

NATIONAL UNIVERSITY



Syllabus Department of Physics

**Four Year B.Sc Honours Course
Effective from the
Session : 2009–2010**

National University
Subject: Physics
Syllabus for Four Year B.Sc Honours Course
Effective from the Session: 2009-2010

Year wise courses and marks distribution

First year Honours

Course Code	Course Title	Marks	Credits
	Mechanics	100	4
	Properties of Matter, Waves & Oscillations	100	4
	Heat, Thermodynamics and Radiation	100	4
	Physics Practical-I	100	4
	Fundamentals of Mathematics	100	4
	Calculus-I	50	2
	{ Chemistry-I	100	4
	{ Chemistry-I Practical Or	50	2
	{ Introduction to Statistics	100	4
	{ Statistics Practical-I	50	2
	Total=	700	28

Detailed Syllabus

First Year

First Year B.Sc. Honours in Physics

Course Code:

Course Name: Mechanics

60 Lectures

Examination duration: 4 hrs.

Marks: 100

Credits: 4

- 1. Vector Algebra:** Vector and scalar quantities; Vectors and their components, Vector addition and subtraction, Scalar and vector triple products, scalar and vector fields, Vector differentiation and integration, Gradient, Divergence and Curl and their physical significance, Gauss's divergence theorem, Green's theorem and Stoke's theorem, Polar, Spherical and Cylindrical co-ordinates.
- 2. Concept of Measurement:** Different Measurement units, International system of units, Origin of Length mass and time, Conversion of units from one system to another.

3. **Particles Motion in one dimension:** Concept of motion and frame of reference, Position and displacement, Average velocity and average speed, Instantaneous velocity and speed, Acceleration, Constant acceleration, Equations for motion with constant acceleration, Free-fall acceleration, Equation for free-fall acceleration, Particles of physics and basic structure of atoms and nuclear.
4. **Particles Motion in Two and Three Dimensions:** Position and displacement using vectors, Velocity and average velocity, Acceleration and average acceleration, Equation of motion using vector, Projectile motion, Uniform circular motion.
5. **Force and Motion:** Newton's laws of motion and their applications, Concept of mass, Force and weight, Frictional forces and Properties of friction, Drag force and terminal speed, Forces of nature.
6. **Work, Energy and Power:** Kinetic and Potential energy, Work done by constant and variable forces, Work-energy theorem, Hooke's law, Work done by a spring force, Work done by weight, Power, Gravitational potential energy, Conservation of energy.
7. **System of Particles:** Center of mass of systems of particles, Center of mass of rigid bodies, Linear momentum of a particle, Linear momentum of a system of particles, Conservation of linear momentum for a system of particles.
8. **Collisions of Bodies:** Collisions and its classification, Impulse and linear momentum, Elastic and inelastic collision in one dimension, Motions of the center of mass of colliding bodies.
9. **Rotational Kinematics:** Translational and Rotational motion, Angular Position, Angular displacement, Angular Velocity and angular acceleration, Rotation with constant angular acceleration, Relation between linear and angular kinematics of a particles in circular motion.
10. **Rotational Dynamics:** Torque and angular momentum and their relation, Kinetic energy of rotation and rotational inertia (moment of inertia), Combined Translational and rotational motion of a rigid body, Parallel and perpendicular axes theorems of moment of inertia, calculation of moment of inertia for solids of different shapes, conservation of angular momentum. Relation between angular momentum and torque.

Books Recommended:

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|--|---|-------------------------|
| 1. Spiegel, M.R. | : | Vector Analysis |
| 2. Halliday, D., Resnick, R. and Walker, J | : | Fundamentals of Physics |
| 3. Halliday, D and Resnick, R. | : | Physics |
| 4. Sears, F.W., Zemansky, M.W. and Young, H.D. | : | University Physics |

Course Code:	Course Name: Properties of Matter, Waves & Oscillations	60 Lectures
Examination duration: 4 hrs.	Marks: 100	Credits: 4

1. **Gravitation:** Kepler's Laws, Law of universal gravitation, G and its determination, Inertial and gravitational mass, Acceleration due to gravity and its variation, Measurement of acceleration due to gravity by compound pendulum and Kater's pendulum, Gravitational potential and field in simple cases, Gravitational potential energy.
2. **Elasticity:** Hooke's Law, Elastic constants of isotropic solids, Poisson's ratio and their interrelations, Internal elastic potential energy, Experimental determination of elastic constants, Torsion of a cylinder, Bending of beams, Cantilever, Variation of elasticity with temperature.

3. **Surface Tension:** Surface tension and surface energy, Adhesive and cohesive forces, Molecular theory of surface tension, Pressure on a curved membrane of uniform tension, Soap bubble, Capillarity, Angle of contact and its measurement, Determination of surface tension of water and mercury drop, Variation of surface tension with temperature.
4. **Fluid Dynamics:** General concepts of fluid flow, Streamlines, Equation of continuity, Bernoulli's equation, Application of Bernoulli's equation and equation of continuity. Coefficient of viscosity, Critical velocity and Reynold's number, Poiseuille's formula and its correction, Measurement of viscosity, Variation of viscosity with temperature.
5. **Waves:** Waves and Particles, Types of waves, Transverse and Longitudinal waves, Wavelength and frequency, The Speed of a traveling Wave, Wave speed on a stretched string, Energy and power of a traveling string wave, The principle of superposition for waves, Interference of waves, Complex waves, Standing waves and Resonance.
6. **Sound Waves:** The Speed of Sound, Propagation and speed of longitudinal waves, Traveling longitudinal waves, Standing longitudinal waves, Beats, Doppler effect.
7. **Oscillations:** Simple harmonic motion (SHM), Energy consideration in SHM, Applications of SHM, Relation between SHM and uniform circular motion, Combinations of two SHM's, Lissajous' figures, Two-body oscillations, Damped harmonic motion, Forced oscillations and resonance, Power and intensity of wave motion.
8. **Vibrations:** Vibrations of string, Membranes, bars, plates and air-column, Sonometer, Melde's experiment, Rectangular and circular membranes, Transverse and longitudinal vibration of rod, Air-columns in cylindrical pipes, Organ pipes, Chladni's figure.

Books Recommended:

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|--|---|-------------------------------|
| 1. Halliday, D, Resnick, R. and Walker, J. | : | Fundamentals of Physics |
| 2. Halliday, D. Resnick, R. | : | Physics |
| 3. Sears, F.W., Zemansky, M.W. and Young, H.D. | : | University Physics |
| 4. Mathur, D.S. | : | Properties of Matter |
| 5. Newman, F.W. and Searle, V.H.L | : | General Properties of Matter. |

Course Code:	Course Name: Heat, Thermodynamics & Radiation	60 Lectures
Examination duration: 4 hrs.	Marks: 100	Credits: 4

1. **Heat and Temperature:** Concept of temperature, Thermal equilibrium, Measurement of low and high temperatures, The Clausius & Fahrenheit scales, Thermal expansion, Gas Thermometers, Platinum resistance thermometer, Thermocouple.
2. **Kinetic Theory of Gases:** Equation of state of an ideal gas, Equipartition of energy, Translational kinetic energy, Mean free path, Maxwell's theory of distribution of velocities, Brownian motion, Degrees of freedom & Molar Specific Heats, Van der Waals' Equation of state, Transport phenomena.
3. **Transmission of Heat:** Conduction, Convection, Radiation, Conduction of heat in solids, Measurement of thermal conductivity of a bad conductor, Heat conduction through composite walls.
4. **First Law of Thermodynamics:** Internal Energy, Heat and work, Isothermal and adiabatic processes, Work done by expanding gases, Statement of first law of thermodynamics and applications.

5. **Second Law of Thermodynamics and Entropy:** The Thermodynamic temperature scale, Concept of entropy, Calculation of entropy change in reversible and irreversible processes, Entropy and second law of thermodynamics, Entropy and disorder. The Carnot engine, Efficiency of heat engines, Carnot's theorem, Refrigerator and air-conditioner, Clausius theorem, Clausius-Clapeyron equation.
6. **Third Law of Thermodynamics:** Nernst heat theorem, Phase rule and its uses, Third law of thermodynamics.
7. **Thermodynamic Functions:** Thermodynamic potentials at constant volume and pressure, Maxwell's thermodynamic relations, Specific heat equations, Joule-Thomson effect and its applications.
8. **Radiation Laws:** Concept of black body and black body radiation, Emissive and absorptive powers, Kirchhoff's law, Stefan-Boltzmann's Law, Wien's displacement law, Rayleigh-Jean's law, Planck's quantum hypothesis, Planck's law, Applications of radiations laws.

Books Recommended:

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|--|---|-----------------------------------|
| 1. Halliday, D, Resnick, R. and Walker, J. | : | Fundamentals of Physics |
| 2. Sears, F.W., Zemansky, M.W. and Young, H.D. | : | University Physics |
| 3. Zemansky, M.W. | : | Heat and Thermodynamics |
| 4. Sears, F.W. | : | An Introduction to Thermodynamics |
| 5. Hossain, T. | : | Text Book of Heat |
| 6. Saha, M.N. and Srivastava, B.N. | : | A Treatise on Heat. |

Course Code: Course Name: Physics Practical-I 90 Hours Practical Classes
Examination duration: 6 hrs. Marks: 100 Credits: 4

To perform two experiments (one from each group) each of three hours duration.

i) Experiments (3 hours each)	2 x 40 =	80
ii) Laboratory note book		10
iii) Experimental Viva-voce		10
		Total marks = 100

Marks for each experiment shall be distributed as follows:

a) Theory		5
b) Data collection and tabulation		15
c) Calculation, graphs and result		15
d) Discussion		5
		Total marks = 40

Group – A

1. Determination of acceleration due to gravity 'g' by compound pendulum.
2. Determination of acceleration due to gravity 'g' by Kater's pendulum.
3. Determination of Young's modulus and rigidity modulus by Searle's dynamic method.
4. Determination of rigidity modulus of a wire/rod by static method.
5. Determination of rigidity modulus of the material of a wire by dynamic method.
6. Determination of the spring constant and effective mass of a given spiral spring and hence to calculate the rigidity modulus of the material of the spring.
7. Determination of the Young's modulus by the flexure of a beam (bending method).
8. Determination of the moment of inertia of a fly-wheel about its axis of rotation.

9. Determination of the Young's modulus for the material of a wire by Searle's apparatus.
10. Determination of Surface tension of water by capillary tube method.
11. Determination of surface tension of mercury by Quincke's method.

Group – B

1. Determination of the specific heat of solid by method of mixture, with radiation correction.
2. Determination of the specific heat of a liquid by the method of cooling.
3. Determination of the thermal conductivity of a good conductor by Searle's apparatus.
4. Determination of the thermal conductivity of a bad conductor by Lee's method.
5. Determination of mechanical equivalent of heat 'J' with radiation correction.
6. Investigation of the variation of resistance of a copper wire with temperature and determination of its temperature coefficient of resistance.
7. Verify the laws of transverse vibration of a stretched string with a sonometer ($n-l$, and $n - \frac{1}{l}$ curves only)
8. Determination of the frequency of a tuning fork by Melde's experiment.
9. Determination of latent heat of fusion of ice with radiation correction.
10. Determination of latent heat of condensation of steam with radiation correction.
11. Determination of density of water at various temperature by specific gravity bottle and study the variation of density with temperature from the graph.

Books Recommended:

1. Ahamed, G.U. and Uddin, M.S. : Practical Physics
2. Chawdhury, S.A. and Bashak, A.K. : ব্যবহারিক পদার্থবিদ্যা
3. Din, K. and Matin, M.A. : Advanced Practical Physics
4. Worsnop and Flint : Advanced Practical Physics

Course Code:	Course Name: Fundamentals of Mathematics	60 Lectures
Examination duration: 4 hrs.	Marks: 100	Credits: 4

1. **Real Number System:** Field and order properties, Natural numbers, Integers and rational numbers, Absolute value and their properties, Basic inequalities.
2. **Complex Number System:** Field of Complex numbers, De Moivre's theorem and its applications.
3. **Theory of equations:** Relations between roots and coefficients, Symmetric functions of roots, Sum of the powers of roots, Synthetic division, Des Cartes' rule of signs, Multiplicity of roots, Transformation of equations.
4. **Matrices and Determinants:** Notion of matrix, Types of matrices, Algebra of matrices, Determinant function and its properties, Minors, Cofactors, Expansion and evaluation of determinants, Elementary row and column operations and row-reduced echelon matrices, Invertible matrices, Diagonal, triangular and Symmetric matrices.
5. **System of Linear Equations:** System of linear equations (homogeneous and non-homogeneous) and their solutions, Gaussian elimination, Application of matrices and determinants for solving system of linear equations, Applications of system of equations in real life problems.
6. **Vector Spaces:** Euclidean n -space, Real vector spaces, Subspaces, Linear combination of vectors, Linear dependence of vectors, Basis and dimension, Linear transformations, Matrix representation of linear transformation, Kernel and image, Eigenvalues and Eigenvectors.

7. **Two-dimensional Geometry:** Transformation of coordinates, Pair of straight lines (homogeneous second degree equations, General second degree equations representing pair of straight lines, angle between pair of straight lines, Bisectors of angle between pair of straight lines), General equations of second degree (reduction to standard forms, Identifications, Properties and tracing of conics).
8. **Three-dimensional Geometry:** Three-dimensional coordinates, Distance, Direction cosines and direction ratios, Planes and straight lines, Vectors in plane and space, Algebra of vectors, Scalar and vector product, Vector equations of straight lines and planes.

Books Recommended :

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| 1. S. Bernard & J M Child | : | Higher algebra. |
| 2. Howard Anton & Chris Rorres | : | Elementary Linear Algebra with Application. |
| 3. Khosh Mohammad | : | Analytic Geometry and Vector Analysis. |
| 4. Md. Abdur Rahman | : | Linear Algebra. |

Course Code:

Course Name: Calculus-I

30 Lectures

Examination duration: 2.5 hrs.

Marks: 50

Credits: 2

1. **Functions & their graphs :** Polynomial and rational functions, Logarithmic and exponential functions, Trigonometric functions & their inverses, Hyperbolic functions & their inverses, Combinations of such functions.
2. **Limit and continuity:** Definitions and basic theorems on limit and continuity, Limit at infinity & infinite limits, Computation of limits.
3. **Differentiation:** Tangent lines and rates of change. Definition of derivative, One-sided derivatives. Rules of differentiation, Successive differentiation, Leibnitz's theorem, Related rates, Linear approximations and differentials.
4. **Applications of Differentiation:** Mean value theorem, Maximum and minimum values of functions, Concavity and points of inflection, Optimization problems.
5. **Integration:** Anti-derivatives and indefinite integrals, Techniques of integration, Definite integration using anti-derivatives, Fundamental theorems of calculus, Basic properties of integration, Integration by reduction.
6. **Applications of Integration:** Arc length. Plane areas, Surfaces of revolution, Volumes of solids of revolution, Volumes by cylindrical shells, Volumes by cross sections.
7. **Approximation and Series:** Taylor polynomials and series, Convergence of series, Taylor's series, Taylor's theorem and remainders, Differentiation and integration of series.

Books Recommended:

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| 1. Howard Anton | : | Calculus (7 th and forward editions). |
| 2. E.W. Swokowski | : | Calculus with Analytic Geometry. |
| 3. Md. A Matin & B Chakraborty | : | Differential Calculus. |

Course Code:
Examination duration: 4 hrs.

Course Name: Chemistry-I
Marks: 100

60 Lectures
Credits: 4

- 1. Measurements and the Scientific Method:** Measurements, units, SI units, reliability of measurements – precision and accuracy, rounding off, significant figures, significant figures in calculation, mean and median, errors, sources of errors.
- 2. Structure of atom:** Atom, isotopes, Atomic masses, Mass spectroscopy, Atomic nucleus, Nuclear binding energy, Nuclear reactions – fission and Fusion reactions, Bohr atom model, Spectrum of atomic hydrogen, Dual nature of electron, Heisenberg uncertainty principle, Quantum numbers, Atomic orbitals, Aufbau principle, Pauli exclusion principle, Hund's rule of maximum multiplicity, Electronic configuration of atoms.
- 3. Periodic Table:** Periodic law, Periodic table, Electronic configurations from the periodic table, Periodic properties of the elements such as ionization energies, Electron affinity, Electro negativity, Atomic/ionic radius along a period and down a group, Diagonal relationship
- 4. Chemical Bonds:** Chemical bond, Types of chemical bonds – ionic, Covalent coordination, Metallic, Hydrogen, Polar and non polar covalent bonds, Lewis dot structure, Shapes of molecules, VSEPR theory, Valence bond theory, Hybridization, σ - and π -bonding in compounds, Molecular orbital theory.
- 5. Oxidation and reduction:** Redox reactions, Writing and balancing Redox reactions,
- 6. States of Matter:** Comparison between solids, Liquids and gases, Changes of state, m.p. and b.p, phase transition, Phase diagram of water.
- 7. Gaseous and Their Properties:** The gas laws, The perfect gas equation, The kinetic theory of gases, Van der Waals equations, Real gases, Graham's laws of diffusion and Effusion.
- 8. Solutions:** Solubility and intermolecular forces, Solubility product, Types of concentration units, Colligative properties of solutions, Henry's law, Nernst distribution law.
- 9. Acids and Bases:** Various concepts on acids and bases, Conjugate acids and bases, Neutralization reactions acid- base strength, p^H , Acid-base titrations, Acid-base indicators, Acid-base properties of salts, The common ion effect, Buffer solutions, Hard and soft acids and bases.
- 10. Chemical Equilibrium:** Reversible reactions and the equilibrium state, The equilibrium law, Reaction quotients and equilibrium constants, Calculations using K_c , K_p , Homogeneous and heterogeneous equilibria, The principle of Le Chatelier and Brown.
- 11. Hydrocarbons:** Hydrocarbons, Saturated and unsaturated hydrocarbons, Alkanes, Alkenes, And Alkynes, Nomenclature of organic compounds-the IUPAC system natural gas, Petroleum, Petrochemicals.
- 12. Study of different classes of organic Compounds:** Alcohols, Aldehydes, Ketones, Carboxylic Acids, Esters, Amines and Amides.

Books recommended:

1. General Chemistry, D. D. Ebbing, Houghton Mifflin Co.
2. Chemistry – The Molecular Nature of Matter and Change, M. Silberberg. WCB /Mc Graw- Hill.
3. Introduction to Modern Inorganic Chemistry, S.Z. haider, Friends' International.
4. Principles of physical chemistry, M. M. Huque and M. A Nawab, students' publications.
5. Essentials of Physical chemistry, B.S Bahl, G.D Tuli and A Bahl, S. Chand & Co.Ltd.
6. Advanced Organic Chemistry, B.S. Bahl and A Bahl, S. Chand & Co. Ltd.
7. A Level chemistry by C.W. Ramsden
8. Organic Chemistry: T Morrison and R.N. Boyed,
9. Fundamental of Organic Chemistry by W Solomons

Course Code: **Course Name: Chemistry-I Practical**
Examination duration: 4-6 hrs. **Marks: 50**

30 Lectures
Credits: 2

1. Preparation of $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$, Mohr's salt and potash alum.
2. Separation and identification of four radicals from a mixture of anions and cations. The cations are Pb^{2+} , Cu^{2+} , Cd^{2+} , Al^{3+} , Fe^{2+} , Fe^{3+} , Co^{2+} , Ni^{2+} , Zn^{2+} , Ca^{2+} , Ba^{2+} , Na^+ , K^+ , and NH_4^+ , the anions are NO_3^- , CO_3^{2-} , S^{2-} , SO_4^{2-} , Cl^- , Br^- and I^- .
3. Standardization of NaOH solution using standard oxalic acid solution,
4. Determination of Fe^{2+} using standard permanganate solution
5. Iodometric determination of copper(II) using standard Na_2SO_3 solution.
6. Gravimetric determination of nickel as $\text{Ni}(\text{HDMG})_2$ complex
7. Determination of the enthalpy change for the decomposition sodium dicarbonate into sodium carbonate.
8. Determination of the p^{H} - neutralization curves of a strong acid by a strong base.
9. Investigation of the conductance behaviour of electrolytic solution and applications (acetic acid)
10. Determination of the presence of nitrogen, halogen and sulphur in organic compounds.
11. Identification of the functional groups (unsaturation, alcohol, phenol, carbonyl, aldehyde, ketone, carboxylic acid, aromatic amine, amide and nitro- groups) in organic compound.

Books Recommended:

1. A Text Book of Quantitative Inorganic Analysis, A.I. Vogel, 3rd/4th edition, ELBS and Longman Green & Co. Ltd.
2. A Text Book of Quantitative Inorganic Analysis, A.I. Vogel 3rd /4th edition, ELBS and Longman Green & Co. Ltd.
3. Practical physical chemistry, A Faraday.
4. A Text Book of practical organic chemistry, A.I. Vogel, ELBS edition.

Course Code: **Course Name: Introduction to Statistics**
Examination duration: 4 hrs. **Marks: 100**

60 Lectures
Credits: 4

1. **Descriptive Statistics:** Statistics—Its nature and some important uses, Qualitative and quantitative data, Classification, Tabulation and frequency distribution, Graphical representation of data, Measures of location, Measures of Dispersion, Skewness and Kurtosis, Mathematical relationship among different measures of location, dispersion, Skewness and kurtosis.
2. **Bivariate Data:** Correlation coefficient, Correlation analysis, The purpose and uses of regression analysis, Simple regression and methods of least squares and estimation of parameters, Correlation ratio, Rank correlation, Partial and multiple correlation.
3. **Elementary Probability:** Meaning of Probability, Classical and empirical definitions of Probability, Axiomatic approach of defining probability, Event, Sample space and simple problems on probability, Addition rule, Conditional probability, Multiplication rule and Bayes theorems, The concept of a random variables, Probability function and probability density function, Joint probability function. Marginal and conditional distributions, Statistical independence, Expected value and related

theorems, Moment generating function, Common probability distributions, Binomial, Poisson and Normal.

4. **Index Number:** Concept of an index number and problems in the construction of index number, Types of indices (Price, Quantity, Value and cost of living indices) and their uses, Tests for index numbers.
5. **Time Series analysis:** Elements of time-series analysis, Measurement of trend by moving average, By least square method, Trend curve, Determination of seasonal indices, Cyclical movements.
6. **Numerical Mathematics:** Differences of a polynomial, Finite difference operator, Difference table, Newton's formula and starling's central difference formula, Inverse interpolation, Numerical integration.

Books Recommended:

1. Yule and Kendall : Introduction to Theory of Statistics.
2. Islam, M. Nurul. : An Introduction to Statistics and Probability.
3. Jalil A. and Ferdous R. : Basic Statistics.
4. Mostafa M.G. : Methods of Statistics.
5. David E.N. : Probability Theory for Statistical Methods.
6. Weatherburn C.F. : A First Course in Mathematical statistics.
7. Mosteller, Roure and Thomas : Probability with Statistical Applications.
8. Ali A. : Theory of Statistics Vol. I
9. Mallick, S.A. : সাংখ্যিক গনিত
10. Freeman H. : Acturial, Mathematics Vols; I and II
11. Scarborough : Numerical Mathematics.
12. David F.N. : Probability theory for Statistical Methods.
13. Shil R.N. : Introduction to Theory of Statistics.
14. Feller, W : Introduction to Statistical Time Series (latest ed.).
15. Gupta and Kapoor : Applied Statistics.

Course Code:
Examination duration: 3 hrs.

Course Name: Statistics Practical-I
Marks: 50

30 Lectures
Credits: 2

Condensation and tabulation of data, Graphical representation of data, Frequency table, Measures of location, Dispersion, Moments, Skewness and Kurtosis, measures of correlation coefficient, Rank correlation, Fitting of simple regression lines, Fitting of Binomial, Normal and Poisson's distributions, Finding trend values and seasonal variation from time series data by different methods, Calculation of Index numbers and test of index number, Use of Newton's forward and backward formula, Solution of numerical integration.