Telangana Council of Higher Education

Mathematics Course Structure

B.Sc. Common Core Syllabus for All the Students Admitted

From the Academic Year 2025-2026 Batch onwards

B.Sc.(Mathematics) Course Structure

W.E.F. 2025-2026 academic year batch onwards

Year	Paper	Semester	Subject	Hours/Per Week		Credits	Marks (IA)	Marks (EE)	Total Marks
				Theory	Tutorials				
1	**DSC I**	I	Differential Equations	5	1	5	25	100	125
	DSC II	II	Real Analysis	5	1	5	25	100	125
2	**DSC III**	III	Differential & Vector Calculus	5	1	5	25	100	125
	DSC IV	IV	Algebra	5	1	5	25	100	125
3	**DSC V**	V	Linear Algebra	5	1	5	25	100	125
	DSE VI	VI	**(A)** Numerical Analysis **OR** **(B)** Integral Transforms **OR** **(C)** Analytical Solid Geometry	5	1	5	25	100	125
3	**SEC 4**	VI	Number Theory **OR** Quantitative Aptitude	2	-	2	10	40	50
3	**MDC**	V	Basic Mathematics (Multi - Discipline)	4	-	4	20	80	100

Tutorials: Problems solving session for each 20 students one batch.

IA: Internal Assessment

EE: End Examination

DSC: Discipline Specific Course

SEC: Skill Enhancement Course

MDC: Multi-Disciplinary Course

SEMESTER- I

DIFFERENTIAL EQUATIONS

Theory: 5 hours /week and Tutorials: 1 hour /week

DSC-I

Objective: The main aim of this course is to introduce the student to the techniques of solving Differential Equations and to apply their skills in solving some of the problems of Engineering and Science.

Outcome: After learning the course, the student will be equipped with various tools to solve few types of Differential Equations that arise in several branches of science.

UNIT- I

Differential Equations of First Order and First Degree: Introduction- Equations in Which Variables are Separable – Homogeneous Differential Equations - Differential Equations Reducible to Homogeneous Form – Linear Differential Equations - Differential Equations Reducible to Linear Form – Exact Differential Equations – Integrating Factors – Change in Variables (Text Book : 2.1 to 2.9)

UNIT- II

Equations of First Order But Not of The First Degree: Case I: Equations Solvable for p -Case II : Equations Solvable for y - Equations Solvable for x – Equations that do not Contain x *(or y)* - Equations Homogeneous in x and y – Equations of First Degree in x and y – Clairaut's Equation.

Applications of First Order Differential Equations: Growth and Decay – Dynamics of Tumor Growth – Radioactivity and Carbon Dating – Compound Interest – Orthogonal Trajectories.

(Text Book : 3.1 to 3.2 & 4.1 to 4.4 & 4.20)

UNIT- III

Higher Order Linear Differential Equations: Introduction - Solution of Homogeneous Linear Differential Equations of Order n with Constant Coefficients - Solution of the Non-Homogeneous Differential Equations with Constant Coefficients by Means of Polynomial Operators - Method of Undetermined Coefficients. (Text Book : 5.1 to 5.4)

UNIT- IV

Method of variation of Parameters – Linear Differential Equations with Non-Constant Coefficients – The Cauchy – Euler Equation – Legendre's Linear Equations – Miscellaneous Differential Equations. Total Differential Equations – Simultaneous Total Differential Equations – Equations of the form $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$. (Text Book : 5.5 to 5.9 & 2.10 to 2.12)

TEXT BOOK:

Zafar Ahsan, Differential Equations and Their Applications (Second Edition)

REFERENCE BOOKS :

1. Frank Ayres Jr, Theory and Problems of Differential Equations.
2. Ford, L.R ; Differential Equations.
3. Daniel Murray, Differential Equations.
4. S. Balachandra Rao, Differential Equations with Applications and Programs.
5. Stuart P Hastings, J Bryce McLead; Classical Methods in Ordinary Differential Equations.

SEMESTER- II

REAL ANALYSIS

Theory: 5 hours /week and Tutorials: 1 hour /week

DSC-II

Objective: The course is aimed at exposing the student to the foundations of analysis which will be useful in understanding various physical phenomena.

Outcome: After the completion of the course the student will be in a position to appreciate the beauty and applicability of the course.

UNIT-I

Real Numbers: Field Structure and Order Structure-Bounded and Unbounded Sets- Completeness in the Set of Real Numbers- Absolute Value of a Real Number (Text Book : Chapter 1: 2 to 5)

Open Sets, Closed Sets and Countable Sets : Limit Points of a Set-Closed Sets-Countable and Uncountable Sets (Text Book : Chapter 2 : 2 to 4)

Real Sequences: Sequences-Limit points of a Sequence-Convergent Sequences-Non-Convergent Sequences (Definitions)-Cauchy's General Principle of Convergence- Algebra of Sequences- Some Important Theorems-Monotonic Sequences.(Text Book : Chapter 3: 1 to 2 & 4 to 9)

UNIT-II

Infinite Series : Introduction-Positive Term Series- Comparison Tests for Positive Term Series-Cauchy's Root test- D'Alembert's Ratio Test-Integral Test-Alternating Series(Leibnitz Test).
(Text Book : Chapter 4 : 1 to 5, 8 & 10.1)

Functions of a Single Variable (I): Limits-Continuous Functions-Functions Continuous on Closed Intervals. (Text Book : Chapter 5: 1 to 3)

UNIT -III

Functions of a Single Variable (II): The Derivative-Increasing and Decreasing Functions- Rolle's Theorem-Lagrange's Mean Value Theorem- Cauchy's Mean Value Theorem- Higher Order Derivatives. (Text Book : Chapter 6: 1, 3 & 5 to 8)

UNIT -IV

The Riemann Integral: Definition and Existence of the Integral-Refinement of Partitions-Darboux's Theorem-Conditions of Integrability-Integrability of the Sum and Difference of Integrable Functions-The Integral as a Limit of Sums-Some Integrable Functions-Integration and Differentiation-The Fundamental Theorem of Calculus. (Text Book : Chapter 9: 1 to 9)

TEXT BOOK :

S.C. Malik and Savita Arora, Mathematical Analysis, Fourth Edition, New Age International Publishers

REFERENCE BOOKS:

1. Kenneth A Ross, Elementary Analysis-The Theory of Calculus
2. William F. Trench, Introduction to Real Analysis
3. Lee Larson, Introduction to Real Analysis I
4. Shanti Narayan and Mittal, Mathematical Analysis
5. Brian S. Thomson, Judith B. Bruckner, Andrew M. Bruckner; Elementary Real analysis

SEMESTER- III

DIFFERENTIAL AND VECTOR CALCULUS

Theory: 5 hours /week and Tutorials: 1 hour /week

DSC-III

Objective: The course is aimed at exposing the student to some basic notions in Differential Calculus.

Outcome: After the completion of the course the student realizes wide-ranging applications of the subject.

UNIT- I

Partial Differentiation: Introduction - Functions of Two Variables - Neighbourhood of a Point (a, b) - Continuity of a Function of Two Variables- Continuity at a Point - Limit of a Function of Two Variables - Partial Derivatives - Geometrical Representation of a Function of Two Variables - Homogeneous Functions. (Text Book 1 : 11.1 to 11.8)

UNIT- II

Theorem on Total Differentials-Composite Functions- Differentiation of Composite Functions- Implicit Functions- Equality of $f_{xy}(a, b)$ and $f_{yx}(a, b)$, Taylor's Theorem for a Function of Two Variables- Maxima and Minima of Function of Two variables- Lagrange's Method of Undetermined Multipliers (Text Book 1 : 11.9 to 11.11 & 9.6, 9.7)

UNIT- III

Gradient, Divergence and Curl : Introduction-Gradient- Divergence-Curl -Formulas Involving ∇-Invariance (Text Book 2: Chapter 4: 4.1 to 4.6)

Multiple Integrals : Double Integrals- Double Integrals in Polar Form (Book 3: 13.1 & 13.3)

Vector Integration : Introduction- Ordinary Integrals of Vector Valued Functions - Line Integrals-Surface Integrals- Volume Integrals. (Text Book 2: Chapter 5: 5.1 to 5.5)

UNIT- IV

The Divergence Theorem, Stoke's Theorem and Related Integral Theorems : Introduction-Main Theorems- Related Integral Theorems (Text Book 2: Chapter 6: 6.1 to 6.3)

TEXT BOOKS:

1. Shanti Narayan, P.K. Mittal Differential Calculus, S.CHAND, NEW DELHI, Fifteenth Edition
2. Vector Analysis , Second Edition (Schaum's Outlines) , By Murray R. Spiegel, Seymour Lipschutz, Dennis Spellman.
3. Calculus and Analytical Geometry by George B. Thomas, Ross. L. Finney (Nineth Edition)

REFERENCE BOOKS:

1. William Anthony Granville, Percey F Smith and William Raymond Longley; Elements of the Differential and Integral Calculus
2. Joseph Edwards, Differential calculus for Beginners
3. Smith and Minton, Calculus
4. Elis Pine, How to Enjoy Calculus

SEMESTER – IV
ALGEBRA

Theory: 5 hours /week and Tutorials: 1 hour /week

DSC-IV

Objective: The course is aimed at exposing the student to learn some basic algebraic structures like groups, rings etc.,

Outcome: On successful completion of the course the student will be able to recognize algebraic structures that arise in matrix algebra, linear algebra and will be able to apply skills learnt in understanding various such subjects.

UNIT – I

Group Theory: Definition of a Group, Some Examples of Groups - Some Preliminary Lemmas – Subgroups - A Counting Principle. (Text Book : 2.1 to 2.5)

UNIT – II

Group Theory: Normal Subgroups and Quotient Groups –Homomorphsims -Cayley's Theorem - Permutation Groups.(Text Book : 2.6, 2.7, 2.9, 2.10)

UNIT – III

Ring Theory: Definition and Examples of Rings - Some Special Classes of Rings - Homomorphisms. (Text Book : 3.1 to 3.3)

UNIT – IV

Ring Theory: Ideals and Quotient Rings -More Ideals and Quotient Rings – Euclidean Rings - Polynomial Rings. (Text Book : 3.4, 3.5, 3.7, 3.9)

TEXT BOOK :

I. N. Herstein : Topics in Algebra, John Wiley & Sons (Second Edition)

REFERENCE BOKS :

1. Bhattacharya. P.B, Jain. S.K and Nagpaul. S.R : Basic Abstract Algebra
2. Fraleigh. J.B: A First Course in Abstract Algebra.
3. Joseph A Gallian: Contemporary Abstract Algebra (9^{th} Edition).

SEMESTER-V

LINEAR ALGEBRA

Theory: 5 hours /week and Tutorials: 1 hour /week

DSC-V

Objectives: The student is exposed to various concepts like vector space, bases, dimension, eigen values, etc.,

Outcomes: After completion of this course student appreciates its interdisciplinary nature.

UNIT – I

Vector Spaces: Vector Spaces – Subspaces - Span of a Set - More about Subspaces - Linear Dependence – Independence - Dimension and Basis. (Text Book : 3.1 to 3.6)

UNIT – II

Linear Transformations: Definition and Examples - Range and Kernal of a Linear Map - Rank and Nullity - Inverse of a Linear Transformation - Consequences of Rank-Nullity Theorem - The Space L(U,V) - Composition of Linear Maps. (Text Book : 4.1 to 4.7)

UNIT – III

Matrices: Matrix Associated with a Linear Map - Linear Map Associated with a Matrix – Linear Operations in $M_{m\times n}$ - Matrix multiplication- Rank and Nullity of a Matrix. (Text Book : 5.1 to 5.5)

UNIT – IV

Elementary Row Operations - System of Linear Equations - Eigen values and Eigen Vectors – Wronskians - Inner Product Spaces. (Text Book : 5.7, 5.8, 6.8, 6.9, 7.2)

TEXT BOOK:

V. Krishnamurthy, V.P. Manira and J.L. Arora : An Introduction of Linear Algebra,© 1976 Affiliated East-West Press Pvt Ltd.

REFERENCE BOOKS:

1. Kenneth Hoffman and Ray Kunze: Linear Algebra, Prentice-Hall, Inc., Englewood Cliffs, New Jersey.
2. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence: Linear Algebra.

SEMESTER-VI

(A) NUMERICAL ANALYSIS

Theory: 5 hours /week and Tutorials: 1 hour /week

DSE-VI (A)

Objective: Student will be made to understand some methods of Numerical Techniques.

Outcome: Student realizes the importance of the subject in solving some problems of algebra and calculus.

UNIT- I

Errors In Numerical Calculations - Mathematical Preliminaries-Errors and their Computation- A General Error Formula-Error in a Series Approximation (Book1: 1.3 to 1.6)

Solutions of Algebraic and Transcendental Equations: -Introduction -The Bisection Method - The Iteration Method –Acceleration of Convergence- The Method of False Position- Newton Raphson Method -Generalized Newton's Method - Muller's Method.

(Text Book : 2.1 to 2.5 & 2.7)

UNIT- II

Interpolation : Introduction - Finite Differences - Differences of a Polynomial - Newton's Formulae for Interpolation - Central Difference Interpolation Formulae : Gauss's Central Difference Formulae Stirling's Formula- Bessel's Formula - Lagrange's Interpolation Formula - Divided Differences and their Properties - Newton's General Interpolation Formula. (Text Book : 3.1, 3.3, 3.5, 3.6, 3.7 (3.7.1, 3.7.2, 3.7.3), 3.9.1, 3.11 (3.11.1))

UNIT- III

Curve Fitting: Least Square Curve Fitting Procedures- Fitting a Straight Line - Nonlinear Curve Fitting (Text Book : 4.2 (4.2.1,4.2.2))

Numerical Differentiation and Integration: Introduction -Numerical Differentiation (Using Newton's Forward and Backward Difference Formulae only) – Numerical Integration: Trapezoidal Rule-Simpson's-1/3-Rule-Simpson's- 3/8-Rule- Boole's and Weddle's Rules. (Text Book : 5.1, 5.2 , 5.4 (5.4.1 to 5.4.4))

UNIT- IV

Numerical Solution of Ordinary Differential Equations: Introduction-Solution by Taylor's Series-Picard's Method of Successive Approximations - Euler's Methods-Modified Euler's Method – Runge-Kutta Methods.(Text Book : 7.1, 7.2, 7.3, 7.4, (7.4.2) , 7.5)

TEXT BOOK:

S. S. Sastry, Introductory Methods of Numerical Analysis, Third Edition.

REFERENCES:

1. Richard L. Burden and J. Douglas Faires, Numerical Analysis (9e)
2. M K Jain, S R K Iyengar and R K Jain, Numerical Methods for Scientific and Engineering computation
3. B. Bradie , A Friendly introduction to Numerical Analysis

SEMESTER-VI

(B) INTEGRAL TRANSFORMS

Theory: 5 hours /week and Tutorials: 1 hour /week

DSE-VI (B)

Objective: Student will be exposed to Integral Transforms. The students also learning the Applications of Laplace Transforms to Differential Equations which arises in Physics and Engineering Problems.

Outcome: Student applies the knowledge to solve some problems in special functions and Differential Equations by using the Integral Transforms.

UNIT -I

Laplace Transforms :- Laplace Transform Definition -Linear Property of Laplace Transform-Piecewise Continuous Function-Existence of Laplace Transform-Functions of Exponential Order- A Function of Class A - Laplace Transform of Some Elementary Functions-First Shifting Theorem-Second Shifting Theorem-Change of Scale Property-Laplace Transforms of Derivative of $F(t)$- Laplace Transforms of n^{th} Order Derivative of $F(t)$- Initial Value Theorem- Final Value Theorem-Laplace Transforms of Integrals -Multiplication by t - Multiplication by t^n -Division by t -Evaluation of Integrals-Periodic functions (Text Book : 1.1 to 1.21)

Unit -II

Inverse Laplace Transform : Inverse Laplace Transform Definition-Null function- Lerch's Theorem- Linear Property – First Shifting Theorem -Second Shifting Theorem - Change of Scale Property -Use of Partial Factions- Inverse Laplace Transform of Derivatives - Inverse Laplace Transform of Integrals - Multiplication by Powers of p- Division by Powers of p-Convolution Definition Convolution Theorem (Text Book : 2.1 to 2.15)

Unit-III

Applications of Laplace Transform to Solutions of Differential Equations-Solution of Ordinary Differential Equations with Constant Coefficients- Solution of Ordinary Differential Equations with Variable Coefficients- Solution of Simultaneous Ordinary Differential Equations.
(Text Book : 3.1 to 3.3)

Unit-IV

Fourier Transforms :-Dirichlet Conditions- Fourier Series-Fourier Integral Formula- Fourier Transform or Complex Fourier Transform- Inversion Theorem for Complex Fourier Transform-Fourier Sine Transform- Inversion Formula for Fourier Sine Transform- Fourier Cosine Transform-Inversion Formula for Fourier Cosine Transform- Linear Property of Fourier Transform-Change of Scale Property- Shifting Property -Modulation Theorem- Examples. (Text Book : 6.1 to 6.14)

TEXT BOOK :

A.R. Vasishtha and R.K. Gupta, Integral Transforms (Thirty Eighth Edition)

REFERENCE BOOK: Integral Transforms and their Applications by Brian Davies, Springer Publications.

SEMESTER-VI

(C) ANALYTICAL SOLID GEOMETRY

Theory: 5 hours /week and Tutorials: 1 hour /week

DSE-VI (C)

Objective: Student learns to describe some of the surfaces by using Analytical Geometry.
Outcome: Student understands the beautiful interplay between Algebra and Geometry.

UNIT- I

Right line: Representation of line-Angle between a Line and a Plane-Conditions for a Line to lie in a Plane- Coplanar Lines , Condition for the Coplanarity of Lines - Number of Arbitrary Constants in the Equations of a Straight Line - The Shortest Distance Between Two Lines - Length of the Perpendicular from a Point to a Line. (Text Book : 3.1 to 3.7)

UNIT- II

The Sphere: Definition-The Sphere Through Four Given Points-Sphere-Equations of a Circle-Intersection of a Sphere and a Line-Equation of a Tangent Plane-Angle of Intersection of Two Spheres-Radical Plane. (Text Book : 6.1 to 6.8)

UNIT- III

Cones , Cylinders: Definition-Condition that the General Equation of the Second Degree Should Represent a Cone-Cone and a Plane Through its Vertex -Intersection of a Line with a Cone.
(Text Book : 7.1 to 7.4)

UNIT- IV

Cones , Cylinders: The Right Circular Cone -The Cylinder- The Right Circular Cylinder.
(Text Book : 7.6 to 7.8)
The Conicoid: The General Equation of the Second Degree-Intersection of a Line with a Conicoid.
(Text Book : 8.1, 8.3 (8.3.1 to 8.3.3))

TEXT BOOK :

Shanti Narayan and P K Mittal, Analytical Solid Geometry ,Seventeenth Edition

REFERENCES:

1. Khaleel Ahmed, Analytical Solid Geometry
2. S L Loney , Solid Geometry

SKILL ENHANCEMENT COURSE

SEMESTER-VI

NUMBER THEORY

Theory: 2 hours /week

SEC-IV(A)

Objective: Student will be exposed to some of the jewels like Fermat's theorem, Euler's theorem in Number theory.

Outcome: Student acquires knowledge in solving some divisor problems.

UNIT- I

The Goldbach Conjecture - Basic Properties of Congruence- Binary and Decimal Representation of Integers

Number Theoretic Functions : The Sum and Number of Divisors- The Mobius Inversion Formula- The Greatest Integer Function. (Text Book : 3.3, 4.2, 4.3, 6.1 to 6.3)

UNIT- II

Euler's Generalization of Fermat's Theorem : Euler's Phi- function- Euler's Theorem-Some Properties of the Phi- Function. (Text Book : 7.2 to 7.4)

TEXT BOOK :

David M Burton, Elementary Number Theory , Seventh Edition.

REFERENCES:

1. Thomas Koshy, Elementary Number Theory and its Applications
2. Kenneth H Rosen, Elementary Number Theory

SKILL ENHANCEMENT COURSE

SEMESTER-VI

QUANTITATIVE APTITUDE

Theory: 2 hours /week

SEC-VI (B)

Objective: Student can enhance problem-solving skills relevant to competitive exams.

Outcome: Student can improve overall quantitative aptitude, required for competitive and academic assessments.

UNIT-I

Number Systems: (Page : 3 to 50)

H.C.F and L.C.M of Numbers: (Page : 51 to 68)

Decimal Fractions: (Page : 69 to 94)

Percentage: (Page : 308 to 373)

Ratio and Proportion: (Page : 426 to 475)

Profit and Loss : (Page : 374 to 425)

UNIT -II

Time and Work: (Page : 526 to 561)

Time and Distance: (Page : 562 to 599)

Average: (Page : 206 to 239)

Simple and Compound Interest: (Page : 641 to 687)

Partnership: (Page : 476 to 492)

TEXT BOOK: Quantitative Aptitude by Dr. R. S. Aggarwal (2017 Edition)

MULTI DISCIPLINARY COURSE
SEMESTER-V
BASIC MATHEMATICS
Theory: 4 hours /week

MDC -V

Objective: Student can learn statistical measures**,** fundamental principles of probability theory. Also, learn the problem-solving skills using linear systems and mathematical tools applied to real-life business problems .

Outcome: Student realizes how the quantitative analysis will be an aid to decision-making process. Also, the quantitative analysis , how it will be linked with other information in making decisions.

UNIT- I

Descriptive Measures: Averages- Arithmetic Mean- Median- Mode- Geometric Mean- Harmonic Mean. (Text Book 1: 2.4 to 2.7 & 2.9)

UNIT- II

Theory of Probability: Basic Terminology- Mathematical probability- Statistical probability- Axiomatic Approach to Probability (Text Book 1: 3.3 to 3.5 & 3.8)

UNIT- III

Matrices: Introduction - Definitions and Notations - Operations on Matrices - Determinant of a Square Matrix - Non-Singular matrix and Singular Matrix- Sarrus Diagram for Expansion of Determinant of a matrix 3X3 - Properties of Determinants.
(Text Book 2 : Chapter 15 : 15.1 to 15.3, 15.5.1 to 15.5.3)

UNIT- IV

Linear System of Equations: Conversion of a business problem into a Linear System of Equations – Rank of a Matrix – Application of Rank concept – Minor and Cofactor – Adjoint of a Square matrix -Inverse of a Square Matrix – Matrix Equation – Methods to Solve Linear System of Equations – Solution to the linear system of Equations – Types of Solutions – Cramer's rule – Matrix Inversion method
(Text Book 2 : Chapter 15 : 15.4, 15.5.4 to 15.5.8, 15.6, 15.7.1 to 15.7.4).

TEXT BOOK :

1. S.C Gupta , S.K Kapur , Fundamentals of Mathematical Statistics (Twelfth Edition)
2. P. Mariappan , Business Mathematics, Pearson Publication 2015, New Delhi.

Few Websites :

NPTEL: nptel.ac.in

COURSERA:

www.coursera.org MITOCW:

ocw.mit.edu

ACADEMIC EARTH: www.academicearth.org

EdX : www.edx.org

KHAN ACADEMY

:www.khanacademy.org ALISON:

www.alison.com

STANFORD ONLINE: www.online.stanford.edu

VIDEO LECTURES: videolectures.net

INTERACTIVE REAL ANALYSIS: mathcs.org

VISUAL CALCULUS: archives.math.utk.edu/visual.calculus

MOOCS CALCULUS: mooculus.osu.edu

Few Math Softwares

Useful for Classroom teaching: Geogebra (Freeware)

Type setting software:LaTeX

High end commercial softwares: Mathematica , Maple , Matlab

Answering search engine: www.wolframalpha.com

Group theory software: group explorer 2.2 (Freeware)

Visualization software: Mathematics Visualization Toolkit (freeware)