# NEP: UGCF 2022

# B.Sc. (Hons.) Mathematics

# *Syllabi* and *Books* for Discipline-Specific Core Courses

# Semester-II

Syllabi (Source File):
**13032023_65_Math_SC.pdf**

(From Page 1)

( The books are hosted on **GitHub** and **Drive** )

Depending on the features of the cited PDF file, either the PDF viewer or the Browser may be invoked.

## DSC-IV
## LINEAR ALGEBRA

**Unit-I** **Matrices and System of Linear Equations**

♦ Fundamental operations with vectors in Euclidean space $\mathbb{R}^n$ ♦ Linear combinations of vectors ♦ Dot product and their properties ♦ Cauchy−Schwarz inequality ♦ Triangle inequality ♦ Solving linear systems using Gaussian elimination ♦ Gauss−Jordan row reduction ♦ Reduced row echelon form ♦ Equivalent systems ♦ Rank and row space ♦ Eigenvalues ♦ Eigenvectors ♦ Eigenspace ♦ Diagonalization ♦ Characteristic polynomial of a matrix ♦ Cayley−Hamilton theorem

**Unit-II** **Introduction to Vector Spaces**

♦ Vector spaces ♦ Subspaces ♦ Algebra of subspaces ♦ Linear combination of vectors ♦ Linear span ♦ Linear independence ♦ Bases and dimension ♦ Dimension of subspaces

**Unit-III** **Linear Transformations**

♦ Linear transformations ♦ Null space ♦ Range ♦ Rank and nullity of a linear transformation ♦ Matrix representation of a linear transformation ♦ Algebra of linear transformations ♦ Invertibility and isomorphisms ♦ Application: Computer Graphics - Fundamental movements in a plane, homogenous coordinates, composition of movements

### Essential Readings


1. Andrilli, S. & Hecker, D. (2016) - Elementary Linear Algebra (5th Edition) - Elsevier India
   **View/Download** (10.1 MB)

2. Friedberg, Stephen H., Insel, Arnold J. & Spence, Lawrence E. (2003) - Linear Algebra (4th Edition) - Prentice-Hall of India Pvt. Ltd., New Delhi
   **View/Download** (3.55 MB)

## Suggestive Readings

- Lay, David C., Lay, Steven R. & McDonald, Judi J. (2016) - Linear Algebra and its Applications (5th Edition) - Pearson Education
  **View/Download** (29.2 MB)
- Kolman, Bernard & Hill, David R. (2001) - Introductory Linear Algebra with Applications (7th Edition) - Pearson Education, Delhi (First Indian Reprint 2003)
  Not Available
- Hoffman, Kenneth, & Kunze, Ray Alden (1978) - Linear Algebra (2nd Edition) - Prentice Hall of India Pvt. Limited, Delhi - Pearson Education (Indian Reprint 2015)
  [1971] **View/Download** (8.57 MB)

# DSC-V
# CALCULUS

**Unit-I** **Limits and Continuity**

♦ Limits of functions ($\varepsilon - \delta$ and sequential approach) ♦ Algebra of limits ♦ Squeeze theorem ♦ One-sided limits ♦ Infinite limits and limits at infinity ♦ Continuous functions and its properties on closed and bounded intervals ♦ Uniform continuity

**Unit-II** **Differentiability and Mean Value Theorems**

♦ Differentiability of a real-valued function ♦ Algebra of differentiable functions ♦ Chain rule ♦ Relative extrema ♦ Interior extremum theorem ♦ Rolle's theorem ♦ Mean-value theorem and its applications ♦ Intermediate value theorem for derivatives

**Unit-III** **Successive Differentiation, Taylor's Theorem and Tracing of Plane Curves**

♦ Higher order derivatives and calculation of the $n^{\text{th}}$ derivative ♦ Leibnitz's theorem ♦ Taylor's theorem ♦ Taylor's series expansions of $e^x$, $\sin x$, $\cos x$ ♦ Indeterminate forms ♦ L'Hôpital's rule ♦ Concavity and inflexion points ♦ Singular points ♦ Asymptotes ♦ Tracing graphs of rational functions and polar equations

## Essential Readings

1. Anton, Howard, Bivens, Irl & Davis, Stephen (2013) - Calculus (10th Edition) - John Wiley & Sons Singapore Pvt. Ltd. Reprint (2016) by Wiley India Pvt. Ltd. Delhi
   [2012] **View/Download** (22.8 MB)
2. Bartle, Robert G. & Sherbert, Donald R. (2011) - Introduction to Real Analysis (4th Edition) - John Wiley & Sons. Wiley India Edition (Reprint)
   **View/Download** (9.18 MB)
3. Prasad, Gorakh (2016) - Differential Calculus (19th Edition) - Pothishala Pvt. Ltd., Allahabad
   **View/Download** (82 MB)
4. Ross, Kenneth A. (2013) - Elementary Analysis: The Theory of Calculus (2nd Edition) - Undergraduate Texts in Mathematics, Springer (Indian Reprint)
   **View/Download** (3.28 MB)

## Suggestive Readings

- Apostol, T. M. (2007) - Calculus: One-Variable Calculus with an Introduction to Linear Algebra (2nd Edition) Vol. 1. - Wiley India Pvt. Ltd.
  [1967, P.C.*] **View/Download** (48.4 MB)

*Partially Corrupted

- Ghorpade, Sudhir R. & Limaye, B. V. (2006) - A Course in Calculus and Real Analysis - Undergraduate Texts in Mathematics, Springer (SIE) (Indian reprint)
**View/Download** (4.46 MB)

# DSC-VI
# ORDINARY DIFFERENTIAL EQUATIONS

**Unit-I** **First-Order Differential Equations**

♦ Concept of implicit, general and singular solutions for the first order ordinary differential equation
♦ Bernoulli's equation ♦ Exact equations ♦ Integrating factors ♦ Initial value problems
♦ Reducible second order differential equations ♦ Applications of first order differential equations to Newton's law of cooling, exponential growth and decay problems

**Unit-II** **Second and Higher-Order Differential Equations**

♦ General solution of homogenous equation of second order
♦ Principle of superposition for a homogenous equation ♦ Wronskian and its properties
♦ Linear homogeneous and non-homogeneous equations of higher order with constant coefficients
♦ Method of variation of parameters ♦ Method of undetermined coefficients
♦ Two-point boundary value problems ♦ Cauchy−Euler's equation
♦ System of linear differential equations ♦ Application of second order differential equation: Simple pendulum problem

**Unit-III** **Formulation and Analysis of Mathematical Models**

♦ Introduction to compartmental models ♦ Lake pollution model
♦ Density-dependent growth model ♦ Interacting population models
♦ Epidemic model of influenza and its analysis ♦ Predator-prey model and its analysis
♦ Equilibrium points ♦ Interpretation of phase plane

## Practical

Practical/Lab work to be performed in a computer Lab:

Modeling of the following problems using SageMath/Mathematica/MATLAB/Maple/Maxima/Scilab etc.

1) Solutions of first, second and third order differential equations.
2) Plotting of family of solutions of differential equations of first, second and third order.
3) Solution of differential equations using method of variation of parameters.
4) Growth and decay model (exponential case only).
5) Lake pollution model (with constant/seasonal flow and pollution concentration).
6) Density-dependent growth model.
7) Predatory-prey model (basic Volterra model, with density dependence, effect of DDT, two prey one predator).
8) Epidemic model of influenza (basic epidemic model, contagious for life, disease with carriers).

### Essential Readings

1. Barnes, Belinda & Fulford, Glenn R. (2015) - Mathematical Modelling with Case Studies, Using Maple and MATLAB (3rd Edition) - CRC Press. Taylor & Francis Group
**View/Download** (4.33 MB)

2. Edwards, C. Henry, Penney, David E. & Calvis, David T. (2015) - Differential Equations and Boundary Value Problems: Computing and Modelling (5th Edition) - Pearson Education
**View/Download** (9.02 MB)

3. Ross, Shepley L. (2014) - Differential Equations (3rd Edition) - Wiley India Pvt. Ltd.
[1984] **View/Download** (43.3 MB)

## Suggestive Readings

- Simmons, George F. (2017) - Differential Equations with Applications and Historical Notes (3rd Edition) - CRC Press - Taylor & Francis Group
**View/Download** (3.77 MB)