DEPARTMENT OF PHYSICS

BSc. (Hons.) Physics

Category-I

DISCIPLINE SPECIFIC CORE COURSE – 1 (DSC-1) Mathematical Physics I

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Mathematical Physics I	4	3	0	1	Class XII pass with Physics and Mathematics as main subjects	Physics and Mathematics syllabus of class XII

Learning Objectives

The emphasis of the course is on applications in solving problems of interest to physicists. The course will teach the students to model a physics problem mathematically and then solve those numerically using computational methods. The course will expose the students to fundamental computational physics skills enabling them to solve a wide range of physics problems. The skills developed during course will prepare them not only for doing fundamental and applied research but also for a wide variety of careers.

Learning Outcomes

After completing this course, student will be able to,

- Draw and interpret graphs of various elementary functions and their combinations.
- Understand the vector quantities as entities with Cartesian components which satisfy appropriate rules of transformation under rotation of the axes.
- Use index notation to write the product of vectors in compact form easily applicable in computational work.
- Solve first and second order differential equations and apply these to physics problems.
- Understand the functions of more than one variable and concept of partial derivatives.
- Understand the concept of scalar field, vector field, gradient of scalar field and divergence and curl of vector fields.
- Perform line, surface and volume integration and apply Green's, Stokes' and Gauss's theorems to compute these integrals and apply these to physics problems
- Understand the properties of discrete and continuous distribution functions.

In the laboratory course, the students will learn to,

- Prepare algorithms and flowcharts for solving a problem.
- Design, code and test simple programs in Python/C++ to solve various problems.

- Perform various operations of 1-d and 2-d arrays.
- Visualize data and functions graphically using Matplotlib/Gnuplot

SYLLABUS OF DSC – 1

THEORY COMPONENT

Unit 1 (18 Hours)

Functions: Plotting elementary functions and their combinations, Interpreting graphs of functions using the concepts of calculus, Taylor's series expansion for elementary functions.

Ordinary Differential Equations: First order differential equations of degree one and those reducible to this form, Exact and Inexact equations, Integrating Factor, Applications to physics problems

Higher order linear homogeneous differential equations with constant coefficients, Wronskian and linearly independent functions. Non-homogeneous second order linear differential equations with constant coefficients, complimentary function, particular integral and general solution, Determination of particular integral using method of undetermined coefficients and method of variation of parameters, Cauchy-Euler equation, Initial value problems. Applications to physics problems

Unit 2 (12 Hours)

Vector Algebra: Transformation of Cartesian components of vectors under rotation of the axes, Introduction to index notation and summation convention. Product of vectors - scalar and vector product of two, three and four vectors in index notation using δ_{ij} and ε_{ijk} (as symbols only – no rigorous proof of properties). Invariance of scalar product under rotation transformation.

Vector Differential Calculus: Functions of more than one variable, Partial derivatives, chain rule for partial derivatives. Scalar and vector fields, concept of directional derivative, the vector differential operator $\vec{\nabla}$, gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field and their physical interpretation. Laplacian operator. Vector identities.

Unit 3 (15 Hours)

Vector Integral Calculus: Integrals of vector-valued functions of single scalar variable. Multiple integrals, Jacobian, Notion of infinitesimal line, surface and volume elements. Line, surface and volume integrals of vector fields. Flux of a vector field. Gauss divergence theorem, Green's and Stokes' Theorems (no proofs) and their applications

Probability Distributions: Discrete and continuous random variables, Probability distribution functions, Binomial, Poisson and Gaussian distributions, Mean and variance of these distributions.

PRACTICAL COMPONENT (30 Hours)

The aim of this lab is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics. The course will consist of practical sessions and lectures on the related theoretical aspects of the laboratory. Assessment is to be done not only on the programming but also on the basis of formulating the problem.

- Every student must perform at least 6 programs covering each unit.
- The list of recommended programs is suggestive only. Students should be encouraged to do more practice. Emphasis should be given to assess student's ability to formulate a physics problem as mathematical one and solve by computational methods.
- The implementation can be either in Python or C++. Accordingly, the instructor can choose section A or B respectively from Unit 1 and 2. The list of programs is common for both sections. If C++ is used, then for all plotting programs, Gnuplot has to be used.

Basics of scientific computing (Mandatory):

(a) Binary and decimal arithmetic, Floating point numbers, single and double precision arithmetic, underflow and overflow, numerical errors of elementary floating point operations, round off and truncation errors with examples.

(b) Introduction to Algorithms and Flow charts. Branching with examples of conditional statements, for and while loops.

Unit 1

Section A:

Basic Elements of Python: The Python interpreter, the print statement, comments, Python as simple calculator, objects and expressions, variables (numeric, character and sequence types) and assignments, mathematical operators. Strings, Lists, Tuples and Dictionaries, type conversions, input statement, list methods. List mutability, Formatting in the print statement.

Control S tructures: Conditional operations, if, if-else, if-elif-else, while and for loops, indentation, break and continue, List comprehension. Simple programs for practice like solving quadratic equations, temperature conversion etc.

Functions: Inbuilt functions, user-defined functions, local and global variables, passing functions, modules, importing modules, math module, making new modules. Writing functions to perform simple operations like finding largest of three numbers, listing prime numbers, etc., Generating pseudo random numbers.

OR

Section B:

Introduction to C++: Basic idea of Compilers. Structured programming. Idea of Headers, Data Types, Enumerated Data, Conversion and casting, constants and variables, Mathematical, Relational, Logical and Bit wise Operators. Precedence of Operators, Expressions and Statements, Scope and Visibility of Data, block, Local and Global variables, Auto, static and External variables. Input and output statements. I/O manipulations, iostream and cmath header files, using namespace.

Control Statements: The if-statement, if-else statement, Nested if Structure, If - Else if – else block, Ternary operator, Goto statement, switch statement, Unconditional and Conditional looping, While loop, Do-while loop, For loop, nested loops, break and continue statements. Simple programs for practice like solving quadratic equations, temperature conversion etc.

Functions: Inbuilt functions. User-defined functions, function declaration, function definition, function prototype, void functions and function arguments, return statement. Local and global variables. The main function. Passing parameter by value and by reference. Inline functions. Function overloading. Writing functions to perform simple operations like finding largest of three numbers, listing prime numbers etc., Generating pseudo random numbers.

Recommended List of Programs (At least Two)

(a) Make a function that takes a number N as input and returns the value of factorial of N. Use this function to print the number of ways a set of m red and n blue balls can be arranged.
(b) Generate random numbers (integers and floats) in a given range and calculate area and volume of regular shapes with random dimensions.
(c) Generate data for coordinates of a projectile and plot the trajectory. Determine the range, maximum height and time of flight for a projectile motion.

Unit 2

Section A:

NumPy Fundamentals: Importing Numpy, Difference between List and NumPy array, Adding, removing and sorting elements, creating arrays using ones(), zeros(), random(), arange(), linspace(). Basic array operations (sum, max, min, mean, variance), 2-d arrays, matrix operations, reshaping and transposing arrays, savetxt() and loadtxt().

Plotting with Matplotlib: matplotlib.pyplot functions, Plotting of functions given in closed form as well as in the form of discrete data and making histograms.

OR

Section B:

Arrays: Array definition, passing arrays to functions, Finding sum, maximum, minimum, mean and variance of given array. 2-d arrays, matrix operations (sum, product, transpose etc). Saving data generated by a C++ program in a file.

Gnuplot: Introduction to Gnuplot. Visualization of discrete data and plotting functions given in closed form and data for graphical visualization. Plotting data from the output file created by a C++ program, making histogram.

Recommended List of Programs (At least Three)

(a) To plot the displacement-time and velocity-time graph for the un-damped, under-damped critically damped and over-damped oscillator using matplotlib (or Gnuplot) using given formulae.

(b) To compute the left, right and central approximations for derivative of a function given in closed form. Plot both the function and derivative on the same graph. Plot (using matplotlib/Gnuplot) the error as a function of step size on a log-log graph, study the behaviour of the plot as step size decreases and hence discuss the effect of round off error.

(c) To generate array of N random numbers drawn from a given distribution (uniform, binomial, poisson and gaussian) and plot them using matplotlib/Gnuplot for increasing N to verify the distribution. Verify the central limit theorem.

(d) To implement the transformation of physical observables under Galilean, Lorentz and Rotation transformation

Unit 3

Recommended List of Programs (At least one)

(a) To find value of π and to integrate a given function using acceptance-rejection method.

(b) To perform linear fitting of data using the inbuilt function scipy.stats.linregress in Python or using Gnuplot. Plot the data points and the fitted line on the same graph.

References (for Laboratory Work):

1) Documentation at the Python home page (https://docs.python.org/3/) and the tutorials there (https://docs.python.org/3/tutorial/).
2) Documentation of NumPy and Matplotlib : https://numpy.org/doc/stable/user/ and https://matplotlib.org/stable/tutorials/
3) Schaum's Outline of Programming with C++, J. Hubbard, 2000, McGraw-Hill Education.
4) C++ How to Program, Paul J. Deitel and Harvey Deitel, Pearson (2016).
5) Computational Physics, Darren Walker, 1st Edn., Scientific International Pvt. Ltd (2015).
6) Elementary Numerical Analysis, K. E. Atkinson, 3rd Edn., 2007, Wiley India Edition.
7) An Introduction to Computational Physics, T. Pang, Cambridge University Press (2010).
8) Introduction to Numerical Analysis, S. S. Sastry, 5th Edn., 2012, PHI Learning Pvt. Ltd.
9) Applied numerical analysis, Cutis F. Gerald and P. O. Wheatley, Pearson Education, India (2007).

Essential/Recommended Readings

REFERENCES FOR THEORY COMPONENT

1) An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning.
2) Differential Equations, George F. Simmons, 2007, McGraw Hill.
3) Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book.
4) Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning.

5) Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
6) Probability and Statistics, Murray R Spiegel, John J Schiller and R Alu Srinivasan, 2018, McGraw Hill Education Private Limited.
7) Essential Mathematical Methods, K.F.Riley and M.P.Hobson, 2011, Cambridge Univ. Press.
8) Vector Analysis and Cartesian Tensors, D.E. Bourne and P.C. Kendall, 3 Ed. , 2017, CRC Press.
9) Vector Analysis, Murray Spiegel, 2 Ed., 2017, Schaum's outlines series.
10) John E. Freund's Mathematical Statistics with Applications, I. Miller and M. Miller, 7th Ed., 2003, Pearson Education, Asia.

.Suggestive readings:

1) Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 7 Ed., 2013, Elsevier.
2) Introduction to Electrodynamics, Chapter 1, David J. Griffiths, 4 Ed., 2017, Cambridge University Press.
3) The Feynman Lectures on Physics, Volume II, Feynman, Leighton and Sands, 2008, Narosa Publishing House.
4) Introduction to Vector Analysis, Davis and Snider, 6 Ed., 1990, McGraw Hill.
5) Differential Equations, R. Bronson and G.B. Costa, Schaum's outline series.
6) Mathematical Physics, A.K. Ghatak, I.C. Goyal and S.J. Chua, Laxmi Publications Private Limited (2017)
7) Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.

DISCIPLINE SPECIFIC CORE COURSE – 2 (DSC - 2) MECHANICS

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Mechanics **DSC – 2**	**4**	**3**	**0**	**1**	Class XII pass with Physics and Mathematics as main subjects	Physics and Mathematics syllabus of class XII

Learning Objectives

This course reviews the concepts of mechanics learnt at school from a more advanced perspective and goes on to build new concepts. It begins with Newton's Laws of Motion and ends with the Fictitious Forces and Special Theory of Relativity. The students will learn the collisions in the centre of mass frame, rotational motion and central forces. They will be able to apply the concepts learnt to several real world problems. In the laboratory part of the course, the students will learn to use various instruments, estimate the error for every experiment performed and report the result of experiment along with the uncertainty in the result up to correct significant figures.

Learning Outcomes

Upon completion of this course, students will be able to,

- Learn the Galilean invariance of Newton's laws of motion.
- Understand translational and rotational dynamics of a system of particles.
- Apply Kepler's laws to describe the motion of planets and satellite in circular orbit.
- Understand Einstein's postulates of special relativity.
- Apply Lorentz transformations to describe simultaneity, time dilation and length contraction
- Use various instruments for measurements and perform experiments related to rotational dynamics, elastic properties, fluid dynamics, acceleration due to gravity, collisions, etc.
- Use propagation of errors to estimate uncertainty in the outcome of an experiment and perform the statistical analysis of the random errors in the observations.

SYLLABUS OF DSC- 2

THEORY COMPONENT

Unit 1: (14 Hours)

Fundamentals of Dynamics: Inertial and Non-inertial frames, Newton's Laws of Motion and their invariance under Galilean transformations. Momentum of variable mass system: motion of rocket. Dynamics of a system of particles. Principle of conservation of momentum. Impulse. Determination of Centre of Mass of discrete and continuous objects having cylindrical and spherical symmetry. Differential analysis of a static vertically hanging massive rope

Work and Energy: Work and Kinetic Energy Theorem. Conservative forces and examples (Gravitational and electrostatic), non-conservative forces and examples (velocity dependent forces e.g. frictional force, magnetic force), Potential Energy. Energy diagram. Stable, unstable and neutral equilibrium. Force as gradient of the potential energy. Work done by non-conservative forces.

Collisions: Elastic and inelastic collisions between two spherical bodies. Kinematics of 2 → 2 scattering in centre of mass and laboratory frames.

Unit 2: (12 Hours)

Rotational Dynamics: Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Determination of moment of inertia of symmetric rigid bodies (rectangular, cylindrical and spherical) using parallel and perpendicular axes theorems. Kinetic energy of rotation. Motion involving both translation and rotation.

Non-Inertial Systems: Non-inertial frames and fictitious forces. Uniformly rotating frame. Centrifugal force. Coriolis force and its applications.

Unit 3: (7 Hours)

Central Force Motion: Central forces, Law of conservation of angular momentum for central forces, Two-body problem and its reduction to equivalent one-body problem and its solution. Concept of effective potential energy and stability of orbits for central potentials of the form kr^n for n = 2 and -1 using energy diagram, discussion on trajectories for n=-2. Solution of the Kepler Problem, Kepler's Laws for planetary motion, orbit for artificial satellites

Unit 4: **(12 Hours)**

Relativity: Postulates of Special Theory of Relativity, Lorentz Transformations, simultaneity, length contraction, time dilation, proper length and proper time, life time of a relativistic particle (for example muon decay time and decay length). Space-like, time-like and light-like separated events, relativistic transformation of velocity and acceleration, variation of mass with velocity, mass-energy equivalence, transformation of energy and momentum.

PRACTICAL COMPONENT (30 Hours)

Introductory Concepts and related activities (Mandatory)

- **Use of Basic Instruments**

Determination of least count and use of instruments like meter scale, vernier callipers, screw gauge and travelling microscope for measuring lengths.

- Errors

(a) Types of errors in measurements (instrumental limitations, systematic errors and random errors), accuracy and precision of observations, significant figures.
(b) Introduction to error estimation, propagation of errors and reporting of results along with uncertainties with correct number of significant figures.
(c) Statistical analysis of random errors, need for making multiple observations, standard error in the mean as estimate of the error.

- Graph Plotting

Pictorial visualisation of relation between two physical quantities, Points to be kept in mind while plotting a graph manually.

- Data Analysis

Principle of least square fitting (LSF) and its application in plotting linear relations, estimation of LSF values of slope, intercept and uncertainties in slope and intercept.

Mandatory Activities

- Determine the least count of meter scale, vernier callipers, screw gauge and travelling microscope, use these instruments to measure the length of various objects multiple time, find the mean and report the result along with the uncertainty up to appropriate number of significant digits.
- Take multiple observations of the quantities like length, radius etc. for some spherical, cylindrical and cubic objects, find mean of these observations and use them to

determine the surface area and volume of these objects. Estimate the uncertainties in the outcome using law of propagation of errors. Report the result to appropriate number of significant figures.

- Given a data (x, y) corresponding to quantities x and y related by a relation $y = f(x)$ that can be linearised, plot the data points (manually) with appropriate choice of scale, perform least square fitting to determine the slope and intercept of the LSF line and use them to determine some unknown quantity in the relation. Determine the uncertainties in slope and intercept and use these to estimate the uncertainty in the value of unknown quantity.

Every student must perform at least 4 experiments from the following list.

1) To study the random errors in observations. It is advisable to keep observables of the order of least count of the instruments.
2) To determine the moment of inertia of a symmetric as well as asymmetric flywheel
3) To determine coefficient of viscosity of water by Capillary Flow Method (Poiseuille's method).
4) To determine g and velocity for a freely falling body using Digital Timing Technique.
5) To determine the Young's Modulus of a Wire by Optical Lever Method.
6) To determine the vertical distance between two given points using sextant.
7) To determine the coefficients of sliding and rolling friction experienced by a trolley on an inclined plane.
8) To verify the law of conservation of linear momentum in collisions on air track.

Suggested additional activities:

1) Virtual lab collision experiments on two dimensional elastic and inelastic collisions (for example available on following suggested links
   a) https://archive.cnx.org/specials/2c7acb3c-2fbd-11e5-b2d9-e7f92291703c/collision-lab/#sim-advanced-sim)
   b) https://phet.colorado.edu/en/simulations/collision-lab
2) Amrita Virtual Mechanics Lab: https://vlab.amrita.edu/?sub=1&brch=74

References (for Laboratory Work):

1) Advanced Practical Physics for students, B. L. Flint and H. T. Worshnop, 1971, Asia Publishing House.
2) Engineering Practical Physics, S. Panigrahi and B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
3) Practical Physics, G. L. Squires, 2015, 4/e, Cambridge University Press.
4) A Text Book of Practical Physics, Vol I, Prakash and Ramakrishna, 11/e, 2011, Kitab Mahal.
5) An introduction to Error Analysis: The study of uncertainties in Physical Measurements, J.
R. Taylor, 1997, University Science Books

Essential readings:

FOR THEORY COMPONENT

1) An Introduction to Mechanics (2/e), Daniel Kleppner and Robert Kolenkow, 2014, Cambridge University Press.
2) Mechanics Berkeley Physics Course, Vol. 1, 2/e: Charles Kittel, et. al., 2017, McGraw Hill Education
3) Classical Mechanics by Peter Dourmashkin, 2013, John Wiley and Sons.
4) Theory and Problems of Theoretical Mechanics, Murray R. Spiegel, 1977, McGraw Hill Education.
5) Introduction to Classical Mechanics With Problems and Solutions, David Morin, 2008, Cambridge University Press.
6) Fundamentals of Physics, Resnick, Halliday and Walker 10/e, 2013, Wiley.
7) Introduction to Special Relativity, Robert Resnick, 2007, Wiley.

Suggestive Link:
https://phys.libretexts.org/Bookshelves/Classical_Mechanics/classical_Mechanics_(Dourm ash kin)/

Suggestive readings:

1) Feynman Lectures, Vol. 1, R. P. Feynman, R. B. Leighton, M. Sands, 2008, Pearson Education.
2) University Physics, H. D. Young, R. A. Freedman, 14/e, 2015, Pearson Education.
3) Classical Mechanics, H. Goldstein, C. P. Poole, J. L. Safko, 3/e, 2002, Pearson Education.
4) Newtonian Mechanics, A.P. French, 2017, Viva Books.

DISCIPLINE SPECIFIC CORE COURSE– 3 (DSC – 3) WAVES AND OSCILLATIONS

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Waves and Oscillations **DSC – 3**	**4**	**2**	**0**	**2**	Class XII pass with Physics and Mathematics as main subjects	Physics and Mathematics syllabus of class XII

Learning Objectives

This course reviews the concepts of waves and oscillations learnt at school from a more advanced perspective and goes on to build new concepts. It begins with explaining ideas of free oscillations and superposition of harmonic motion leading to physics of damped and forced oscillations. The course will also introduce students to coupled oscillators, normal modes of oscillations and free vibrations of stretched strings. Concurrently, in the laboratory component of the course students will perform experiments that expose them to different aspects of real oscillatory systems.

Learning Outcomes

On successful completion of this course, the students will have the skill and knowledge to,

- Understand simple harmonic motion
- Understand superposition of N collinear harmonic oscillations
- Understand superposition of two perpendicular harmonic oscillations
- Understand free, damped and forced oscillations
- Understand coupled oscillators and normal modes of oscillations
- Understand travelling and standing waves, stretched strings

SYLLABUS OF DSC – 3

THEORY COMPONENT

Unit 1: Simple Harmonic Motion (12 Hours)

Differential equation of simple harmonic oscillator, its solution and characteristics, energy in simple harmonic motion, linearity and superposition principle, rotating vector representation of simple harmonic oscillation, motion of simple and compound pendulum (Bar and Kater's pendulum), loaded spring.

Superposition of N collinear harmonic oscillations with (1) equal phase differences and (2) equal frequency differences, Beats

Superposition of two perpendicular harmonic oscillations: Graphical and Analytical Methods. Lissajous Figures with equal and unequal frequencies, effect of variation of phase

Unit 2: Damped and Forced Oscillations (8 Hours)

Damped Oscillations: Equation of motion, dead beat motion, critically damped system, lightly damped system: relaxation time, logarithmic decrement, quality factor

Forced Oscillations: Equation of motion, complete solution, steady state solution, resonance, sharpness of resonance, power dissipation, quality factor

Unit 3: Coupled Oscillations **(6 Hours)**

Coupled oscillators, normal coordinates and normal modes, energy relation and energy transfer, di-atomic molecules, representation of a general solution as a linear sum of normal modes, normal modes of N coupled oscillators.

Unit 4: Wave Motion **(4 Hours)**

One dimensional plane wave, classical wave equation, standing wave on a stretched string (both ends fixed), normal modes. Travelling wave solution

PRACTICAL COMPONENT (60 Hours)

Every student must perform at least 5 experiments

1) Experiments using bar pendulum:
    a) Estimate limits on angular displacement for SHM by measuring the time period at different angular displacements and compare it with the expected value of time period for SHM.
    b) Determine the value of g using bar pendulum.
    c) To study damped oscillations using bar pendulum
    d) Study the effect of area of the damper on damped oscillations. Plot amplitude as a function of time and determine the damping coefficient and Q factor for different dampers.
2) To determine the value of acceleration due to gravity using Kater's pendulum for both the cases (a) T_1≈T_2 and (b) T_1≠T_2 and discuss the relative merits of both cases by estimation of error in the two cases.
3) Understand the applications of CRO by measuring voltage and time period of a periodic waveform using CRO. And study the superposition of two perpendicular simple harmonic oscillations using CRO (Lissajous figures)
4) Experiments with spring and mass system
    a) To calculate g, spring constant and mass of a spring using static and dynamic methods.
    b) To calculate spring constant of series and parallel combination of two springs.
5) To study normal modes and beats in coupled pendulums or coupled springs.
6) To determine the frequency of an electrically maintained tuning fork by Melde's experiment and to verify λ^2 – T Law.
7) To determine the current amplitude and phase response of a driven series LCR circuit with driving frequency and resistance. Draw resonance curves and find quality factor for low and high damping.

References (For Laboratory Work):

1) Advanced Practical Physics for students, B. L. Flint and H. T. Worsnop, 1971, Asia Publishing House.
2) Engineering Practical Physics, S. Panigrahi and B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
3) Practical Physics, G. L. Squires, 2015, 4/e, Cambridge University Press.
4) A Text Book of Practical Physics, Vol I and II, Prakash and Ramakrishna, 11/e, 2011, Kitab Mahal.
5) An Introduction to Error Analysis: The study of uncertainties in Physical Measurements,

J. R. Taylor, 1997, University Science Books List of experiments

Essential Readings:

FOR THEORY COMPONENT

1) Vibrations and Waves by A. P. French. (CBS Pub. and Dist., 1987)

2) The Physics of Waves and Oscillations by N.K. Bajaj (Tata McGraw-Hill, 1988)
3) Fundamentals of Waves and Oscillations By K. Uno Ingard (Cambridge University Press, 1988)
4) An Introduction to Mechanics by Daniel Kleppner, Robert J. Kolenkow (McGraw-Hill, 1973)
5) Waves: BERKELEY PHYSICS COURSE by Franks Crawford (Tata McGrawHill, 2007).
6) Classical Mechanics by Peter Dourmashkin, John Wiley and Sons
7) https://phys.libretexts.org/Bookshelves/Classical_Mechanics/classical_Mechanics_(Dou r mashkin)

Suggestive Readings:

1) Fundamentals of Physics, Resnick, Halliday and Walker 10/e, 2013, Wiley.
2) Feynman Lectures, Vol. 1, R. P. Feynman, R. B. Leighton, M. Sands, 2008, Pearson Education.
3) University Physics, H. D. Young, R. A. Freedman, 14/e, 2015, Pearson Education.