenses. Familiarisation with eyepieces.
2. Familiarisation with spectrometer : Schuster's focusing: determination of angle of prism.
3. Familiarisation with ballistic galvanometer : determination of charge sensitivity, current sensitivity, time period, logarithmic decrement and critical damping resistance.
4. Investigation of factors, which affect induced voltages in a coil using a CRO.
5. Investigation of factors, which determine secondary emf and current in, coupled cells.

Unit II: Optics

1. Experiments on prism-Resolving power/depressive power/Determination of wavelength/Cauchy's constants.
2. Experiments on grating-Resolving power/depressive power/Determination of wavelength.
3. Determination of wavelength using Fresnel's biprism.
4. Determination of wavelength using Newton's rings.
5. Determination of wavelength using Michelson's Interferometer.
6. Measurement of small thickness using Interference or diffraction.
7. Measurement of refractive index of transparent and opaque liquids using total internal reflection.
8. Measurement of Intensity using photo sensor and laser in diffraction patterns of single and double slits.

Phy-308 Semester-III Digital Micro Processors and Computer Lab-I

The distribution of marks in laboratory papers will be as follows:

Written test (45 minutes duration)	15	
Internal assessment including laboratory report	20	
Experiment and viva (35+5)	40	
Total (each paper)		75

Unit I : Combinational logic

1. Verification and design of AND, OR, NOT and XOR gates using NAND gates.
2. To design a combinational logic system for a specified truth table.
3. To convert a Boolean expression into a logic gate circuit and assemble it using logic gate Ics.
4. To minimize a given logic circuit.
5. To study TTL Ics (binary decoder, 7-segment decoder, Schmitt trigger).
6. To design a seven-segment display driver.

Unit II: Arithmetic and Logic Units (ALU)
(Building of basic ingredients of ALU)

1. Half adder, full adder and 4-bit binary adder.
2. Half subtract or, full subtract or adder subs tractor using full adder IC
3. To built flip flop circuits using elementary gates (Rs, Clocked RS, D-Type, JK flip-flop).
4. To build a 4-bit counter using D-type/JK flip-flop.
5. To make a shift register from D-type flip-flop.
6. Serial and parallel shifting of data.
7. To design an analog to digital converter of given specifications.
8. To design a digital to analog converter of given specifications

Phy-401 Semester-IV Mathematical Physics IV

Max. Marks : 40
Internal Assessment : 10
Time : 3 Hrs.

NOTE:

1. The syllabus is divided into 2 units. Eight questions will be set up. Four questions from each unit. Student will have to attempt at least two question from each unit. A student has to attempt five question in all.
2. 20% numerical problems are to be set.
3. Use of Scientific (non-programmable) calculator is allowed.

Unit I : Special Functions

Gamma and Beta functions.

Legendre, hermite and Laguerre Polynomials: Rodrigues formulae, generating functions, recurrence relations, orthogonality, Series expansion of a function in terms of a complete set of Legendre functions. Bessel functions : first and second kind, generating function, recurrence formulas, zeros of Bessel functions and orthogonality Fraunhofer, diffraction integral for circular aperture.

Unit II: Partial Differential Equations:

General solution of wave equation in 1 dimension. Transverse vibration of stretched string. Oscillation of hanging chain. Wave equation in 2 and 3 dimensions. Vibrations of rectangular and circular membrane. Derivation of the equation of heat conduction. Heat flow in one-two-and three- dimensional rectangular systems of finite boundaries, Temperature inside circular plate. Laplace equation in Cartesian, cylindrical and spherical coordinate systems. Problems of steady flow of heat in rectangular and circular plate. Gravitational potential of a ring.

Phy-402 Semester-IV Thermal Physics-II

Max. Marks : 40
Internal Assessment : 10
Time : 3 Hrs.

NOTE :

1. The syllabus is divided into 2 units. Eight questions will be set up. Four questions from each unit. Student will have to attempt at least two questions from each unit. A student has to attempt five questions in all.
2. 20% numerical problems are to be set.
3. Use of Scientific (non-programmable) calculator is allowed.

Unit I : Thermodynamics:

Zeroth and first law of thermodynamics. Reversible and irreversible processes. Conversion of heat into work. Carnot theorem Second law of thermodynamics. Thermodynamic temperature. Clausius inequality. Entropy, Entropy changes in reversible and irreversible processes. Temperature-entropy diagrams. The principle of increase of entropy & its applications.

Unit II

Thermodynamic potentials: Enthalpy, Gibbs and Helmholtz functions. Maxwell relations and their applications. Magnetic work. Magnetic cooling by adiabatic demagnetization, approach to absolute zero, change of phase, equilibrium between a liquid and its vapour. Clausius-Clapeyron equation. The triple point with examples from physics. Second order phase transitions.

Phy-403 Semester-IV Vibration and Wave Optics-II

Max. Marks : 40
Internal Assessment : 10
Time : 3 Hrs.

NOTE :

1. The syllabus is divided into 2 units. Eight questions will be set up. Four questions from each unit. Student will have to attempt at least two question from each unit. A student has to attempt five question in all.
2. 20% numerical problems are to be set.
3. Use of Scientific (non-programmable) calculator is allowed.

Unit I Diffraction

Kirchhoff's integral theorem. Fresnel-Kirchhoff integral formula and its application to diffraction problems.

Fraunhofer diffraction: Single slit, rectangular and circular aperture. Multiple slit. Plane diffraction grating. Resolving power and depressive power of a plane diffraction grating.

Unit II

Fresnel diffraction: Fresnel's integrals, Cornu's spiral, Fresnel diffraction pattern at a straight edge, a slit and a wire (qualitatively using Cornu's spiral).

Holography : Principle of holography, recording and reconstruction method and its theory as interference between two plane waves.

Phy-404 Semester-IV Atomic and Nuclear Physics

Max. Marks : 40
Internal Assessment : 10
Time : 3 Hrs.

NOTE :

1. The syllabus is divided into 2 units. Eight questions will be set up. Four questions from each unit. Student will have to attempt at least two question from each unit. A student has to attempt five question in all.
2. 20% numerical problems are to be set.
3. Use of Scientific (non-programmable) calculator is allowed.

Unit I

Atoms in electric and magnetic fields: Electron spin. Stern-Gerlach experiment. Orbital angular momentum, dipole moment and energy in magnetic field from classical viewpoint. Zeeman effect. Spin-orbit coupling. Fine structure. Total angular momentum.

Many-electron atoms: Pauli exclusion principle, Many particles in one-dimensional box, Symmetric and antisymmetric wave functions. Atomic shell model and periodic table, Spectral notations for atomic states. Vector model. L-S and jj coupling Doublet Structure of alkali spectra. Empirical evidence of multiplets, Selection rules.

Unit II : Nucleus

Properties: mass, size, angular momentum, constituents, binding energy, stability.

Models: Liquid drop model. Mass formula. Shell model, nuclear forces.

Radioactivity : Law of radioactive decay. Theory of successive radioactive transformations. Radioactive series (mention the series-diagram not needed)

Phy-405 Semester-IV Mathematics IV

Max. Marks : 40
Internal Assessment : 10
Time : 3 Hrs.

NOTE :

1. The syllabus is divided into 2 units. Eight questions will be set up. Four questions from each unit. Student will have to attempt at least two question from each unit. A student has to attempt five question in all.
2. 20% numerical problems are to be set.
3. Use of Scientific (non-programmable) calculator is allowed.

Unit-I

Discrete and continuous distribution, Binomial, Poisson, geometric, normal and exponential distributions. Bivariate distribution, conditional distribution and marginal distribution. Correlation and regression for two variables only, Weak law of large numbers. Central limit theorem for independent and identically distributed random variables.

Unit-II : Statistical inference:

definitions of random sample, parameter and statistic. Concept of sampling distribution and standard error sampling distribution of mean variance of random sample from a normal population. Tests of significance based on t.f. and chi-square distributions.

Phy-406 Semester-IV Computer Fundamentals and Programming-II

Max. Marks : 40
Internal Assessment : 10
Time : 3 Hrs.

NOTE :

1. The syllabus is divided into 2 units. Eight questions will be set up. Four questions from each unit. Student will have to attempt at least two question from each unit. A student has to attempt five question in all.
2. 20% numerical problems are to be set.
3. Use of Scientific (non-programmable) calculator is allowed.

Unit I: Errors and Iterative Methods.

Truncation and round-off errors, floating point computation, overflow and underflow, single and double precision arithmetic, iterative process, solution of non-linear equations: bisection, secant and Newton-Raphson methods. Comparison and error estimation. Program for finding zeros of a given function.

Solution of simultaneous linear equations : Gauss elimination and iterative (Gauss-Seidel) method. Computation of eigenvalues and eigenvectors of matrices using iterative process. Program for finding solution of a given system of three coupled linear equations. Solution of simultaneous linear equations : Gauss elimination and iterative (Gauss-Seidel) method. Computation of eigenvalues and eigenvectors of matrices using iterative process. Program for finding solution of a given system of three coupled linear equations.

Unit II : Numerical Differential and integral Calculus.

Interpolation (Newton forward and backward formulas). Program for (a) Interpolating data points and (b) first and second derivative of a given function/data.

Integration: General quadrature formula, trapezoidal and Simpson's rule, Gauss quadrature formulas: Gauss-Hermite, Gauss-Legendre. Program for Integrating a given function using Simpson and Gauss-Legendre methods.

Solution of ordinary differential equations : Euler method and Runge-Kutta method of second order with error estimation, idea of predictor-corrector method. Program for solving initial value problem for a first order differential equation using Runge-Kutta method.

Phy-407 Semester-IV Physics Laboratory II

The distribution of marks in laboratory papers will be as follows:

Written test (45 minutes duration)	15	
Internal assessment including laboratory report	20	
Experiment and viva (35+5)	40	
Total (each paper)		75

Unit I: Measurement of High Resistance and Charge

1. Determination of dielectric constant of a dielectric placed inside a parallel plate capacitor using a B.G.
2. Measurement of charge by determination of time of impact.
3. Measurement of high resistance by method of leakage.

Unit II : Measurement of Self Inductance and Mutual Inductance

1. Using absolute method.
2. Using A.C. bridge.
3. Determination of heat conductivity of a good conductor by Angstrom method/Searle's method.
4. Determination of heat conductivity of a bad conductor by Lee's method. (Use of heating elements in preference to steam recommended).

Phy-408 Semester-IV Digital Micro Processors and Computer Lab-II

The distribution of marks in laboratory papers will be as follows:

Written test (45 minutes duration)	15	
Internal assessment including laboratory report	20	
Experiment and viva (35+5)	40	
Total (each paper)		75

Unit I : Use of Microprocessor kit and Elements of assembly Language.

1. Use of hardware.
2. Addition and subtraction of numbers using direct and indirect addressing modes.
3. Multiplication by repeated addition.
4. Division by repeated subtraction.
5. Handling of 16-bit numbers
6. Use of CALL and RETURN interdictor.
7. Block data handling.
8. Other exercises (e.g. parity check etc.)

Unit II: Elements of FORTRAN Programming.

1. To evaluate a polynomial (e.g. converting Fahrenheit to Celsius, area of a circle, volume of sphere etc.)
2. to find roots of a quadratic equation (real and distinct, real and repeated and imaginary).
3. To find sum and average of a list of numbers, both with and without the use of arrays.
4. To calculate powers of a number.
5. (i) To locate a number in a given list (linear search)
   (ii) To check whether a given name is in a list.
6. (i) To find the largest of three numbers.
   (ii) To find the largest number in a given list of numbers.
7. (i) To check whether a given number is a prime number.
   (ii) To calculate the first 100 prime numbers.
8. To rearrange a list of numbers in ascending and descending order.
9. (i) To calculate factorial of a number.
   (ii) To calculate the first factorials.
10. Manipulation of matrices.
    (i) Addition, subtraction and multiplication.
    (ii) Trace of a matrix
    (iii) Sum of elements of a row and a column.
11. Solution of simultaneous equations.
12. Programming exercises based on numerical methods.