NATIONAL UNIVERSITY

Syllabus
Department of Mathematics

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

National University

Subject: Mathematics

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
3752	Fundamentals of Mathematics	100	4
3753	Calculus – I	100	4
3754	Linear Algebra	100	4
3755	Analytic and Vector Geometry	100	4
	Any TWO of the following:		
6282	Chemistry-I	100	4
6285	Chemistry-I Practical	50	2
6362	Introduction to Statistics	100	4
6365	Statistics Practical-I	50	2
6272	Physics-I (Mechanics, Properties of Matter, Waves & Optics)	100	4
6273	Physics-II (Heat, Thermodynamics and Radiation)	50	2
	Total=	**700**	**28**

Detailed Syllabus

First Year

Course Code:3752, Course Title: Fundamentals of Mathematics 100 Marks, 4 Credits, 60 Lectures

Elements of logic: Mathematical statements, Logical connectives, Conditional and bi-conditional statements, Truth tables and tautologies, Quantifiers, Logical implication and equivalence, Deductive reasoning.

Set Theory : Sets and subsets, Set operations, Cartesian product of two sets, Operations on family of sets, De Morgan's laws.

Relations and functions:. Relations. Order relation. Equivalence relations. Functions. Images and inverse images of sets. Injective, surjective, and bijective functions. Inverse functions.

Real Number System: Field and order properties, Natural numbers, Integers and rational numbers, Absolute value and their properties, Basic inequalities. (Including inequalities of means, powers; inequalities of Cauchy, Chebyshev, Weierstrass).

Complex Number System: Field of Complex numbers, De Moivre's theorem and its applications.

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, Transfor-

Elementary number theory: Divisibility. Fundamental theorem of arithmetic. Congruences (basic properties only).
Summation of series: Summation of algebraic and trigonometric series.

Evaluation: Final examination (Theory, 4 hours): 100 marks.

Ten questions will be set, of which any six are to be answered.

Books Recommended :

Schaums Outline Series- *Theory and problems on set theory and related topics.*
S. Bernard & J M Child- *Higher algebra.*

Md. Abdur Rahman - *Basic Algebra.*

Course Code: 3753, Course Title: Calculus-I 100 Marks, 4 Credits, 60 Lectures

Functions & their graphs : Polynomial and rational functions, logarithmic and exponential functions, trigonometric functions & their inverses, hyperbolic functions & their inverses, combinations of such functions.
Limit and continuity: Definitions and basic theorems on limit and continuity. Limit at infinity & infinite limits, Computation of limits.
Differentiation: Tangent lines and rates of change. Definition of derivative. One-sided derivatives. Rules of differentiation (proofs and applications). Successive differentiation. Leibnitz's theorem (proof and application). Related rates. Linear approximations and differentials.
Applications of Differentiation: Mean value theorem. Maximum and minimum values of functions. Concavity and points of inflection. Optimization problems.
Integration: Antiderivatives and indefinite integrals. Techniques of integration. Definite integration using antiderivatives. Fundamental theorems of calculus (proofs and applications). Basic properties of integration. Integration by reduction.
Applications of Integration: Arc length. Plane areas. Surfaces of revolution. Volumes of solids of revolution. Volumes by cylindrical shells. Volumes by cross sections.
Graphing in polar coordinates: Tangents to polar curves. Arc length in polar coordinates. Areas in polar coordinates.
Improper integrals : Tests of convergence and their applications. Gamma and Beta functions. Indeterminate form of type 0/0. L'Hospital's rule. Other indeterminate forms.
Approximation and Series: Taylor polynomials and series. Convergence of series. Taylor's series. Taylor's theorem and remainders. Differentiation and integration of series. Validity of Taylor expansions and computations with series.

Evaluation: Final exam (Theory, 4 hours): 100 marks.
Ten questions will be set, of which any six are to be answered.

Books Recommended:

1. Howard Anton -*Calculus (7^{th} and forward edition).*
2. E.W. Swokowski, *Calculus with Analytic Geometry.*
3. Md. A Matin & B Chakraboty, *Differential Calculus.*

Course Code: 3754, Course Title: Linear Algebra 100 Marks, 4 Credits, 60 Lectures

Matrices and Determinants:,
Notion of matrix. Types of matrices. Algebra of matrices. Determinant function. Properties of determinants. Minors, Cofactors, expansion and evaluation of determinants. Elementary row and column operations and row-reduced echelon matrices. Invertible matrices. Different types of matrices, Rank of matrices.

Vectors in R^n and C^n: Review of geometric vectors in R^2 and R^3 spaces. Vectors in R^n and C^n. Inner product. Norm and distance in R^n and C^n.
System of Linear Equations: System of linear equations (homogeneous and non-homogeneous) and their solutions. Application of matrices and determinants for solving system of linear equations. Applications of system of equations in real life problems.
Vector Spaces: Notion of groups and fields. Vector spaces. Subspaces. Linear combination of vectors. Linear dependence of vectors. Basis and dimension of vector spaces. Row and column space of a matrix. Rank of matrices. Solution spaces of systems of linear equations.
Linear Transformation: Linear transformations. Kernel and image of a linear transformation and their properties. Matrix representation of linear transformations. Change of bases.
Eigenvalues and Eigenvectors: Eigenvalues and Eigenvectors. Diagonalization. Cayley-Hamilton theorem and its application.

Evaluation: Final exam (Theory, 4 hours): 100 marks.
Ten questions will be set, of which any six are to be answered.

Books Recommended :

1. Howard Anton & Chris Rorres – *Elementary Linear Algebra with Application.*
2. Seymour Lipschutz (Schaum's Outline Series)-*Linear Algebra.*
3. Md. Abdur Rahman- *Linear Algebra.*

Course Code: 3755, Course Title: Analytic and Vector Geometry 100 Marks, 4 Credits, 60 Lectures

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).

Three-dimensional Geometry: Coordinates, Distance, Direction cosines and direction ratios, Planes (equation of plane, angle between two planes, distance of a point from a plane), Straight lines (equations of lines, relationship between planes and lines, shortest distance). Spheres. Conicoids (basic properties).

Vector Geometry: Vectors in plane and space. Algebra of vectors. Rectangular Components. Scalar and Vector products. Triple scalar product. Applications of vectors to geometry (vector equations of straight lines and planes, areas and volumes).
Evaluation: Final exam (Theory; 4 hours): 100 marks.
Ten questions will be set, of which six are to be answered.

Books Recommended :

1. H.H. Askwith - *Analytic Geometry of Conic Section.*
2. J. A. Hummel- *Vector Geometry.*

Course Code: 6282, Course Title: Chemistry-I 100 Marks, 4 Credits, 60 Lectures

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 no 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 kietic 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 indicatiors, 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 Miffin Co.
2. Chemistry – The Molecular Nature of Matter and Change, M. Siberberg. WCB /Mc Graw- Hill.
3. Introduction to Modern Inogranic 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: 6285, Course Title: Chemistry-I Practical 50 Marks, 2 Credits, 30 Lectures

1. Preparation of $FeSO_4$ $7H_{2O,}$ 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_2SO3 solution.
6. Gravimetric determination of nickel as $Ni(HDMG)_2$ 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, aldehlyde, 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, $3^{rd}/4^{th}$ edition, ELBS and Longman Green & Co. Ltd.
2 A Text Book of Quantitative Inorganic Analysis, A.I. Vogel 3^{rd} /4^{th} edition, ELBS and
   Longman Green & Co. Ltd.

Course Code: 6362, Course Title: Introduction to Statistics 100 Marks, 4 Credits, 60 Lectures

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

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. : সাংখিক 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: 6365, Course Title: Statistics Practical-I 50 Marks, 2 Credits, 30 Lectures

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.

Course Code: 6272, Course Title: Physics-I (Mechanics, Properties of Matter, Waves & Optics) Marks 100,
4 Credits, 60 Lectures

1. **Vector Analysis**: Vectors and scalars, Addition and multiplication of vectors, Triple scalar & vector products, Derivatives of vectors, Gradient, divergence and curl-their physical significance, Theorems of Gauss, Green & Stoke's.
2. **Work, Energy and Power**: Work energy theorem, Conservation of energy and linear momentum, Conservative and non-conservative forces and systems, Conservation of energy and momentum, Centre of mass, Collision problems.
3. **Rotational Motions:** Rotational variables, Rotation with constant angular acceleration, Relation between linear and angular kinematics, Torque on a particle, Angular momentum of a particle, kinetic energy of rotation and moment of intertia. Combined translational and rotational motion of a rigid body, Conservation of angular momentum.
4. **Gravitation**: Centre of gravity of extended bodies, Gravitational field and potential their calculations, Determination of gravitation constant and gravity, Compound and kater's pendulums, Motion of planets and satellites, Escape velocity.

6. **Surface Tension**: Surface tension as a molecular phenomenon, Surface tension and surface energy, Capillary rise or fall of liquids, Pressure on a curved membrane due to surface tension, Determination of surface tension of water, mercury and soap solution, Effect of temperature.
7. **Fluid Dynamics**: Viscosity and coefficient of viscosity, Poiseulle's equation, Determination of the coefficient of viscosity of liquid by Stoke's method, Bernoulli's theorem and its applications, Toricelli's theorem, Venturimeter.
8. **Waves**: Mechanical waves, types of waves, travelling waves. The superposition principle. Wave speed, Power and intensity in wave motion. Interference of waves, Standing Waves and resonance.
9. **Oscillatory Motions**: Simple harmonic motion, Combination of harmonic motions, Damped harmonic motion, Forced oscillations and resonance.
10. **Geometrical Optics**: Fermat's Principles, Theory of equivalent lenses, Defect of images, Optical instrument, Dispersion rainbow.
11. **Nature and Propagation of light**: Properties of light, Wave theory and Huygene's Principle, Theories of light.
12. **Interference**: Young's experiment: Bi-prism, Newton's ring.
13. **Diffraction**: Fresnels and Fraunhofer types, Diffraction through single slit and double slit, diffraction grating, Dispersive and resolving powers of gratings.
14. **Polarization**: Plane, Elliptical and circular Polarizations, Optical, Rotatory dispersion, Polarimeters.

Books Recommended:

1.	Spiegel, M.R.	:	Vector Analysis
2.	R.S. Halliday, R. Resnick, and J.Walker	:	Fundamentals of Physics
3.	Halliday, D and Resnick, R.	:	Physics
4.	Sears, F.W., Zimansky, M.W. and Young, H.D.	:	University Physics
5.	Mathur, D.S.	:	Properties of Matter
6.	Newman, F.W. and Serale, V.H.L	:	General Properties of Matter.
7.	A text Book of Light	:	Choudhury, Saha & Pramanik
8.	Fundamantals of Optics	:	F.A. Jenking & H.E. White
9.	A Text Book of Light	:	K.G. Mazumder
10.	Principles of Optics	:	B.K. Mathur

Course Code: 6273, Course Title: Physics-II (Heat, Thermodynamics and Radiation)
Marks 50, 2
Credits, 30 Lectures

1. **Thermometry**: Temperature, Concepts of thermal equilibrium, measurement of low and high temperature: Gas thermometers, Resistance thermometer, Thermocouple, Pyrometry, International temperature scale.
2. **Calorimetry**: Specific heats of solids, liquids and gases by method of mixture with radiation corrections: Newton's Law of cooling, Variations of specific heats, Atomic and molecular heats.
3. **Transmission of Heat**: Thermal conductivity, Determination of thermal conductivities of good and bad conductors.
4. **Thermodynamic Systems**: Concept of internal energy: The first law of thermodynamics, Work and specific heats, Isothermal and adiabatic processes.
5. **The second law of thermodynamics**: Reversible and irreversible processes: Carnot cycle, Efficiency of reversible engines, Absolute thermodynamic temperature scale, Change of phase: Clausius and Clapeyron equation, Porous plug experiment.
6. **Entropy**: Entropy of an ideal gas, Temperature-entropy diagram, Increase of entropy.
7. **Thermodynamic Functions**: The Maxwell's relations, Specific heat equations.
8. **Radiation**: Concept of black body radiation, Kirchhoff's law, Stefan–Boltzmann law, Wien's dis-

Books Recommended:

1.	R.S. Halliday, R. Resnick, and J.Walker	:	Fundamentals of Physics
2.	Halliday, D and Resnick, R.	:	Physics
3.	A Text Book of Heat	:	T. Hossain
4.	Principles of Heat, Thermodynamics and Radiation	:	M.A. Haque
5.	Text Book of Heat, Thermodynamics and Radiation	:	M. Ishaque & A.M.Z. Islam
6.	Taxt Book of Heat , Thermodynamics and Radation	:	Z.I. Bhuiyan & S. Rahman
7.	Heat and Theromodynamics	:	N. Uddin & A Kalam
8.	Tap O Tapagati Bijnan	:	M.A. Jabbar
9.	Heat & Thermodynamics	:	M.W. Zemansky