Dept. of Mathematics
MAHATMA GANDHI UNIVERSITY, NALGONDA

Mathematics Course Structure
(B.Sc. Common Core Syllabus for the Students Admitted from the Academic Year 2019-2020 Batch onwards)
## Contents

1 B.Sc. Course Structure Template
   1.1 Differential and Integral Calculus ................................................. 4
   1.2 Differential Equations ........................................................................ 6
   1.3 Real Analysis ...................................................................................... 8
   1.4 Algebra ............................................................................................. 9
   1.5 Linear Algebra .................................................................................. 11
   1.6 Numerical Analysis .......................................................................... 12
   1.7 Integral Transforms .......................................................................... 13
   1.8 Analytical Solid Geometry .................................................................. 14
   1.9 Theory of Equations ......................................................................... 15
   1.10 Logic and Sets ................................................................................ 16
   1.11 Number Theory ............................................................................... 17
   1.12 Vector Calculus ............................................................................... 18
   1.13 Basic Mathematics ......................................................................... 19
   1.14 Mathematical Modeling ................................................................. 20
1  B.Sc. Course Structure Template
# Telangana State Council of Higher Education

**B.A/B.Sc. Mathematics Course Structure**

(Common Core Syllabus for All Universities of Telangana State for the Students Admitted from the Academic Year 2019-20 Batch onwards)

<table>
<thead>
<tr>
<th>Paper</th>
<th>Semester</th>
<th>Subject</th>
<th>Hours/ per week</th>
<th>Hours/per week</th>
<th>Max. Marks</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Theory*Tutorials</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DSC - I</td>
<td>I</td>
<td>Differential &amp; Integral Calculus</td>
<td>6</td>
<td>5</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>DSC - II</td>
<td>II</td>
<td>Differential Equations</td>
<td>6</td>
<td>5</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>DSC - III</td>
<td>III</td>
<td>Real Analysis</td>
<td>6</td>
<td>5</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>DSC - IV</td>
<td>IV</td>
<td>Algebra</td>
<td>6</td>
<td>5</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>DSC - V</td>
<td>V</td>
<td>Linear Algebra</td>
<td>6</td>
<td>5</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>DSE – VI(A)</td>
<td>VI</td>
<td>(A) Numerical Analysis</td>
<td>6</td>
<td>5</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>DSE – VI(B)</td>
<td>VI</td>
<td>(B) Integral Transforms</td>
<td>6</td>
<td>5</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>DSE – VI(C)</td>
<td>VI</td>
<td>(C) Analytical Solid Geometry</td>
<td>6</td>
<td>5</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>SEC-I</td>
<td>III</td>
<td>Theory of Equations</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>50</td>
</tr>
<tr>
<td>SEC-II</td>
<td>III</td>
<td>Logic &amp; Sets</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>50</td>
</tr>
<tr>
<td>SEC-III</td>
<td>IV</td>
<td>Number Theory</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>50</td>
</tr>
<tr>
<td>SEC-IV</td>
<td>IV</td>
<td>Vector Calculus</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>50</td>
</tr>
<tr>
<td><strong>Generic Elective</strong></td>
<td>V-A*</td>
<td>1. Basic Mathematics or 2. Mathematics of Finance &amp; Insurance</td>
<td>4</td>
<td>4</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td><strong>Project/Optional</strong></td>
<td>VI*</td>
<td>Mathematical Modelling</td>
<td>4</td>
<td>4</td>
<td>-</td>
<td>100</td>
</tr>
</tbody>
</table>

*Tutorials: Problems solving session for each 20 student’s one batch.
SEMESTER-I

1.1 Differential and Integral Calculus
(w.e.f. academic year 2019-20)

DSC-1A

Objective: The course is aimed at exposing the students to some basic notions in differential calculus.
Outcome: By the time students complete the course they realize 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.

Unit- II
Theorem on Total Differentials - Composite Functions - Differentiation of Composite Functions - Implicit Functions - Equality of \(f (\phi, b)\) and \(f (\phi, b)\) - Taylor's theorem for a function of two Variables - Maxima and Minima of functions of two variables – Lagrange’s Method of undetermined multipliers.

Unit- III
Evolutes: Evolutes and Involutes - Properties of the evolute.
Envelopes: One Parameter Family of Curves - Consider the family of straight lines - Definition - Determination of Envelope.

Unit- IV
Lengths of Plane Curves: Introduction - Expression for the lengths of curves \(y = f (x)\) - Expressions for the length of arcs \(x = f (t), y = \phi(t)\); \(r = f (\theta)\)
Volumes and Surfaces of Revolution: Introduction - Expression for the volume obtained by revolving about either axis - Expression for the volume obtained by revolving about any line - Area of the surface of the frustum of a cone - Expression for the surface of revolution - Pappus Theorems - Surface of revolution.

Text:

- Shanti Narayan, P.K. Mittal Differential Calculus, S.CHAND, NEW DELHI
- Shanti Narayan Integral Calculus, S.CHAND, NEW DELHI
References:

- William Anthony Granville, Percey F Smith and William Raymond Longley; *Elements of the differential and integral calculus*
- Joseph Edwards, *Differential calculus for beginners*
- Smith and Minton, *Calculus*
- Elis Pine, *How to Enjoy Calculus*
- Hari Kishan, *Differential Calculus*
1.2  Differential Equations
(w.e.f. academic year 2019-20)

Theory: 5 credits and Tutorials: 0 credits
Theory: 5 hours /week and Tutorials: 1 hours /week

Objective: The main aim of this course is to introduce the students to the techniques of solving differential equations and to train to apply their skills in solving some of the problems of engineering and science.

Outcome: After learning the course the students will be equipped with the various tools to solve few types 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 - Total Differential Equations - Simultaneous Total Differential Equations - Equations of the form \( \frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R} \).

Unit- II
Differential Equations first order but not of first degree: Equations Solvable for \( p \) - Equations Solvable for \( y \) - Equations Solvable for \( x \) - Equations that do not contain \( x \) (or \( y \))-Equations Homogeneous in \( x \) and \( y \) - Equations of the First Degree in \( x \) and \( y \) - Clairaut’s equation.
Applications of First Order Differential Equations: Growth and Decay - Dynamics of Tumour Growth - Radioactivity and Carbon Dating - Compound Interest - Orthogonal Trajectories.

Unit- III
Higher order Linear Differential Equations: Solution of homogeneous linear differential equations with constant coefficients - Solution of non-homogeneous differential equations \( P(D)y = Q(x) \) with constant coefficients by means of polynomial operators when \( Q(x) = b^x, b \in \mathbb{R} \), \( ax/b \cos ax, bx \), \( Ve^k \), \( ax \).
- Method of undetermined coefficients.

Unit- IV

Text:
- Zafar Ahsan, Differential Equations and Their Applications

References:
• Ford, L.R; *Differential Equations*.
• Daniel Murray, *Differential Equations*.
• S. Balachandra Rao, *Differential Equations with Applications and Programs*.
• Stuart P Hastings, J Bryce McLead; *Classical Methods in Ordinary Differential Equations*. 
1.3 Real Analysis

(w.e.f. academic year 2020-21)

DSC-1C

Theory: 5 credits and Tutorials: 0 credits
Theory: 5 hours /week and Tutorials: 1 hours /week

Objective: The course is aimed at exposing the students to the foundations of analysis which will be useful in understanding various physical phenomena.
Outcome: After the completion of the course students will be in a position to appreciate beauty and applicability of the course.

Unit- I

Unit- II
Continuity: Continuous Functions -Properties of Continuous Functions -Uniform Continuity - Limits of Functions

Unit- III
Differentiation: Basic Properties of the Derivative - The Mean Value Theorem - , L’Hospital Rule - Taylor’s Theorem.

Unit- IV
Integration : The Riemann Integral - Properties of Riemann Integral-Fundamental Theorem of Calculus.

Text:
- Kenneth A Ross, *Elementary Analysis-The Theory of Calculus*

References:
- William F. Trench, *Introduction to Real Analysis*
- Lee Larson, *Introduction to Real Analysis I*
- Shanti Narayan and Mittal, *Mathematical Analysis*
- Brian S. Thomson, Judith B. Bruckner, Andrew M. Bruckner; *Elementary Real analysis*
- Sudhir R., Ghorpade, Balmohan V., Limaye; *A Course in Calculus and Real Analysis*
1.4 Algebra

(w.e.f. academic year 2020-21)

DSC-1D BS:401

Theory: 5 credits and Tutorials: 0 credits
Theory: 5 hours /week and Tutorials: 1 hours /week

Objective: The course is aimed at exposing the students to learn some basic algebraic structures like groups, rings etc.
Outcome: On successful completion of the course students will be able to recognize algebraic structures that arise in matrix algebra, linear algebra and will be able to apply the skills learnt in understanding various such subjects.

Unit- I
Cyclic Groups: Properties of Cyclic Groups - Classification of Subgroups Cyclic Groups.

Unit- II
Permutation Groups: Definition and Notation - Cycle Notation - Properties of Permutations - A Check Digit Scheme Based on $D_5$ Isomorphisms - Motivation - Definition and Examples - Cayley’s Theorem Properties of Isomorphisms - Automorphisms - Cosets and Lagrange’s Theorem Properties of Cosets 138 - Lagrange’s Theorem and Consequences - An Application of Cosets to Permutation Groups - The Rotation Group of a Cube and a Soccer Ball.

Unit- III
Introduction to Rings: Motivation and Definition - Examples of Rings - Properties of Rings - Subrings.
Integral Domains: Definition and Examples - Fields - Characteristics of a Ring.

Unit- IV
Ideals and Factor Rings: Ideals - Factor Rings - Prime Ideals and Maximal Ideals.
Ring Homomorphisms: Definition and Examples - Properties of Ring Homomorphisms.

Text:


References:

• Herstein, I.N, *Topics in Algebra*

• Robert B. Ash, *Basic Abstract Algebra*

• I Martin Isaacs, *Finite Group Theory*

• Joseph J Rotman, *Advanced Modern Algebra*
1.5 Linear Algebra
(w.e.f. academic year 2021-22)

DSC-E

Theory: 5 credits and Tutorials: 0 credits
Theory: 5 hours /week and Tutorials: 1 hours /week

Objective: The students are exposed to various concepts like vector spaces, bases, dimension, Eigen values etc.
Outcome: After completion this course students appreciate its interdisciplinary nature.

Unit- I
Vector Spaces: Vector Spaces and Subspaces - Null Spaces, Column Spaces, and Linear Transformations - Linearly Independent Sets; Bases - Coordinate Systems - The Dimension of a Vector Space

Unit- II
Rank-Change of Basis - Eigenvalues and Eigenvectors - The Characteristic Equation

Unit- III
Diagonalization - Eigenvectors and Linear Transformations - Complex Eigenvalues - Applications to Differential Equations.

Unit- IV

Text:
• David C Lay, Linear Algebra and its Applications 4e

References:
• S Lang, Introduction to Linear Algebra
• Gilbert Strang, Linear Algebra and its Applications
• Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence; Linear Algebra
• Kuldeep Singh; Linear Algebra
• Sheldon Axler; Linear Algebra Done Right
1.6 **Numerical Analysis**  
(w.e.f. academic year 2021-22)

Theory: 5 credits and Tutorials: 0 credits  
Theory: 5 hours /week and Tutorials: 1 hours /week

**Objective:** Students will be made to understand some methods of numerical analysis.  
**Outcome:** Students realize the importance of the subject in solving some problems of algebra and calculus.

**Unit- I**  

**Unit- II**  
**Interpolation and Polynomial Approximation:** Interpolation - Finite Differences - Differences of Polynomials - Newton’s formula for Interpolation - Gauss’s central differences formulae - Stirling’s and Bessel’s formula - Lagrange’s Interpolation Polynomial - Divided Differences - Newton’s General Interpolation formula - Inverse Interpolation.

**Unit- III**  
**Curve Fitting:** Least Square Curve Fitting: Fitting a Straight Line-Nonlinear Curve Fitting.  

**Unit- IV**  
**Numerical Solutions of Ordinary Differential Equations:** Taylor’s Series Method - Picard’s Method - Euler’s Methods - Runge Kutta Methods.

**Text:**  

**References:**  
- B.Bradie, *A Friendly introduction to Numerical Analysis*
1.7 Integral Transforms
(w.e.f. academic year 2021-22)

DSE - 1F/B  BS:601/B

Theory: 5 credits and Tutorials: 0 credits
Theory: 5 hours /week and Tutorials: 1 hours /week

Objective: Students 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: Students apply their knowledge to solve some problems on special functions and Differential Equations by using the Integral Transforms.

Unit- I
Laplace Transforms-Definition-Existence theorem-Laplace transforms of derivatives and integrals – Periodic functions and some special functions.

Unit- II
Inverse Transformations - Convolution theorem - Heaviside’s expansion formula.

Unit- III
Applications to ordinary differential equations - solutions of simultaneous ordinary differential equations - Applications to Partial differential equations.

Unit- IV
Fourier Transforms- Sine and cosine transforms-Inverse Fourier Transforms.

Text:

• Vasishtha and Gupta, *Integral Transforms, Krishna Prakashan Media(P), Ltd,Meerut* (2e)
1.8 Analytical Solid Geometry
(w.e.f. academic year 2021-22)

DSE - 1F/C

Theory: 5 credits and Tutorials: 0 credits
Theory: 5 hours /week and Tutorials: 1 hours /week

Objective: Students learn to describe some of the surfaces by using analytical geometry.
Outcome: Students understand the beautiful interplay between algebra and geometry.

Unit- I
Sphere: Definition-The Sphere Through Four Given Points-Equations of a Circle- Intersection of a Sphere and a Line-Equation of a Tangent Plane-Angle of Intersection of Two Spheres-Radical Plane.

Unit- II
Cones and Cylinders: Definition-Condition that the General Equation of second degree Represents a Cone-Cone and a Plane through its Vertex -Intersection of a Line with a Cone.

Unit- III
The Right Circular Cone-The Cylinder- The Right Circular Cylinder.

Unit- IV

Text:
• Shanti Narayan and P K Mittal, Analytical Solid Geometry (17e)

References:
• Khaleel Ahmed, Analytical Solid Geometry
• S L Loney, Solid Geometry
• Smith and Minton, Calculus
1.9  **Theory of Equations**  
(w.e.f. academic year 2020-21)

**SEC-I**

Theory: 2 credits
Theory: 2 hours /week

**Objective:** Students learn the relation between roots and coefficients of a polynomial equation, Descartes’s rule of signs in finding the number of positive and negative roots if any of a polynomial equation besides some other concepts.

**Outcome:** By using the concepts learnt the students are expected to solve some of the polynomial equations.

**Unit- I**

Graphic representation of a polynomial-Maxima and minima values of polynomials-Theorems relating to the real roots of equations-Existence of a root in the general equation -Imaginary roots-Theorem determining the number of roots of an equation-Equal roots-Imaginary roots enter equations in pairs-Descartes’ rule of signs for positive roots- Descartes’ rule of signs for negative roots.

**Unit- II**

Relations between the roots and coefficients-Theorem-Applications of the theorem-Depression of an equation when a relation exists between two of its roots-The cube roots of unity Symmetric functions of the roots-examples.

**Text:**

- W.S. Burnside and A.W. Panton,*The Theory of Equations*

**References:**

- C. C. Mac Duffee, *Theory of Equations*
- Hall and Knight, *Higher Algebra*
SEMESTER-III

1.10  Logic and Sets
(w.e.f. academic year 2020-21)

SEC - II

Theory: 4 credits and Tutorials: 0 credits
Theory: 4 hours /week and Tutorials: 1 hours /week

Objective: Students learn some concepts in set theory and logic.
Outcome: After the completion of the course students appreciate its importance in the development of computer science.

Unit- I
Basic Connectives and truth tables - Logical equivalence : Laws of Logic - Logical Implication : Rules Inference : The Use of Quantifiers - Quantifiers, Definitions, and proofs of Theorems.

Unit- II

Text:

• Ralph P Grimaldi, *Discrete and Combinatorial Mathematics* (5e)

References:

• P R Halmos, *Na`ive Set Theory*
• E Kamke , *Theory of Sets*
1.11 Number Theory
(w.e.f. academic year 2020-21)

SEC-III

Theory: 2 credits
Theory: 2 hours /week

Objective: Students will be exposed to some of the jewels like Fermat's theorem, Euler's theorem in the number theory.
Outcome: Student uses the knowledge acquired solving some divisor problems.

Unit- I
The Goldbach conjecture - Basic properties of congruences- Binary and Decimal Representation of Integers - Number Theoretic Functions; The Sum and Number of divisors- The Mobius Inversion Formula- The Greatest integer function.

Unit- II
Euler’s generalization of Fermat’s Theorem: Euler’s Phi function- Euler’s theorem Some Properties of the Euler’s Phi function.

Text:

- David M Burton, *Elementary Number Theory (7e)*

References:

- Thomas Koshy, *Elementary Number Theory and its Applications*
- Kenneth H Rosen, *Elementary Number Theory*
SEMESTER-IV

1.12 Vector Calculus
(w.e.f. academic year 2020-21)

SEC-IV

Theory: 2 credits
Theory: 2 hours /week

Objective: Concepts like gradient, divergence, curl and their physical relevance will be taught.
Outcome: Students realize the way vector calculus is used to addresses some of the problems of physics.

Unit-I
Line Integrals: Introductory Example - Work done against a Force-Evaluation of Line Integrals
Conservative Vector Fields.

Unit-II
Volume Integrals: Evaluation of Volume integrals
Gradient, Divergence and Curl: Partial differentiation and Taylor series-Partial differentiation
Taylor series in more than one variable-Gradient of a scalar field-Gradients, conservative fields and potentials-Physical applications of the gradient.

Text:
• P.C. Matthews, Vector Calculus

References:
• G.B. Thomas and R.L. Finney, Calculus
• H. Anton, I. Bivens and S. Davis; Calculus
• Smith and Minton, Calculus

———