

**North Lakhimpur College (Autonomous)****Department Of Mathematics**B.A./B.Sc. Mathematics **Elective(Pass)** Course

## Course Structure

<b>Semester</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Credit</b>
I	ET-5-MTH-101	Classical Algebra , Trigonometry , Vector Calculus	5
II	ET-5-MTH-201	Matrices, Ordinary Differential Equations , Numerical Analysis	5
III	ET-5-MTH-301	Co-ordinate Geometry, Real Analysis	5
IV	ET-3-MTH-401	Linear Programming	3
	EP-2-MTH-402	Computer Laboratory	2
V (For Non- Core)	ET-3-MTH-501	Complex Analysis	3
	ET-4-MTH-502	Mechanics	4
VI (For Non- Core)	ET-3-MTH-601	Statistics	3
	ET-2-MTH-602	Abstract and Boolean Algebra	4
<b>Total Credit =20 (For Major/Core Students)</b> <b>=34 (For Non Major/Core Students)</b>			

**SEMESTER-I**

**Mathematics Elective (General)**

**Title: Classical Algebra, Trigonometry, Vector Calculus**

**Code (Paper): ET-5-MTH-101**

**Credit: 5**

**Total Marks: 100**

**Lecture Hours: 80**

**L-4, T-1,P-0 Credit: 5**

**Objective:** To introduce basic ideas of algebraic and analytic structures. Students can have a deeper insight of Trigonometry. Students will have an orientation towards the vectorial notations of multivariable calculi.

**(A) Classical Algebra**

**Lecture Hours: 40**

**Unit I:** Real sequences: Definition, bounds of a sequence, convergence of sequences and related theorems , limit of a sequence, Bolzano Weierstrass theorem, Definitions of limit inferior and superior with simple examples, Convergent sequences and statements of related theorems , non convergent sequences, Cauchy's General Principle of convergence and Cauchy sequence, monotonic sequences( **Lecture Hours: 13**)

**Unit II:** Infinite Series and its convergence: Introduction, Necessary condition for convergence, Cauchy's general principle of convergence for series, Statements of preliminary theorems, positive series and its necessary condition of convergence, Geometric series , Comparison series ,Statements of comparison test (first and second types), Cauchy's Root Test ,D'Alembert's Ratio Test, , and Raabe's Test, Leibnitz's Test for convergence of an alternating Series. (**Lecture Hours: 15**)

**Unit III:** Theory of Polynomial equations: Definitions. Division algorithm, Remainder theorem, factor theorem and theorems on Existence of real roots (statements only) with examples, Descartes' rule of sign., Fundamental Theorem of Algebra, Existence of complex roots, Relation between roots and coefficients and related problems, Transformation of equation, Cardon's method of solution of cubic equation. (**Lecture Hours: 12**)

**(B) Trigonometry:**

**Lecture Hours: 24**

**Unit I:** De Moivre's theorem and important deductions from De Moivre's theorem (**Lecture Hours: 9**)

**Unit II:** Trigonometrical and exponential functions of complex arguments. (**Lecture Hours: 5**)

**Unit III :** Gregory's series and evaluation of  $\pi$  .(**Lecture Hours: 5**)

**Unit IV:** Summation of trigonometric series and hyperbolic functions. (**Lecture Hours: 5**)

**(C) Vector Calculus**

**Lecture Hours: 16**

**Unit – I:** Ordinary derivatives of vectors, Space curves, Continuity and differentiability, Differentiation formulae, Partial derivatives of vectors and related problems, Vector differential operator del, Gradient, Directional derivative, Divergence and Curl, Laplacian operator , Vector identities and related problems. (**Lecture Hours: 16**)

**Text Books :**

- [1] Mathematical Analysis; S. C. Malik and S. Arora, New age International (P) Ltd. New Delhi.
- [2] Higher Algebra; B. Das & S.R. Maity, Ashoke Prakashan, Calcutta.
- [3] Higher Trigonometry; B.C. Das, B.N. Mukherjee, U.N. Dhur and Sons, Calcutta.
- [4] Introduction to Real Analysis; Robert G Bartle, Donald R Sherbert; Wiley John and sons
- [5] A text book of vector calculus; Shanti Narayan, J. N. Kapur, S. Chand and company, N. Delhi.

**Reference Books :**

- 1. A Text Book of Higher Algebra; M.Ray, H. S. Sarma, S. Chand and Company, New Delhi.
- 2. Theory and Problems of Vector Analysis, Murray R. Spiegel, Schaum's outline series, Mc Graw Hill Book Company.
- 3. Higher Algebra, Hall and Knight, Arihant Publication

**SEMESTER-II****Mathematics Elective (General)****Title: Matrices, Ordinary Differential Equations, Numerical Analysis**

Lecture Hours:80

L-4,T-1,P-0 Credit:5

**Objective:** To enable students to use matrix methods for solving linear equations. They will learn the basics of differential equations and also about the numerical methods of solving various types of equations.

**A. Matrices**

**Lecture Hours: 20**

**Unit I:** Rank of a matrix, Elementary operations on a matrix, Determination of rank by reduction into echelon form & normal form, elementary matrices. **(Lecture Hours: 8)**

**Unit II:** Solution of homogeneous & non homogeneous linear equations, Characteristic polynomial, characteristic equation, Eigen values and Eigen vectors, Cayley-Hamilton theorem. **(Lecture Hours: 12)**

**B. Ordinary Differential equations:**

**Lecture Hours: 32**

**Unit I:** Exact differential equations of first order, Equations of first order higher degree, Clairaut's form, wronskian, its properties and application. **(Lecture Hours: 12)**

**Unit II:** Linear differential equation of higher order with constant coefficients, linear homogeneous equations. **(Lecture Hours: 8)**

**Unit III:** Linear equation of second order with variable coefficients: Removal of first order derivative, Change of independent variables, Method of variation of parameters. **(Lecture Hours: 12)**

**C. Numerical Analysis:**

**Lecture Hours: 28**

**Unit I:** Solution of algebraic and transcendental equation: Bisection method, Regula Falsi Method, Iteration method, Newton-Raphson method and its geometrical interpretation. Solution of system of equations: Gauss elimination method, Gauss Seidal Method, Gauss Jordan method. **(Lecture Hours: 13)**

**Unit II:** Diagonal and horizontal difference tables, finite difference operators, Newton's forward, backward and general interpolation formulae, Lagrange's interpolation formula, Quadrature: Trapezoidal rule, Simpson's quadrature (1/3 and 3/8 rule). **(Lecture Hours: 15)**

**Text Books :**

[1] A Text Book of Matrices; Shanti Narayan and P.K.Mittal, S. Chand and Company Ltd.

[2] Advanced Differential Equation; M D Raisinghania, S Chand Company.

[3] Numerical Analysis; Jain, Iyenger, Jain; New Age Publication

**Reference Books :**

1. Differential Equations; S. L. Ross, John Wiley and sons, India ,2004.
2. Numerical Analysis; G. Shanker Rao, New Age International Publisher..
3. Introductory Method of Numerical Analysis; S.S. Sastry, Prentice Hall of India Pvt. Ltd.
4. Numerical Mathematical Analysis; J B Scarborough, Oxford & IBH Publication
5. Numerical Methods, P. Kandasamy, S. Chand and Company

**SEMESTER-III**  
**Mathematics Elective (General)**  
**Title: Co-ordinate Geometry, Real Analysis**  
**Code (Paper): ET-5-MTH-301**  
**Credit: 5**  
**Total Marks: 100**

**Lecture Hours:80**

**L-4,T-1,P-0 Credit:5**

**Objective:** To enable students to have a deeper understanding of Co-ordinate geometry and a broader insight towards the analytical aspects of Mathematics.

**(A) Co-ordinate Geometry Lecture Hours: 40**

**(a) 2 - Dimension Lecture Hours: 24**

**Unit I:** Transformation of coordinates: Translation of axes, Rotation of axes, Invariants, Removal of  $xy$ -term. (**Lecture Hours: 7**)

**Unit II:** Pair of straight lines: Pair of straight lines through origin, Angle and Bisectors of the angle between the lines given by homogenous equation of 2nd degree, Condition for the general equation of second degree to represent a pair of straight lines, Pair of intersecting straight lines, Pair of parallel straight lines. (**Lecture Hours: 9**)

**Unit III:** General Equation of second degree: Equation to the conic sections, Centre of a conic, Reduction to central and non central conic, Tangent to the conic and condition of tangency, Chord of contact, Pole and Polar, conjugate diameter, (**Lecture Hours: 8**)

**(b) 3- Dimension Lecture Hours: 16**

**Unit I:** Sphere, Section of a sphere by plane, Intersection of two spheres, Tangent line and tangent plane. (**Lecture Hours: 9**)

**Unit II:** Cone, Right circular cone, Tangent planes, Cylinder, Right circular cylinder. (**Lecture Hours: 9**)

**(B) Real Analysis Lecture Hours: 40**

**Unit I:** Successive differentiation, Leibnitz's theorem, indeterminate forms, Sub tangent, sub normal, curvature and radius of curvature. (**Lecture Hours: 10**)

**Unit II:** Function of one variable: Functions continuous on closed intervals, Differentiability, Darboux's theorem(statement only), Rolle's theorem, Lagrange mean value theorem, Cauchy's mean value theorem, Taylor's theorem, Taylor's series, Maclaurin's series. (**Lecture Hours: 16**)

**Unit III:** Partial Derivatives, Euler's theorem on homogeneous function. (**Lecture Hours: 7**)

**Unit IV:** Reduction formula of the integrands  $\sin^n x$ ,  $\cos^n x$ ,  $\tan^n x$ , and  $\sin^n x \cos^m x$ , Rectification of plane curves. (**Lecture Hours: 7**)

**Text Books :**

- [1] Analytical Geometry of two dimensions; P K Jain & K. Ahmed, Wiley Eastern Ltd.
- [2] Analytical Geometry of three dimensions; P K Jain & K. Ahmed, Wiley Eastern Ltd.
- [3] Differential Calculus; B C Das and B N Mukherjee , U.N. Dhar and Sons, Calcutta
- [4] Integral Calculus; B. C. Das and B. N. Mukherjee. ,U.N. Dhar and Sons, Calcutta
- [5] Mathematical Analysis; S.C. Malik, S. Arora, New Age International, New Delhi

**Reference Books :**

- 1. Analytical Geometry and Vector Analysis; B. Das, Orient Book Company, Calcutta.
- 2. Analytical Geometry of two and three dimensions; R.M. Khan, New Central Book Agency, Calcutta
- 3. Integral Calculus, Ghosh and Maity; Central Book Publisher

# B.A./B.Sc. 4<sup>th</sup> Semester Mathematics Elective(Pass) Course Syllabus

Course Code: ET-3-MTH-401  
**Course Title: Linear Programming**  
**Total Marks : 60**

**Lecture Hours: 48**

**L-3,T-0,P-0 Credit:3**

**Objective :** The students will be able to formulate and solve various practical models using Linear Programming techniques.

**Linear Programming (LP)**

**Lecture Hours: 48**

**Unit I:** LP Model formulation & Graphical Method: Introduction, General structure and assumption of LP model, Mathematical formulation of a linear programming problem, Example of LP model Formulation, Feasible solution, basic solution, graphical method for the solution of a linear programming problem, convex set. **(Lecture Hours: 12)**

**Unit II:** Theory of simplex algorithm and simplex method: Standard form of an LP Problem, Simplex Algorithm, Solutions of unique optimal solution, alternative optimal solution, unbounded solution, artificial variable technique (Charnes' M-technique, two phase method), Degeneracy. **(Lecture Hours: 16)**

**Unit III:** Duality Theory: Concept of duality, Types of primal dual problem, Standard form, Rules for constructing the dual from primal, Simple and mixed type problems, Theorem on duality, Fundamental duality theorem (Statement only). **(Lecture Hours: 8)**

**Unit IV:** Transportation Problem: Definition, Transportation Table, Loops in transportation tables and their properties, Determination of an initial basic feasible solution by North West corner method, Matrix minima or least cost method and Vogel approximation method, unbalanced transportation problem, optimization by Modi method. **(Lecture Hours: 12)**

## **Text Books :**

- [1] Operation Research – Theory and Application; J.K.Sharma, McMillan India Ltd. New Delhi.
- [2] Linear Programming and Game Theory; Dipak Chatterjee, Prentice Hall of India (P) Ltd

## **Reference Books :**

1. Linear programming and Theory of Game ; P. M. Karak, New Central Book Agency(P) Ltd
2. Linear Programming; G. Hadley, Narosa Publishing House.



**Course Code: EP-2-MTH-402**  
**Course Title: Computer Laboratory**  
**Total Marks : 40**

**Lecture Hours: 48**

**L-0,T-0,P-2 Credit:2**

**Computer Laboratory (Practical)**

**Lecture Hours: 32**

**Matlab / Mathematica:** Evaluation of arithmetic expression, exponential and logarithms, trigonometric functions, computation of complex numbers, Plotting of curves (Algebraic function, trigonometric function, and exponential function), Operations in matrices, Plotting of three 3D curves and shapes, Solution of algebraic equation, simultaneous linear equations .Evaluation of integral, Solution of differential equations.

**Text Books :**

- [1] Getting Started with MatLab; A quick Introduction for Scientists and Engineers; Rudra Pratap; Oxford University Press
- [2] Mathematica, Schuam Series

**Referecne Books:**

- 1. A Handbook on Mathematica Programming; B.C. Chetia,Dutta Publication
- 2. Elementary Matlab, P. D. Goswami, Kaustubh Prakashan

# B.A./B.Sc. 5<sup>th</sup> Semester Mathematics Elective(Pass) Course Syllabus

Course Code: ET-3-MTH-501  
Course Title: Complex Analysis

Lecture Hours: 48

L-3,T-0,P-0 Credit:3

**Objective:** Students will also learn about the analytical aspects of complex numbers.

Complex Analysis

Lecture Hours: 48

**Unit I:** Analytic Function: Limit, Continuity and differentiability, Analytic functions, Cauchy-Riemann equations. Necessary and sufficient condition for a function to be analytic, polar form of C.R. equation, Harmonic functions, Construction of analytic function. **(Lecture Hours: 12)**

**Unit II:** Complex Integrals : Definite integral, Jordan arc, contour, line integrals, Cauchy's theorem, simply and multiply connected domains, Cauchy's integral formula, Derivatives of analytic function, Morera's theorem, Liouville's theorem. **(Lecture Hours: 15)**

**Unit III:** Power series: Taylor's series, Laurent's series and their related problems. **(Lecture Hours: 8)**

**Unit IV:** Poles & Residues: Definition and statement of the related theorems of isolated singularity, removable singularity and poles, calculation of residues, Cauchy's residue theorem, Contour Integration (Integration round the unit circle, Integration of the type  $\int_{-\infty}^{\infty} f(x)dx$  where no poles on the real axis) **(Lecture Hours: 13 )**

## **Text Books :**

- [1] Complex Variable and Application; R.V. Churchill and Brown, McGraw Hill book Company
- [2] Complex Variables; Murray R. Spiegel: McGraw Hill.

## **Reference Books :**

- 1. Foundation of Complex Analysis; S Ponnusamy, Narosa Pub House
- 2. Function of one Complex Variable, J B Conway, Narosa Pub House

Course Code: ET-4-MTH-502  
Course Title: Mechanics

Lecture Hours: 64

L-4,T-0,P-0 Credit:4

**Objective:** Students will have deeper knowledge of Mechanics and the corresponding problem solving techniques.

A. Mechanics

Lecture Hours: 64

(a) Statics

**Unit I:** Reduction of a system of forces on a rigid body, Change of base point, Conditions of equilibrium, Poinsot's central axis, wrench, pitch, screw, Invariants, Equations of central axis. **(Lecture Hours: 13)**

**Unit I:** Virtual work, Common centenary, Stability of equilibrium. **(Lecture Hours: 15)**

**(b) Dynamics**

**Unit I:** Motion in a straight line and plane, Radial and transverse velocities and acceleration, angular velocity and angular acceleration, tangential and normal acceleration, Simple Harmonic Motion. **(Lecture Hours:12)**

**Unit II:** Central forces, Motion under resistance. **(Lecture Hours: 8)**

**Unit III:** Dynamics of Rigid Body: Moments of inertia, Theorems of parallel and perpendicular axes, Moment of inertia about a line, Moment and product of inertia of a plane lamina, Momental ellipsoid and momental ellipse. D'Alembert's principle and general equations of motion, Motion of the centre of inertia and relative to the centre of inertia. **(Lecture Hours: 16)**

**Text Books :**

[1] Statics ; Dr Md Motiur Rahman, New Central Book Agency (P) Ltd

[2] A Text Book on Dynamics; M. Ray & G.C. Sharma, S. Chand and Company Ltd.

[3] Rigid Dynamics; Dr Md Motiur Rahman, New Central Book Agency (P) Ltd

**Reference Books :**

1. Dynamic of a Particle and of Rigid Bodies; S.L. Loney, Cambridge University Press

2. An Elementary Treatise on Statics; S.L. Loney, Cambridge University Press.

3. A Text Book on Statics; M. Ray. R.D. Manglik, G.C. Sharma. S. Chand and Company Ltd.

4. Mathematical Physics; Rajput

**B.A./B.Sc. 6<sup>th</sup> Semester Mathematics Elective(Pass) Course Syllabus**

**Course Code: ET-3-MTH-601**

**Course Title: Statistics**

**Objective:** Students will be able to identify the relations between statistics and mathematics.

**A. Statistics Lecture Hours: 48**

**Unit I:** Probability: Basic terminology, Mathematical probability, Statistical probability, Axiomatic approach to probability. Conditional probability, Multiplication theorem of probability, Independent events, Multiplication theorem of probability for independent events, Extension of multiplication theorem of probability, Baye's theorem. **(Lecture Hours: 15)**

**Unit II:** Measures of Dispersion: Standard deviation, Quartile deviation, co-efficient of variation. **(Lecture Hours: 10)**

**Unit IV:** Correlation and regression: Karl Pearson's co-efficient of correlation, Spearman Rank correlation co-efficient, regression lines and equation. **(Lecture Hours: 10)**

**Unit V:** Theoretical Probability Distribution: Binomial, Poisson and Normal Distribution and their applications to simple problems. **(Lecture Hours: 13)**

**Text Books :**

[1] Fundamentals of Mathematical Statistics; V.K. Kapoor, S.C.Gupta, Sultan Chand & Sons.

**Reference Books :**

**1. Probability and statistics for scientists and engineers; S Ross**

**Course Code: ET-4-MTH-602**

**Course Title: Abstract and Boolean Algebra**

**Lecture Hours: 64**

**L-4,T-0,P-0 Credit:4**

**Objective:** The students will have knowledge about basic concepts of abstract algebra and Boolean algebra used in theoretical computer science.

**A. Abstract Algebra Lecture Hours: 32**

**Unit I:** Binary Composition, Definition and Examples of Group, Elementary properties and theorem of Group, Subgroups, Lagrange's theorem, cyclic groups. **(Lecture Hours: 20)**

**Unit II:** Normal subgroups, Quotient groups, Homomorphisms – Isomorphisms **(Lecture Hours: 12)**

**B. Boolean Algebra Lecture Hours: 32**

**Unit III:** Boolean Algebra: Boolean algebra as lattice and an algebraic system, Properties of Boolean algebra, Sub-algebra and homomorphism of Boolean algebra, Boolean expressions, sum-of-products canonical form, values of Boolean expression & Boolean functions, **(Lecture Hours: 17)**

**Unit IV:** Logic Gates, Switching circuits & Logic circuits: Introduction, Gates and Boolean algebra, Applications, Special Sequences, Switching circuits, simplification of circuits, bridge circuits, logic circuits, multiple output logic circuit. **(Lecture Hours: 15)**

**Text Books :**

[1] A course in Abstract algebra; V.K.Khanna & S.K.Bhambri, Vikas Publishing House Pvt. Ltd.

[2] Boolean Algebra and switching circuits; Schaum outline Series, Tata McGraw Hill Publication

**Reference Books :**

1. Abstract Algebra; Surjit Singh and Quazi Zamiruddin, Vikas Publishing House Pvt. Ltd.

2. Discrete Mathematics; Schaum outline Series, Tata Mc graw Hill Publication

3. Discrete Mathematics; Swapan Kumar Sarkar, S. Chand & company