

NORTH LAKHIMPUR COLLEGE, ASSAM (AUTONOMOUS)

Estd. 1952



COLLEGE WITH POTENTIAL FOR EXCELLENCE

[Re-Accredited 'A' Grade by NAAC with 3.08 CGPA]

SYLLABI

FOR THREE YEAR DEGREE COURSE

IN

MATHEMATICS

UNDER SEMESTER SYSTEM

B.A/B.Sc Elective(Pass) and Core (Major) Course Programme

North Lakhimpur College (Autonomous)
Department Of Mathematics
B.A./B.Sc. Mathematics Core (Major) Course
Course Structure

Semester	Course Code	Course Title	Credit
I	CT-5-MTH-101	Classical Algebra , Trigonometry , Vector Calculus	5
II	CT-5-MTH-201	Matrices, Ordinary Differential Equations and Numerical Analysis	5
III	CT-4-MTH-301	Analysis I : Real Analysis	4
	CT-4-MTH-302	Co-Ordinate Geometry, Algebra-I	4
IV	CT-3-MTH-401	Computer Programming(C- Programming)	3
	CP-2-MTH-402	Computer Laboratory	2
	CT-5-MTH-403	Linear Programming , Analysis-II (Multiple Integral)	5
V	CT-5-MTH-501	Logic and Combinatorics , Complex Analysis	5
	CT-5-MTH-502	Algebra- II , Number Theory	5
	CT-5-MTH-503	Fluid Mechanics	5
	CT-5-MTH-504	Mechanics , Integral Transformation	5
	PR-1-MTH-505	Project -I	1
VI	CT-5-MTH-601	Statistics, Graph Theory, Fuzzy Set Theory	5
	CT-5-MTH-602	Discrete Mathematics, Metric Spaces	5
	CT-5-MTH-603	Linear Algebra, Partial Differential Equation	5
	CT-5-MTH-604	Group (A): Topological Spaces, Functional Analysis Group (B): Space Dynamics, Relativity	5
	PR-1-MTH-605	Project-2	1
Total Credit			70

Note:

- B. Sc.** students taking Mathematics major will have to take **two** elective subjects. Moreover they will have to take **one** compulsory subject (English) and **one** skill based subject.
- B. A.** students taking Mathematics major will have to take **one** elective subject. Moreover they will have to take **two** compulsory subjects (English and MIL) and **one** skill based subject.

Semester wise credit distribution for B.A. and B. Sc. Major in Mathematics is as follows:

Programme: B. Sc. (Mathematics major)

Semester	Core (Major)	Elective	Compulsory	Skill based	Total Credit
I	5	5X2=10	4		19
II	5	5X2=10		4	19
III	8	5X2=10		2	20
IV	10	5X2=10	0(EVS)		20
V	21				21
VI	21				21
Total Credit	70	40	4	6	120

Programme: B. A. (Mathematics major)

Semester	Core (Major)	Elective	Compulsory	Skill based	Total Credit
I	5	5	4X2=8		18
II	5	5	4X2=8		18
III	8	5		4X2=8	21
IV	10	5	3X2=6		21
V	21		0(EVS)		21
VI	21				21
Total Credit	70	20	22	8	120

**B.A./B.Sc. Mathematics Elective(Pass)
Course Syllabus**

**B.A./B.Sc. Mathematics Core(Major)
Course Syllabus**

SEMESTER – I
Mathematics Core (Major)
Title: Classical Algebra, Trigonometry, Vector Calculus
Code (Paper): CT-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 π .(**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 Core (Major)****Title: Matrices, Ordinary Differential Equations and Numerical Analysis****Code (Paper): CT-5-MTH-201****Credit: 5****Total Marks: 100**

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:
14

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: 6**)

Unit II: Solution of homogeneous & non homogeneous linear equations, Characteristic polynomial, characteristic equation, Eigen values and Eigen vectors, Cayley-Hamilton theorem. (**Lecture Hours: 8**)

B. Ordinary Differential equations: Lecture Hours:
28

Unit I: Exact differential equations of first order, Equations of first order higher degree, Clairaut's form, wronskian, its properties and application. (**Lecture Hours: 10**)

Unit II: Linear differential equation of higher order with constant coefficients, linear homogeneous equations. (**Lecture Hours: 9**)

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: 9**)

C. Numerical Analysis: Lecture Hours:
38

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), Weddle's rule (**Lecture Hours: 15**)

Unit III: Numerical solution of ODE, Picard's and Euler's Method (**Lecture Hours: 10**)

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. Introduction to Differential Equations, E A Condington
5. Numerical Methods, P. Kandasamy, S. Chand and Company

SEMESTER – III
Mathematics Core (Major)
Title: Analysis-I: Real Analysis
Code (Paper): CT-4-MTH-301
Credit: 4
Total Marks: 80

Objective : To enable students to identify the analytical aspects of Mathematical concepts.

A. Differential Calculus Lecture Hours: 30

Unit I: Successive differentiation, Leibnitz's theorem, Indeterminate forms, Sub tangent, sub normal, derivative of arc length (Cartesian and polar forms), values of θ , angle between radius vector and tangent, polar sub tangent and polar subnormal, curvature and radius of curvature. **(Lecture Hours: 8)**

Unit II: Function of one variable: Functions continuous on closed intervals, Differentiability, Darboux's theorem, Rolle's theorem, Lagrange mean value theorem, Cauchy's mean value theorem, Taylor's theorem, Taylor's series, Maclaurin's series. **(Lecture Hours: 8)**

Unit III: Partial derivatives, Euler's theorem on homogeneous function. **(Lecture Hours: 4)**

Unit IV: Function of several variable : Explicit and implicit functions, continuity, partial derivatives, definition of Jacobian, partial derivatives of higher order, Young's and Schwarz's theorems(without proof), change of variables, Taylor's theorem, extreme values. **(Lecture Hours: 10)**

B. Integral Calculus Lecture Hours: 10

Unit I: Reduction formula of the integrands $\sin^n x$, $\cos^n x$, $\tan^n x$, and $\sin^n x \cos^m x$ **(Lecture Hours: 6)**

Unit II: Rectification of plane curves, surface and volume of solids of revolution. **(Lecture Hours: 4)**

C. Riemann integral Lecture Hours: 24

Unit I: Definitions and existence of R-integrals, inequalities of R-integrals, refinement and related theorems, Darboux's theorem, conditions of integrability (both the forms). Integral as a limit of sum (Riemann sums) and its relationship with Darboux's condition of integrability, some applications, integrability of continuous and monotonic functions, functions with finite and infinite number of discontinuities, related examples. **(Lecture Hours: 10)**

Unit II: Primitive, fundamental theorem (1st & 2nd) of integral calculus, first mean value theorem and generalized first mean value theorem, related examples, Integration by parts & change of variable on an integral, second mean value theorem (statement only), particular case of second Mean Value theorem. **(Lecture Hours: 5)**

Unit III: Improper integrals: Introduction and their convergence, Statements of Comparison test, Cauchy's test, Abel's test, Dirichlet's test and their applications. **(Lecture Hours: 5)**

Unit IV: Beta and Gamma functions and their relationship. **(Lecture Hours: 4)**

Text Books :

[1] Differential Calculus; B C Das and B N Mukherjee , U N Dhur & Sons , Private Ltd, Calcutta.

[2] Mathematical Analysis; S C Malik & Savita Arora, New Age International (P) Ltd, New Delhi.

[3] Integral Calculus including Differential equations ; B C Das & B N Mukherjee, U N Dhur &

Sons Pvt. Ltd, Calcutta.

Reference Books :

1. Introduction to Real Analysis; R G Bartle and D R Sherbert, John Wiley and Sons (Asia) Pvt.
2. Principals of Mathematical Analysis; Walter Rudin; Mc Graw Hill International.
3. Mathematical Analysis; Tom M Apostol, Narosa Publishing House.
4. Advanced Calculus, Schuam Series

SEMESTER – III

Mathematics Core (Major)

Title: Co-Ordinate Geometry, Algebra-I

Code (Paper): CT-4-MTH-302

Credit: 4

Total Marks: 80

Lecture Hours: 64

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

A. Co-ordinate Geometry

Lecture Hours:

34

(a) 2 - Dimension Lecture Hours: 20

Unit I: Introduction to C-Programming: Basic programming concept, programming approach to solving problem, flowcharts, algorithm, character set, C tokens, keywords and identifiers, constants, variables, data types, declarations of variables, declaration of storage class, assigning values to variables. **(Lecture Hours: 9)**

Unit II: Operators and expressions: Arithmetic operators, relational operators, logical operators, assignment operators, increment and decrement operators, conditional operators, bitwise operators, arithmetic expressions, precedence of arithmetic operators, type conversions in expressions operator precedence and associativity, mathematical functions. **(Lecture Hours: 9)**

Unit III: Input output operations: Reading and writing a character, formatted input and formatted output. **(Lecture Hours: 5)**

Unit IV: Decision Making and Branching, IF statement, IF ... ELSE statement, nested IF, ELSE IF Ladder, WHILE statement, DO statement, FOR statement, Jumps in Loops. **(Lecture Hours: 9)**

Unit V: Arrays: One dimensional arrays, declaration of one dimensional arrays, initialization of one dimensional arrays, two dimensional arrays, initializing two dimensional arrays, multi-dimensional arrays. **(Lecture Hours: 7)**

Unit VI: User defined functions: Elements of user defined functions, Definition of functions, return values and their types, function calls, function declaration, category of functions, no arguments and no return values, arguments with return values, no arguments but returns a value, functions that return multiple values. **(Lecture Hours: 6)**

Unit VII: Concept of C++, Transformation from C to C++. **(Lecture Hours: 3)**

Text Books :

[1] Programming in ANSI C; E Balagurusamy, Tata McGraw-Hill Publishing Company Ltd, New Delhi.

[2] C Programming; Jayapawan

[3] Programming in C; V. Rajaraman, Prentice Hall of India

Reference Books :

1. C- Programming; B.S. Gottfried, Tata McGraw Hill.

2. How to solve it; R.G.Dromey, Prentice Hall of India.

B.A./B.Sc. 4th Semester Mathematics Core (Major) Syllabus

Course Code: CP-2-MTH-402

Course Title: Computer Laboratory

Total Marks : 40

Lecture Hours: 32

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

Computer Laboratory (Practical)

Lecture Hours:

32

(a) C- Programming Lecture Hours: 24

1. Temperature conversion
2. Area of triangle
3. Solution of linear equations
4. Simple and compound interest
5. Sum of series
6. Solution of quadratic equation
7. Checking of Prime numbers
8. Sum of sine, cosine and Fibonacci series,
9. Mean and standard deviation
10. Printing of a matrix
11. Matrix addition, subtraction, multiplication, transpose
12. Solution of equation by Newton – Raphson method, Bisection method.
13. Simpson's 1/3 rule
14. Sorting of numbers (ascending and descending)
15. Computation of salary
16. Find the largest number among n numbers
17. Finding the factorial of a number
18. Finding factors of an integer.
19. Sum of digits of a number
20. Printing of numbers and characters in various forms, number tables.

(b) Matlab/Mathematica Lecture Hours: 8

Evaluation of arithmetic expression, exponential, logarithmic and trigonometric functions, computation of complex numbers, Plotting of curves (Algebraic function, trigonometric function and exponential function), Operations in matrices, Plotting of 3D curves and shapes, Solution of algebraic equation, simultaneous linear equations, Numerical solution of differential equation.

Text Books :

[1] Programming in ANSI C; E Balagurusamy, Tata McGraw-Hill Publishing Company Ltd, New Delhi.

[2] Getting started with Mat lab, A quick introduction for scientist and Engineers; Rudrapratap, Oxford university Press.

[3] Getting Started with MatLab; A quick Introduction for Scientists and Engineers; Rudra Pratap; Oxford University Press

[4] Methematica, 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. 4th Semester Mathematics Core (Major) Syllabus

Course Code: CT-5-MTH-403

Course Title: Linear Programming , Analysis-II (Multiple Integral)

Total Marks : 100

Lecture Hours: 80

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

Objective: Students will be able to determine the Mathematical know-how of linear programming problems of Operations Research and also to solve those using LPP techniques. Students will also learn about multiple integral and their applications.

A. Linear Programming (LP) Lecture Hours: 45

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: 8**)

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: 14**)

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: 15**)

B. Analysis-II (Multiple Integral) Lecture Hours: 35

Unit I: Fourier series: Preliminary & other theorems, main theorem, series for even function, odd functions, half range series, Interval other than $[-\pi, \pi]$ (**Lecture Hours: 10**)

Unit II: Integration over R^2 : Line integrals , double integrals, double integrals over a region double integrals over a closed domain, Green's theorem. (**Lecture Hours: 12**)

Unit III: Integration over R^3 : Surface and surface integral, Stoke's and Gauss's theorems and their applications. (**Lecture Hours: 13**)

Text Books :

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

[3] Mathematical Analysis; S C Malik & Savita Arora, New Age International (P)Ltd, Publishers, New Delhi.

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.
3. Advanced Calculus; Schuam Series

B.A./B.Sc. 5th Semester Mathematics Core (Major) Syllabus

Course Code: CT-5-MTH-501

Course Title: Logic and Combinatorics , Complex Analysis

Lecture Hours: 80

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

Objective: Students will be exposed to the basics of Mathematical Logic and that of the counting principles. Students will also learn about the analytical aspects of complex numbers.

A . Logic and Combinatorics Lecture Hours: 40

Unit I: The Statement Calculus: Introduction, Sentential Connectives ,Truth tables, Truth value, Validity, truth function, tautology and related theorems, arithmetic representation of sentential connectives. **(Lecture Hours: 10)**

Unit II: Theory of Inference: Consequence, rule of inference and applications. Predicate calculus: symbolizing language. **(Lecture Hours: 10)**

Unit III: Fundamental Principles of Counting: Binomial Theorem, Pascal and Vander Monde's identity, Multinomial theorem, Ramsey number, Catalan numbers, Stirling and Bell number. **(Lecture Hours: 10)**

Unit IV: The principles of Inclusion-Exclusion: The principles of Inclusion-Exclusion, Generalization of the principles of Inclusion-Exclusion, Pigeon Hole Principle, Derangement, Generating function and introductory examples, **(Lecture Hours: 10)**

B. Complex Analysis Lecture Hours: 40

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: 8)**

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: 13)**

Unit III: Power series: Taylors's series, Laurent's series and their related problems. **(Lecture Hours: 7)**

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: 12)**

Text Books :

[1] Set Theory and Logic; Robert R. Stoll, Eurasia Publishing House (P) Ltd.

[2] Complex Variable and Application; R.V. Churchill and Brown, McGraw Hill book Company

[3] Theory and problems of Combinatorics; C. Vasudev, New Age International Publishers

[4] Combinatorics; V.K. Balakrishnan, Schaum's Outlines Series

Reference Books :

1. Discrete Mathematical Structures; G. Shanker Rao, New International Publishers.

2. Introduction to Logic; Patrick Suppes. East West Pvt Ltd. New Delhi.

3. Ian Anderson, A First Course in Combinatorial Mathematics, Springer.

4. Complex Variables; Murray R. Spiegel: McGraw Hill.

5. Foundation of Complex Analysis; S Ponnusamy, Narosa Pub House

6. Function of one Complex Variable, J B Conway, Narosa Pub House

B.A./B.Sc. 5th Semester
Mathematics Core (Major) Syllabus
Course Code: CT-5-MTH-502

Course Title: Algebra- II , Number Theory

Lecture Hours: 80

L-4,T-1,P-0

Credit:5

Objective: Students will be able to learn the characteristics of abstract algebraic structures. Students will be exposed to the fundamentals of Numbers and their properties.

**A. Algebra-II Lecture Hours:
40**

Unit I: Automorphism of groups, Inner automorphism, Sylow p-subgroups, Sylow's theorems, external and internal direct products. **(Lecture Hours: 15)**

Unit II: Definition and examples of Ring, Special kinds of rings, integral domain, field, sub rings and ideals, sum and product of ideals. **(Lecture Hours: 15)**

Unit III: Quotient Ring, Homomorphism of ring, Imbedding of rings, Maximal and Prime ideal. **(Lecture Hours: 10)**

**B. Number Theory Lecture Hours:
40**

Unit I: Divisibility theory: The division algorithm, GCD, The Euclidean algorithm, The Diophantine equation $ax + by = c$, Primes and the fundamental theorem of arithmetic. **(Lecture Hours: 15)**

Unit II: Theory of congruences: Basic properties of congruence, Binary and decimal representation of integers, Linear congruences and Chinese remainder theorem, Fermat's little theorem, Wilson's theorem. **(Lecture Hours: 15)**

Unit III: Number theoretic functions: The sum and number of divisors, The Mobius inversion formula, The greatest integer function, Euler's phi-function, Euler's theorem. **(Lecture Hours: 10)**

Text Books :

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

[2] Elementary Number theory; David M. Burton, Tata McGraw Hill.

[3] Contemporary Abstract Algebra, Joseph A. Gallian, Narosa Publishing House.

Reference Books :

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

2. Topics in Algebra; I N Herstein, Wiley Eastern Ltd

3. Algebra, Michael Artin, Prentice- Hall of India.

4. Number Theory, Niven and Zuckerman,

B.A./B.Sc. 5th Semester
Mathematics Core (Major) Syllabus

Course Code: CT-5-MTH-503

Course Title: Fluid Mechanics

Lecture Hours: 80

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

Objective: Students will be introduced to the fundamental concepts of Fluid Mechanics and its various applications in Physical Sciences.

(a) Hydro Dynamics Lecture Hours:
32

Unit I: Kinematics: Real and ideal fluid, velocity of a fluid at a point, Eulerian and Lagrangian method, stream lines and path lines, steady and unsteady flows, velocity potential, rotational and irrotational motions, local and particle rate of change, equation of continuity, examples, acceleration of a fluid at a point, General analysis of fluid motion. **(Lecture Hours: 12)**

Unit II: Equation of Motion: Euler's equation of motion, Bernoulli's equation, steady motion under conservative forces, impulsive motion, circulation, Kelvin's circulation theorem. **(Lecture Hours: 13)**

Unit III: General theory of irrotational motion : Potential flow, deductions from Green's theorem, kinetic energy of a liquid, uniqueness theorems, Kelvin's minimum energy theorem, Mean value of velocity potential. **(Lecture Hours: 7)**

(b) Hydro Statics Lecture
Hours: 48

Unit I: Fluid Pressure: Introduction, Fluid Pressure and related theorems, Density and specific gravity, Theorems on fluid pressure under gravity, Rate of variation of pressure, Differential equation of pressure, Condition of equilibrium, Equi-pressure surfaces and lines of force, Curves of equi-pressure and equi-density, Examples. **(Lecture Hours: 15)**

Unit II: Resultant Pressure and Centre of Pressure: Resultant fluid pressure and related theorems, Centre of pressure, Determination of centre of pressure of parallelogram, triangle, circle under different conditions, Examples, Thrust on curved surfaces, Examples. **(Lecture Hours: 17)**

Unit III: Equilibrium and Stability of Floating Bodies: Condition of equilibrium of floating bodies, Examples, Unstable and Neutral equilibrium, Determination of Meta centre, Examples. **(Lecture Hours: 16)**

Text Books :

[1] Text Books of Fluid Dynamics; F. Chorlton, CBS Publishers & Distributors.

[2] Fluid Dynamics; M.D. Raisinghania, S. Chand & Company Ltd.

[3] A Text Book of Hydrostatics; M.Ray and H.S. Sharma, S. Chand & Company Ltd, New Delhi.

Reference Books :

1. Theoretical Hydrodynamics; Milne Thomson, Macmillan & Co.
2. Hydrostatics; B.D. Sharma, Kedarnath Ramnath Prakashan

**B.A./B.Sc. 5th Semester
Mathematics Core (Major) Syllabus**

Course Code: CT-5-MTH-504

Course Title: Mechanics, Integral Transformation

Lecture Hours: 80

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

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

**A. Mechanics Lecture Hours:
48**

(a) Statics

Unit I: Reduction of a system of forces on a rigid body, Change of base point, Conditions of equilibrium, Point's central axis, wrench, pitch, screw, Invariants, Equations of central axis. **(Lecture Hours: 8)**

Unit I: Virtual work, Common centenary, Stability of equilibrium. **(Lecture Hours: 12)**

(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: 8)**

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: 12)**

**B. Integral Transforms Lecture Hours:
32**

Unit I: Laplace Transforms: Laplace Transforms of some elementary functions, Linearity property, First and second translational or shifting theorem. Change of scale property, Laplace transforms of derivatives Multiplication by powers of t, and related problems. **(Lecture Hours: 8)**

Unit II: The inverse Laplace transforms: Definition, some inverse Laplace transforms properties of inverse Laplace transform, inverse Laplace transforms of derivatives, Multiplication by s, Convolution property, partial fraction method, Complex inversion formula. **(Lecture Hours: 12)**

Unit III: Application to differential equations: Solution of ordinary differential equations with constant coefficients, Solution of ordinary differential equations with variable coefficients, solution of Simultaneous ordinary differential equations, Solution of partial differential equations. **(Lecture Hours: 12)**

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
- [4] Laplace and Fourier Transforms; M.D. Raisinghania. S. Chand and Company 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
- 5. The Laplace Transform; D.V. Widder, Dover Publication

**B.A./B.Sc. 5th Semester
Mathematics Core (Major) Syllabus**

Course Code: PR-1-MTH-505

Course Title: Project-1

Project Work

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

**B.A./B.Sc. 6th Semester Mathematics Core (Major)
Syllabus**

Course Code: CT-5-MTH-601

Course Title: Statistics, Graph Theory, Fuzzy Set Theory

Lecture Hours: 80

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

Objective: Students will be able to identify the relations between statistics and mathematics. Students will be introduced to the fundamentals of graph theory and fuzzy set theory.

**A. Statistics Lecture Hours:
32**

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: 12)**

Unit II: Measures of Dispersion: Standard deviation, Quartile deviation, co-efficient of variation. **(Lecture Hours: 6)**

Unit IV: Correlation and regression: Karl Pearson's co-efficient of correlation, Spearman Rank correlation co-efficient, regression lines and equation. **(Lecture Hours: 7)**

Unit V: Theoretical Probability Distribution: Binomial, Poisson and Normal Distribution and their applications to simple problems. **(Lecture Hours: 7)**

**B. Graph Theory Lecture Hours:
27**

Unit I: Graph Theory: Definition, Directed and undirected graphs, basic terminologies, finite and infinite graph, incidence and degree of vertex, isolated and pendent vertices, null graph, Handshaking theorem, types of graphs, sub graphs, graphs isomorphism, operations of graphs, connected graph, disconnected graphs and components. **(Lecture Hours: 16)**

Unit II: Walk, path and circuits, Eulerian graphs, Hamiltonian graphs, Konigsberg's Bridge problem, Representation of graphs, matrix representation of graph, adjacency matrix, Incidence matrix, Linked representation of graphs. **(Lecture Hours: 11)**

**C. Fuzzy Set Theory: Lecture Hours:
21**

Unit I: Introduction, Definition and examples of fuzzy sets, Relations between fuzzy sets ,Operations on fuzzy sets and their properties, α -cut of a fuzzy set, Fuzzy complements, t-norms, t-conorms. **(Lecture Hours: 12)**

Unit2: Fuzzy relations, Binary fuzzy relations, Domain, Range and height of a fuzzy relation, Compositions of fuzzy relations. **(Lecture Hours: 9)**

Text books:

- [2] Graph Theory, Harrary, Narosa Publ.
[3] Graph Theory with Application; C. Vasudev, New Age International Publishers.
[4] Fuzzy Sets & Fuzzy Logic, Theory & Application; G.J. Klir, B.Yuan, PHI.

Reference Books :

1. Discrete Mathematics, Schaum outline series, Tata McGraw Hill
2. Elements of Probability and Statistics, A.P. Baisnab, M.Jas, Tata-McGraw Hills
3. Fuzzy Set Theory; Lee , Springer
5. Graph Theory with application to Engineering and computer Science; Narasingh Deo, Prentice Hall of India, New Delhi

Course Code: CT-5-MTH-602**Course Title: Discrete Mathematics, Metric Spaces****Lecture Hours: 80****L-4,T-1,P-0 Credit:5**

Objective: Students will be exposed to the metric structures and the generalization concepts arising out of Real Analysis.

**A. Discrete Mathematics Lecture Hours:
40**

Unit I: Recurrence Relations: Formulation as Recurrence Relations, Solutions of Recurrence Relations, Solution of homogeneous and non homogeneous linear Recurrence Relations, Generating Functions. (**Lecture Hours: 8**)

Unit II: Lattice: Definition and examples, Hasse diagram, Properties of Lattice, Lattice as an Algebraic systems, Sub lattice and lattice isomorphism, Special Classes : of lattice, Distributive lattice and Boolean algebras. (**Lecture Hours: 13**)

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: 10**)

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: 9**)

**B. Metric Spaces Lecture Hours:
40**

Unit I: Definition and examples of metric spaces, Open spheres and closed spheres, Neighborhoods, Open sets, Equivalent metrics, Interior points, Closed sets, Limit points and isolated points, Closure of a set, Boundary points, Distance between sets and diameter of a set, Subspace of metric space, Product metric spaces (definition only), Bases. (**Lecture Hours: 15**)

Unit II: Convergent sequences, Cauchy sequences, complete & separable spaces, dense sets. **(Lecture Hours: 11)**

Unit III: Continuous functions: Definition and characterizations, Extension theorem, Uniform continuity (definition only), Homeomorphism. **(Lecture Hours: 7)**

Unit IV: Compact spaces and compact sets, Sequential compactness. **(Lecture Hours: 7)**

Text Books :

[1] Discrete Mathematics; N. Chandrasekaran & M. Umavathi Prentice Hall of India, New Delhi

[3] Metric Space; P K Jain and K Ahmed, Narosa Publications

[4] Introduction to topology and modern analysis; G F Simmons, Tata McGraw Hill

Reference Books :

Course Code: CT-5-MTH-603

Course Title: Linear Algebra, Partial Differential Equation

Lecture Hours: 80

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

Objective: Students will learn about linear spaces and maps and operators on those and also will have ideas on the basics of partial differential equations.

A. Linear Algebra Lecture Hours: 40

Unit I: Vector Spaces: Basic concepts, linear independence, basis and dimension, subspaces, bases of subspaces, quotient spaces. **(Lecture Hours: 20)**

Unit II: Linear Maps: Basic concepts, isomorphism, algebra of linear maps, matrices of linear maps. **(Lecture Hours: 10)**

Unit III: Linear Operators: Introduction, polynomial over fields, characteristic polynomial and eigen values, minimal polynomial, Cayley-Hamilton theorem. **(Lecture Hours: 10)**

B. Partial Differential Equation Lecture Hours: 40

Unit I: Introduction, Origins of First order PDE, Cauchy Problem for First order equations, Linear equations of first order, Lagrange equation, Integral Surface passing through a given curve, surface orthogonal to a given system of surfaces. **(Lecture Hours: 20)** [3]

Unit II: Nonlinear PDE of first order, Cauchy Method of characteristics, Compatible systems of first order equation, Charpit's Method, special types of first order equations, solution satisfying given conditions, Jacobi's Method. **(Lecture Hours: 20)**[3]

Text Books :

[1] Linear Algebra, Schoum Outline Series, Tata McGraw Hill.

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

[3] Linear Algebra; P.K. Saikia, Pearson Publisher

[2] Elements of Partial Differential Equations; I. N. Sneddon, McGraw Hill International.

Reference Books :

1. Advance Differential Equation; M D Raisinghania, S Chand Company.

2. Introduction to Partial Differential Equation; K. Sankara Rao, Prentice-Hall of India

4. Linear Algebra; Hoffman and Kunze, Prentice Hall Pub

5. Algebra, Michael Artin, Prentic- Hall of India.

Course Code: CT-5-MTH-604

Course Title:

(Any one from Group A or B)

Group (A): Topological Spaces, Functional Analysis

Group (B): Space Dynamics, Relativity

Lecture Hours: 80

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

Group (A)

Topological Spaces and Functional Analysis

Lecture Hours:

80

Objective: Students will be exposed to the topological and algebraic structures of abstract mathematics.

A. Topological space

Lecture Hours:

40

Unit-I: Definition and examples, Open sets, Closed sets, Closure of a set, Neighbourhood, Isolated point and Limit point. Subspace, Continuous mapping, Open mapping, Homeomorphism. (**Lecture Hours: 16**)

Unit-II: Base and subbase: Open base and subbase, Second countable space, Concept of strong and weak topology. (**Lecture Hours: 12**)

Unit-III: Compactness: Open cover and subcover, Compact space and subspace, Bolzano-Weierstrass Property. (**Lecture Hours: 12**)

B. Functional Analysis

Lecture Hours:

40

Unit-I: Normed Linear Spaces and Banach spaces, Definition, examples and elementary properties, Some concrete normed linear and Banach Spaces, Subspaces, Definition and Examples, Quotient spaces. (**Lecture Hours: 12**)

Unit-II: Bounded linear Operators, Definition, Examples and basic properties, Norm of a bounded linear operator, invertible operator, Spaces of bounded linear operator, Banach

algebra, Definition and Examples, Equivalent norms, Topological isomorphism, Bounded linear functional (definition, examples and basic properties only) .(**Lecture Hours: 16**)

Unit-III: Dual space, Inner product space and Hilbert space, Definition, examples and basic properties, Schwarz inequality, Parallelogram equality, Polarization equality, subspaces, Orthogonality of vectors, Pythagorean theorem.(**Lecture Hours: 12**)

Text Books :

[1] Introduction to Topology and Modern Analysis; G.F. Simmon, Tata McGraw Hill.

[2] Functional Analysis, P.K. Jain, O.P. Ahuja & K. Ahmed, New Age Int. Pub.

[3] Topology- A First Course; J.R. Munkres, PHI

Reference Books :

1. Functional Analysis; J.N.Sarma, Krishna Prakashan

2. Topology, B.D. Gupta, Kedarnath Ramnath Prakashan

3. Functional Analysis; B.V. Limaye, New Age Intl.

4. Functional Analysis, Erwin Kreiszig

Group (B)

**Space dynamics and Relativity Lecture Hours:
80**

Objective : Students will be introduced to the application of Mathematical principles to the problems of Space Dynamics and Relativity.

**A. Space Dynamics Lecture Hours:
40**

Unit I: Spherical Trigonometry: Spherical triangles and its properties, the sine-cosine formulae, four parts formula. (**Lecture Hours: 12**)

Unit II: Coordinate systems: Position on the earth surface, horizontal system, equatorial system, ecliptic system, elements of the orbit in space, rectangular coordinate system, orbital plane coordinate system, transformation of systems. (**Lecture Hours: 16**)

Unit III: Gravitation, the one and two body problems, elliptic motion, attraction of irregular bodies, rotational distortion, coordinates the orbits in space. (**Lecture Hours: 12**)

**B. Relativity Lecture Hours:
40**

Unit I: Classical theory of relativity: Inertial frame, Galilean transformation, Michelson and Morley experiments. (**Lecture Hours: 9**)

Unit II: Lorentz transformation, equations, composition of velocities in terms of rapidity. Lorentz transformation as rotation, consequences of Lorentz transformation equation viz. Lorentz-Fitzgerald contraction, Time dilation, the clock paradox, space like and time like integrals. (**Lecture Hours: 16**)

Unit II: Relativistic mechanics : The relativistic conception of mass increasing with velocity, transformation laws of mass, velocity, acceleration, density, momentum, energy and force. The mass energy relation and simple examples. (**Lecture Hours: 15**)

Text Books :

- [1] Text book of Astronomy; Smart, Oxford University Press.
- [2] The foundations of Astro-dynamics; A. E. Roy, Mcmillan Co., New York.
- [3] An Introduction to Celestial Mechanics; T. E. Sterne, Inter-Science Pub.
- [4] Introduction to Special Relativity; Robert Resnick, Wiley Intl.
- [5] The Theory of Relativity; P.M. Ray.
- [6] The Mathematical Theory of Relativity, A.S. Edington

Course Code: PR-1-MTH-605

Course Title: Project-2

Project Work

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