Course Structure and Credit Allocation
B.Sc. (Mathematics)
First Year (NHEQF Level- 4.5)

Course Category	Semester-I				Semester-II			
	Subject/Title	No. of paper	Credits		Subject /Title	No. of paper	Credits	
			T	P			T	P
Discipline Specific Core	**Major/Minor Subject-I Differential Calculus**	1	4	-	**Major/Minor Subject-I Differential Equation**	1	4	-
	Major/Minor Subject-II	1	2	2	**Major/Minor Subject-II**	1	2	2
M.D-I/ I.D-I Subject-I	**M.D-I/ I.D-I (Foundations of Applied and Computational Mathematics) Basic Equations**	1	4	-	**M.D-II/ I.D-II (Foundations of Applied and Computational Mathematics) Basic Statistics**	1	4	-
M.D-I/ I.D-I Subject-II	**Subject-II**	1	4	-	**Subject-II**	1	4	-
SEC	**SEC-I 1. Integral Calculus**	1	2	-	**SEC-II 1. Vector Calculus**	1	2	-
VAC	**Understanding and connecting with environment Or Life Skills & personality development**	1	2	--	**Understanding and connecting with environment Or Life Skills & personality development**	1	2	-
Total		6	18	2		6	18	2
NHEQF Level 4.5	*Student on exit after successfully completing first year (i.e., securing minimum required 40 credits + 4 Credits in* one vocational course/skills-enhancement course of 4 credits*) will be awarded "Undergraduate Certificate" of one year, in related field/discipline/subject* **Note: Students will opt skill course of Mathematics either in first year (I & II Semesters) or second year (III & IV Semester)**							

Semester-I
Core Subject-1: Differential Calculus
(Theory- 04-Credits)

Unit-I: Limit and Continuity (ε and δ definition), Types of Discontinuities, Differentiability of functions, Rolle's theorem, Lagrange's Mean Value theorem, Cauchy Mean Value Theorem and their applications.

Unit-II: Successive differentiation, Leibnitz's theorem, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's series, Maclaurin's series of sin x, cos x, e^x, log(l+x), $(1+x)^m$ Indeterminate forms.

Unit-III: Partial Differentiation, Euler's Theorem for Homogeneous functions, Maxima and minima of functions of two variables, Tangents and normal, Cartesian and polar subtangent and subnormal, Intercepts, Length of the tangent and normal, Length of the perpendicular from the pole on tangent

Unit IV: Curvature. Cartesian, polar and parametric formulae for radius of curvature Asymptotes, Singular Points. Tracing of curves. Parametric representation of curves and tracing of parametric curves, Polar coordinates and tracing of curves in polar coordinates

Books Recommended:

1.H. Anton, I. Bivens and S. Davis, *Calculus*, John Wiley and Sons, Inc., 2011.
2.G.B. Thomas and R.L. Finney, *Calculus*, Pearson Education, 2007.

Semester-I

Skill Paper-I
Integral Calculus (02 Credits)

Unit-I: Integration of rational and irrational functions, Properties of definite integrals. Reduction formulae for integrals of rational and trigonometric functions,

Unit-II: Gamma and Beta functions. Areas and lengths of curves in the plane, Volumes and surfaces of solids of revolution. Double and triple integrals.

Books Recommended

1. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.
2.H. Anton, I. Bivens and S. Davis, *Calculus*, John Wiley and Sons (Asia) P. Ltd., 2002.

Semester-II

Skill Paper-II
Vector Calculus (02 Credits)

Unit-I: Scalar and vector products of three and four vectors, Reciprocal systems of vectors, Applications of vectors to three dimensional geometry. Differentiation of vectors, partial differentiation of vectors, Velocity and acceleration, Integration of vectors.

Unit-II: Differential operators, Gradient of a scalar point function, Directional Derivative, divergence and curl of vectors. Line integrals, Surface integrals, Applications of Gauss's, Green's and Stokes' theorems.

Books Recommended
1. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.
2. H. Anton, I. Bivens and S. Davis, Calculus, John Wiley and Sons (Asia) P. Ltd. 2002.
3. P.C. Matthew's, Vector Calculus, Springer Verlag London Limited, 1998.

Semester-II
Core Subject-I: Differential Equations
(Theory-06 Credits)

Unit-I: Classification of differential equations: their origin and applications, initial value problems, boundary value problems, existence of solution. Separable equation and reducible to this form.

Unit-II: Exact differential equations, integrating factors, special integrating factors and transformations. linear differential equation and Bernoulli equations, first order higher degree equations solvable for x, y, p.

Unit-III: Higher-order differential equations with constant coefficients, basic theory of linear differential equations, The Cauchy-Euler equation, Simultaneous differential equations. Wronskian and its properties Second order linear differential equations with variable coefficients, Inspection Method, Reducible to normal form, Change of Independent Variable, Variation of Parameters. Total differential equations.

Unit-IV: Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equation of first order, Lagrange's method, Charpit's method.

Books Recommended
1. Shepley L. Ross, *Differential Equations*, 3rd Ed., John Wiley and Sons, 1984.
2. I. Sneddon, *Elements of Partial Differential Equations*, McGraw-Hill, International Edition, 1967.

M.D/I.D- Foundations of Applied and Computational Mathematics

M.D.-I/I.D.-I

B.Sc.-I Sem: Basic Equations

Unit I: Linear Equations and Systems

Linear equations in one and two variables, Solution methods: substitution, elimination, graphical, Consistency and inconsistency in systems, Applications in Real world problems

Unit II: Quadratic Equations

General form and nature of roots, Factorisation method, completing the square, and quadratic

formula, Discriminant and root types (real, complex, repeated), Graph of a quadratic equation, Applications in physics and economics

Unit III: Higher Degree Polynomial Equations

Cubic and quartic equations, Rational Root Theorem and Factor Theorem, Descartes' Rule of Signs, Symmetric functions of roots, Graphical behaviour of polynomial functions

Unit IV Tools: Use of GeoGebra/Python/ MATLAB

Graphical solution of linear and quadratic equations, Visualisation of roots of polynomial equations, Using software to solve systems of equations, Real-life application modelling using differential equations

Course Outcomes:

After completing this course, students will be able to:

1. Identify and classify various types of equations.
2. Solve algebraic equations of different degrees using analytical methods.
3. Understand the concept of systems of equations and solve them using various techniques.
4. Apply equations in real-world contexts including physics, chemistry, and economics.
5. Use mathematical software/tools to solve and graph equations.

Books Recommended:

1. KOC. Sinha,A1gebra (Vol. l& ll).R.S. Aggarwal, Higher Algebra
2. George Simmons, Differential Equations with Applications and Historical Notes
3. Schaum's Outline Series, College Algebra Teaching

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M.D.-I/I.D.-II

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B.Sc.-II Sem: Basic Statistics

Unit – I: Introduction and Data Handling

Definition and scope of statistics. Types of data: qualitative and quantitative. Scales of measurement: nominal, ordinal, interval, ratio. Collection of data: primary and secondary sources. Frequency distribution, tabulation, graphical representation of data: bar graphs, histograms, pie charts, line graphs.

Unit – II: Descriptive Statistics

Measures of central tendency: mean, median, mode, Measures of dispersion: range, interquartile range, variance, standard deviation, Skewness and kurtosis, Percentiles and quartiles, Box plots and interpretation.

Unit– III: Probability and Distributions

Basic concepts of probability, Independent and dependent events, Conditional probability, Introduction to random variables, Probability distributions: Binomial, Poisson. Normal

distributions and their applications

Unit – IV: Computer-Based Statistical Analysis
Introduction to statistical software/tools (Excel, R, or Python – depending on what's available), Importing and cleaning data from CSV, Excel, Using spreadsheets or libraries (like pandas in Python) for basic analysis: mean, median, mode, standard deviation, Creating charts: bar chart, histogram, scatter plot, boxplot.

Books Recommended:
1· **Navidi, W.** (2021). *Statistics for Engineers and Scientists* (5th Edition). McGraw-Hill.
2· **Sheldon M. Ross** (2017). *Introductory Statistics* (5th Edition). Academic Press.
3· **G. C. Beri** (2013). *Business Statistics* (3rd Edition). Tata McGraw Hill Education.·
Allan B. Downey (2015). *Think Stats: Exploratory Data Analysis in Python* (2nd Edition).
4· **S. C. Gupta** (2018). *Fundamentals of Statistics*. Himalaya Publishing House.

Course Outcomes:
By the end of the course, students will be able to:
1. **Understand fundamental statistical concepts** such as types of data, scales of measurement, and methods of data collection.

2. **Organize, summarize, and present data** using appropriate graphical and numerical techniques, including measures of central tendency and dispersion.

3. **Apply basic probability theory and common probability distributions** (e.g., binomial, normal) to analyze and model uncertainty in data.

4. **Perform basic inferential statistical procedures**, including estimation, hypothesis testing, and interpretation of p-values and confidence intervals.

5. **Use statistical software or tools** (e.g., Python, Excel, or R) to perform descriptive and inferential analysis on real-world data sets.