# B.Sc. (Mathematics) Syllabus

## (Three Years Programme)

# School of Applied Sciences

## Centurion University of Technology & Management

# 2024-25

# Course Structure
## (Core Courses)

| Sl.No | Code | Subject Name | Cerdit | Course Type (Th+Pr+Pj) |
|---|---|---|---|---|
| 1 | CUTM1511 | Calculus | 6 | 3+1 +2 |
| 2 | CUTM1512 | Linear Algebra | 6 | 3+1 +2 |
| 3 | CUTM1513 | Analysis-I | 6 | 3+0 +3 |
| 4 | CUTM1514 | Ordinary Differential Equations | 6 | 3+ 2+1 |
| 5 | CUTM1515 | Analysis-II | 6 | 3+0 +3 |
| 6 | CUTM1516 | Modern Algebra | 6 | 3+0 +3 |
| 7 | CUTM1517 | Partial Differential Equations and System of Ordinary Differential Equation | 6 | 3+2 +1 |
| 8 | CUTM1518 | Numerical Analysis | 6 | 3+ 2+1 |
| 9 | CUTM1519 | Advanced Analysis | 6 | 3+ 0+3 |
| 10 | CUTM1520 | Complex Analysis | 6 | 3+ 1+2 |
| 11 | CUTM1521 | Integral Transformations | 6 | 3+1 +2 |
| 12 | CUTM1522 | Discrete Mathematical Structure | 6 | 3+1 +2 |
| 13 | CUTM1523 | Linear Programming | 6 | 3+2 +1 |
| 14 | CUTM1524 | Probability and Statistics | 6 | 3+1 +2 |
| | | Total | 84 | |

# Course outline

## CUTM1511 CALCULUS

| Subject Name | Code | Type of course | T-P-Pj (Credit) | Prerequisite |
|---|---|---|---|---|
| **CALCULUS** | **CUTM1511** | **Theory + Practice + Project** | **3-1-2** | **Nil** |

### Objective

- To study how things change. It provides a framework for modeling systems in which there is change, and a way to deduce the predictions of such models.
- To construct a relatively simple quantitative models of change, and to deduce their consequences.
- To obtain area bounded by closed curves and volume of solid of revolution.

### Course outcome:

After completion of the course, students will be able to

| COs | Course outcomes |
|---|---|
| CO1 | understand the importance of curvature, asymptotes an curve tracing. |
| CO2 | trace different types of curves in Cartesian and polar forms. |
| CO3 | use the concept of integration for finding the area bounded by closed curves and volume of solid of revolution. |
| CO4 | solve the major problems of differential and integral calculus. |
| CO5 | distinguish between gradient, divergence and curl. |

**Course Outcome to Program Outcome Mapping:**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| CO1 | 3.00 | 2.0 | | 1.0 | 2.0 | | | | | | | 3.0 | 3.0 | 3.0 | 2.0 |
| CO2 | 3.00 | 1.0 | | 3.0 | 1.0 | | 2.0 | | | | | 3.0 | 3.0 | 2.0 | 2.0 |
| CO3 | 3.00 | 2.0 | | 2.0 | 2.0 | | 2.0 | | | | | 2.0 | 2.0 | 1.0 | 1.0 |
| CO4 | 3.00 | | | 2.0 | | | 2.0 | | | | | 2.0 | 1.0 | 2.0 | 2.0 |
| CO5 | 2.00 | 1.0 | | 3.0 | 2.0 | | 1.0 | | | | | 3.0 | 2.0 | 2.0 | 3.0 |

**\*High-3, Medium-2, Low-1**

# Course Outline

**MODULE – I: Curvature (3hr+0hr+4hr)**

Curvature, circle of curvature and radius of curvature, Radius of curvature in Cartesian and polar form.

**Project 1:** To find radius of curvature (Intrinsic and Parametric form)

**Project 2:** To find radius of curvature (Pedal form)

**Module-II: Asymptotes(3hr+0hr+2hr)**

Asymptotes and determination of asymptotes, Asymptotes parallel to coordinate axis, Rules to find asymptotes.

**Project 3:** To find asymptotes of different curves in implicit form

**Module-III: Curve Tracing(4hr+6hr+6hr)**

Curve Tracing, Tracing of Cartesian, parametric and polar curves.

**Project 4:** To trace some Cartesian curves (Folium of Descartes, Astroid) **Project 5:** To trace some polar curves (Cardioid, Lemniscate of Bernaulli) **Project 6:** To trace few more curves (Cartenary, Cycloid etc) and Loops

**Practice 1:** Plotting the graphs of the functions $e^{ax+b}$, log $(ax + b)$, $1/(ax + b)$, sin $(ax + b)$, cos $(ax+ b)$, $|ax +b|$ and to illustrate the effect of a and b on the graph

**Practice 2:** Plotting the graphs of the polynomial of degree 4 and 5, the derivative graph, the second derivative graph and comparing them

**Practice 3:** Sketching parametric curves (e.g. Trochoid, cycloid, epicycloids, hypocycloid)

**Module-IV: Reduction Formula(4hr+0hr+4hr)**

Reduction formula, Reduction formula involving sine and cosine function sin ^nx cos ^nx, Reduction formula for integrals with limits from 0 to pi/2, Reduction formula for integral of sin^px, Cos^qx and also with limits from 0 to Pi/2.

**Project 7:** To find the Reduction formula for integrals of tan^nx, Cot ^nx, sec^nx, cosec^nx

**Project 8:** To find the Reduction formula for integral of sin^pxcos^qx for different values of p and q and different cases

**Module-V: Rectification and Quadrature(6hr+0hr+2hr)**

Rectification of curves, finding arc length for polar curves, area of plane regions for Cartesian, parametric and polar curves, Sectorial area.

**Project 9:** To find the Area bounded by closed curves

**Module-VI: Volume of Solid Body Revolution(3hr+6hr+0hr)**

Volume of solid of revolution, Volume of solid of revolution about any axis, Pappus theorem for volume of revolution.

**Practice 4:** Tracing of conics in Cartesian coordinates/polar coordinates

**Practice 5:** Sketching ellipsoid, hyperboloid of one and two sheets,

**Practice 6:** Sketching elliptic cone, elliptic paraboloid, hyperbolic paraboloid using Cartesian coordinates

**Module-VII: Vector Differential Calculus(7hr+0hr+6hr)**

Introduction to vector calculus: Definitions and characteristics of vectors, algebraic operations, Directional derivatives and directional derivatives along any line, Gradient of scalar point function, Divergence and curl of vector point functions, Second order differential operator the Laplacian operator and its properties.

**Project 10:** To explain about vector, different types of vector and vector algebra with suitable example

**Project 11:** To explain the geometrical significance of Gradient of scalar point function with some examples

**Project 12:** To discuss Laplacian operator and its different properties

**Text Books:**
1. A Text book of Calculus Part – II : Shanti Narayan Chapters: 8 (Art. 24, 25), 10 (Art. 33, 34, 35, 36, 37, 38).
2. A Text book of Calculus Part-III : Shanti Narayan

Chapters: 1 (Art. 1, 2, 3), 3(Art 7, 8, 9), 4(Art 10, 11, 12) omitting Simpson's rule), 5(Arts 13, 14), 6(Arts 15, 16).

3. A Textbook of Vector Calculus by Shanti Narayan & P. K. Mittal, S. Chand & Co., 2003
   Chapters: 1, 6.

**Reference Books:**

1. J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education). Delhi, 2007.

2. Anton, I. Bivens and S. Davis, Calculus, 7th Ed., John Wiley and Sons (Asia) P. Ltd., Singapore, 2002.

3. B. Thomas and R. L. Finney. Calculus, 9th Ed., Pearson Education, Delhi, 2005

4. Courant and F. John Introduction to Calculus and Analysis (Volumes I & II). Springer- Verlag. New York. Inc., 1989

# Course outline

## CUTM1512 LINEAR ALGEBRA

| Subject Name | Code | Type of course | T-P-Pj | Prerequisite |
|---|---|---|---|---|
| **LINEAR ALGEBRA** | **CUTM 1512** | **Theory, Practice & Project** | **3-1-2** | **NIL** |

**Objective**

- To introduce the basic ideas and techniques of linear algebra for use in many other lecture courses.
- To Solve systems of linear equations using various methods including Gaussian and Gauss Jordan elimination and inverse matrices.
- To Prove basic results in linear algebra using appropriate proof-writing techniques such as linear independence of vectors; properties of subspaces; linearity, injectivity and surjectivity of functions; and properties of eigenvectors and eigenvalues.

**Course outcome:**

After completion of the course, students will be able to

| COs | Course outcomes |
|---|---|
| CO1 | Explain the terms related to vector space. |
| CO2 | Describe Linear transformation<br>Evaluate determinants and use them to discriminate between invertible and non-invertible matrices. |
| CO3 | Solve systems of linear equations using multiple methods, including Gaussian elimination and matrix inversion. Carry out matrix operations, including inverses and determinants. |
| CO4 | Judge the existence of solution of systems of euation |
| CO5 | Demonstrate understanding of linear independence, span, and basis. |

**Course Outcome to Program Outcome Mapping:**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| **CO1** | 3.00 | 2.0 | 1.0 | 3 | | | | | | 1.0 | | 2.0 | 3.0 | 2.0 | 1.0 |
| **CO2** | 2.00 | | 2.0 | 2.0 | 2.0 | | 2.0 | 1.0 | | 3.0 | | 2.0 | 2.0 | 1.0 | 3.0 |
| **CO3** | 3.00 | | 3.0 | 3.0 | | | 3.0 | 1.0 | | 3.0 | | 3.0 | 1.0 | 3.0 | 2.0 |
| **CO4** | 1.00 | 1.0 | 1.0 | 2.0 | 3.0 | | 2.0 | 1.0 | | 1.0 | | 3.0 | 3.0 | 2.0 | 1.0 |
| **CO5** | 2.00 | | 2.0 | 3.0 | 2.0 | | 2.0 | 1.0 | | 2.0 | | 2.0 | 2.0 | 2.0 | 1.0 |

**\*High-3, Medium-2, Low-1**

## Course outline

### Module I

Vector spaces, definition and examples, Subspace, Span of a set.

Project-1: Preparation of detail report on Vector space, Subspace.

Project-2: To show that span of a subset of a vector space is a Vector space.

### Module II

Linear dependence and independence, Dimension and basis

Project-3: Preparation of detail report on dependency of vectors.

Project-4: Finding dimension and basis of a vector Space.

### Module III

Linear transformation, definition and examples, Range and kernel, Rank and nullity, The space L(U,V )

Project-5: To find out Range and Kernel of different Linear Transformations.

Project-6: Establishment of R(T) and N(T) are sub spaces of V and U respectively in the linear map T : U-->V

### Module IV

Composition of Linear maps, Matrix and linear map, linear operations, matrix multiplication.

Project-7: To show that L(U,V) is a vector space

Project-8: Establish the condition of non-singularity of Linear Map.

**Module V**

Rank and nullity of matrix, Transpose of a matrix, Elementary row operations

Project-9: Preparation of working rule for finding rank of a matrix with example.

Project-10: To find the matrix associated with Linear Maps

Practice 1: Introduction to MATLAB. Matrix addition and multiplication

Practice 2: Matrix Transpose, Matrix Inversion

**Module VI**

Systems of linear equations, Matrix inversion, Determinants, minors**,** Rank of a matrix Project-11: Finding rank of a matrix by Determinant Method

Practice 3: Finding Rank of a Matrix

Practice 4: Solution of AX=B using Gauss Elimination method.

**Module VII**

Product of determinants,Application to linear equations,Eigen value and Eigen vector

Project-12: Finding the eigen value and eigen vector of a 3x3 matrix having repeated root in it's characteristic equation.

Practice 5: Solution of AX=B using, Gauss Seidal and Gauss-Jacobi method

Practice 6: Finding Eigen Values and Eigen vectors of Matrix


**Text Book:**

An Introduction to Linear Algebra by V. Krishnamurty, V.P.Mainra, J.L.Arora, Affiliated East-West press Pvt.Ltd.

Chapters: 3,4 (4.1 to 4.7), 5,6 (6.5 to 6.8)

**Reference Books**:

Basic Structures in Algebra, Part-I: J.N. Patnaik

Matrix Theory and Linear Algebra: I.N. Herstein and D.J. Winter (Ma Chilan Publishing company)

First course in Linear algebra: Bhattacharya, Jain and Nagpaul (New Age International)

Centurion
UNIVERSITY

# Course outline

## CUTM1513 ANALYSIS-I

| Subject Name | Code | Type of course | T-P-Pj (Credit) | Prerequisite |
|---|---|---|---|---|
| **ANALYSIS-I** | **CUTM1513** | **Theory+Project** | **3-0-3** | **Nil** |

**Objective:**

- To introduce the background information in differentiation, integration, measure, limits, infinite series, and analytic functions, primarily in the context of real and complex number systems.
- To demonstrate competence with properties of real numbers by finding supremum and infimum of sets and using the completeness property of real numbers.
- To apply the Taylor Theorem, the Mean Value Theorem, and use Hospital's Rule to compute limits of functions.

**Course outcome:**

After completion of the course, students will be able to:

| COs | Course outcomes |
|---|---|
| CO1 | Describe the real line as a complete, ordered field, Use the definitions of convergence as they apply to sequences, series, and functions. |
| CO2 | Determine the continuity, differentiability, and integrability of functions defined on subsets of the real line, produce rigorous proofs of results that arise in the context of real analysis. |
| CO3 | Demonstrate ability to think critically by interpreting theorems and relating results to problems in mathematical Analysis. |
| CO4 | Apply the Mean Value Theorem and the Fundamental Theorem of Calculus to problems in the context of real analysis |
| CO5 | Analyze illustrate the effect of uniform convergence on the limit function with respect to continuity, differentiability, and integrability. |

**Course Outcome to Program Outcome Mapping:**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| CO1 | 2.00 |     | 2.0 | 2   |     |     | 3.0 |     |     |      |      | 3.0  | 2.0  | 3.0  | 1.0  |
| CO2 | 2.00 | 2.0 | 1.0 | 1.0 | 1.0 |     | 3.0 |     |     |      |      | 3.0  | 1.0  | 3.0  | 2.0  |
| CO3 | 3.00 |     |     | 2.0 |     |     | 2.0 |     |     |      |      | 2.0  | 2.0  | 1.0  | 3.0  |
| CO4 | 2.00 | 2.0 | 2.0 | 2.0 |     |     | 3   |     |     |      |      | 3.0  | 1.0  | 2.0  | 2.0  |
| CO5 | 2.00 | 1.0 |     | 2.0 |     |     | 1.0 |     |     |      |      | 3.0  | 2.0  | 2.0  | 2.0  |

**\*High-3, Medium-2, Low-1**

# Course Outline

**Module-I (5 hr+0 hr+4 hr)**

Field Structure and Order Structure; Bounded and unbounded Sets, Supremum, Infimum; Completeness in the Set of Real numbers; Archimedean Property of Real numbers; Inequalities and Metric property of R

Project 1: A study on completeness property of R and its application.

Project 2: A Report on Some Inequalities of Real Numbers.

**Module-II (5 hr+0 hr+6 hr)**

Neighborhood of a point, Interior point of a set, Open Sets; Some Important Theorems on open Sets; Limit point of a Set, Closed Sets, Closure of a Set, Dense Set; Some Useful Theorems on Open Set and Closed Sets; Blozano-weirstrass theorem for Sets.

Project 3: A study on some Useful Theorems on Limit point of a Sets.

Project 4: A Study on some Useful Theorems on Open Set and Closed Sets.

Project 5: A study on the Blozano-weirstrass theorem for Sets.

**Module-III (6 hr+0 hr+6 hr)**

Real Sequences and Theorems on Convergence of Sequence; Limit point a Sequence and Bolzano-Weierstrass theorem for Sequences; Convergent and Non-Convergent Sequences; Cauchy's general Principle of Convergence and Cauchy Sequence; Some Important theorems on Real Sequences; Monotonic Sequences and Sub sequences.

Project 6: A Report on Cauchy's general Principle of Convergence and Cauchy Sequence.

Project 7: A Report on Convergent and Non-Convergent Sequences.

Project 8: A study on Some Important Theorems of Real Sequences.

**Module-IV (5 hr+0 hr+6 hr)**

Infinite Series and Some Preliminary Theorems; Positive term Series and Condition for Convergence; Geometric Series and Comparison Series for Convergence of Infinite Series; Comparison Tests for Positive Term Series; Cauchy's Root test and D' Alembert's Ratio Test.

Project 9: A study on Some useful theorems of Infinite Series.

Project 10: A report on Comparison Test for Positive Term Series.

Project 11: A Report on Cauchy's Root test and D' Alembert's Ratio Test.

**Module-V (3 hr+0 hr+4 hr)**

Alternating Series and Leibnitz Test; Absolute and Conditional Convergence; Solving problems on Absolute and Conditional Convergence.

Project 12: A Report on Alternating Series and Leibnitz Test.

Project 13: A Report on Absolute and Conditional Convergence.

**Module-VI (4 hr+0 hr+4 hr)**

Limit and Continuity of Functions; Discontinuities and Types of Discontinuity; Uniform continuity and related Theorems; Differentiability of Real functions.

Project 14: A Report on Finding Limit and continuity of Functions.

Project 15: A Report on Differentiability of Real functions.

**Module-VII (4 hr+0 hr+6 hr)**

The Derivative and Higher Order Differentiation's; Darboux's Theorem and Roll's Theorem; Lagrange's Mean value theorems and Cauchy's Mean value Theorem; Taylor's Theorem with Reminder.

Project 16: A Report on Darboux's Theorem and Roll's Theorem.

Project 17: A Report on Lagrange's Mean value theorems and Cauchy's Mean value Theorem.

Project 18 : A study on Taylor's Theorem with Remainder and its Importance.

**Text Book**:

1. Mathematical Analysis (Wiley Eastern) : S.C. Malik and S.Arora (4 th Edition)

   Chapters: 1 (except 4.3 and 4.4), 2, 3, 4 (upto Art.5 and Art 10.1, 10.2), 5, 6,

**Reference Books**:

1. Fundamental of Mathematical Analysis: G. Das & S. Pattanayak

2. Fundamentals of Real Analysis: S.L.Gupta & Nisha Rani

3. Mathematical Analysis-II: Sharma &Vasistha

# Course outline

## CUTM1514 ORDINARY DIFFERENTIAL EQUATIONS

| Subject Name | Code | Type of course | T-P-Pj (Credit) | Prerequisite |
|---|---|---|---|---|
| ORDINARY DIFFERENTIAL EQUATIONS | CUTM1514 | T + P+Pj | 3-2-1 | Nil |

## Objective

- To introduce basic concepts of ordinary differential equations
- To understand most of the physical phenomena from Science and Engineering which are modeled by differential equations
- To develop the ability to apply differential equations to significant applied and/or theoretical problems.

## Course outcome:

After completion of the course, students will be able to:

| COs | Course outcomes |
|---|---|
| CO1 | explain fundamental concepts of ODE |
| CO2 | solve linear/non-linear $1^{st}$ & higher order ODEs using analytical methods to obtain their exact solutions. |
| CO3 | execute Python programming for solving Second order differential equation |
| CO4 | use power series to solve $2^{nd}$ order differential equations. |
| CO5 | compare different types of methods of solving differential equations |

## Course Outcome to Program Outcome Mapping:

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3.00 | | 2.0 | 3 | 2.0 | | 3.0 | 1.0 | | | | 2.0 | 2.0 | 3.0 | 1.0 |
| CO2 | 3.00 | | 2.0 | 2.0 | 2.0 | | 3.0 | 1.0 | | | | 3.0 | 3.0 | 1.0 | 2.0 |
| CO3 | 2.00 | 2.0 | 2.0 | 2.0 | 2.0 | | 3.0 | 2.0 | | | | 3.0 | 2.0 | 3.0 | 3.0 |
| CO4 | 3.00 | | 2.0 | 2.0 | 2.0 | | 2.0 | 1.0 | | | | 2.0 | 3.0 | 2.0 | 3.0 |
| CO5 | 2.00 | 1.0 | 1.0 | 2.0 | 2.0 | | 1.0 | 2.0 | | | | 2.0 | 2.0 | 2.0 | 2.0 |

**\*High-3, Medium-2, Low-1**

# Course Outline

**Module-I      ( T-5 hrs-P-4 hrs-P-2 hrs )**

Introduction to ordinary differential equations, First order and first degree differential equation, Variable separation method, Homogeneous differential equation, Non-homogeneous equation of first degree.

**Practice-1** : Solving One dimensional heat flow equations using Python

**Practice-2** : Solving Predator-Prey Equations using Python

**Project-1** : Study on different types of first order and first degree ordinary differential equations used in mathematical models

**Module-II      ( T-6 hrs-P-4 hrs-P-2 hrs )**

Exact differential equations, Non-exact differential equations, Integrating factors. **Practice-3** : Solving Growth model (exponential case only) using Python **Practice-4** : Solving Decay model (exponential case only) using Python

**Project-2** : Study of Non-exact differential equations and their solutions

**Module-III      ( T-4 hrs-P-4 hrs-P-2 hrs )**

Linear equation, Bernoulli's equation, Introduction to Second and Higher order Linear Homogeneous and Non-homogeneous equations with constant and variable coefficients.

**Practice-5** : Solving Oxygen debt model using Python

**Practice-6** : Solving Mixing Concentrations problems using Python

**Project -3** : Applications of first order differential equations to Decay models

**Module-IV      ( T-4 hrs-P-4 hrs-P-0 hrs )**

Complimentary function and Particular integral, Finding particular integrals for the differential equations containing the Exponential functions, Trigonometric functions (Sine and Cosine) using inverse operator method.

**Practice-7** : Solving Escape velocity Problem using Python

**Practice-8** : Solving Free Damped Motion of a Spring System using Python

**Module-V      ( T-4 hrs-P-4 hrs-P-2 hrs )**

Finding particular integrals for the differential equations containing Power functions, Product of exponential function with other functions, Functions in the form xV(x) using inverse operator method, Solving second order linear equations using variation of parameters method.

**Practice-9** : Solving Free Undamped Motion of a Spring System using Python

**Practice-10** : Solving RL circuit problems using Python

**Project -4** : Study on Variation of parameter method for solving second order differential equations

**Module-VI      ( T-4 hrs-P-2 hrs-P-2 hrs )**

Solving second order linear equations using Method Of Undetermined Coefficients, Linear equations reducible to constant coefficient form, Euler-Cauchy equation, Legendre's equation.

**Practice-11** : Euler Method for solving Second order differential equation using Python

**Practice-12** : Solving Forced Vibration of a Spring System using Python

**Project -5** : Study on Method Of Undetermined Coefficients for solving second order differential equations

**Module-VII      ( T-3 hrs-P-0 hrs-P-2 hrs )**

Power series solution, Power series solutions of second order differential equations.

**Project -6** : Study on Power series solutions

**Text Book:**

1. Sinha Roy and S. Padhy, A Course of Ordinary and Partial Differential Equations, Kalyani Publishers, New Delhi.

   Chapters: 1, 2(2.1 to 2.7), 4(4.1 to 4.8), 7(7.1 to 7.3)

**Reference Books**:

1. Differential Equations and their Applications: Martin Braun, Springer International.

2. Advanced Differential Equations: M. D. Raisinghania, S. Chand & Company Ltd., New Delhi.

3. A First Course in differential Equations with Modeling Applications: G. Dennis Zill, Cengage Learning India Pvt. Ltd.

4. Text Book of Differential Equations : N.M. Kapoor

5. Introductory course in Differential Equations : D.A. Murray

6. Differential Equations: S. L. Ross, John Wiley & Sons, India, 2004.

# Course outline

## CUTM-1515 ANALYSIS-II

| Subject Name | Code | Type of course | T-P-Pr (Credit) | Prerequisite |
|---|---|---|---|---|
| ANALYSIS-II | CUTM-1515 | Theory+Project | 3-0-3 | Nil |

### Objective:

- To introduce the concept of Improper Integrals and Different Test strategies for Convergence and Absolute Convergence for Finite Range Integrals.
- To describe various theorems about Riemann sums and Riemann integrals and emphasize the proofs' development.
- To apply the definite integral, double integral and triple integral in finding Area, Volume and Centre of gravity of different objects.

### Course outcome:

After completion of the course, students will be able to:

| COs | Course outcomes |
|---|---|
| CO1 | Define Integrability of continuous, Piecewise Continuous and Monotone Functions. |
| CO2 | Be competent in solving Improper Integrals, Double integration and triple integrals over different region. |
| CO3 | Demonstrate ability to think critically by interpreting theorems and relating results to problems in mathematical Analysis. |
| CO4 | Apply change of variables in double integrals and triple integrals. |
| CO5 | Analyze and evaluate the accuracy of common convergence methods. |

**Course Outcome to Program Outcome Mapping:**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| CO1 | 2.00 | | | 3 | 2.0 | | 1.0 | | | | | 3.0 | 2.0 | 2.0 | 3.0 |
| CO2 | 2.00 | | | 2.0 | 1.0 | | 2.0 | | | | | 1.0 | 1.0 | 1.0 | 2.0 |
| CO3 | 3.00 | 2.0 | | 1.0 | | | 1.0 | | | | | 2.0 | 3.0 | 3.0 | 2.0 |
| CO4 | 2.00 | | | 3.0 | | | 3.0 | | | | | 2.0 | 1.0 | 3.0 | 2.0 |
| CO5 | 3.00 | | | 2.0 | 1.0 | | 3.0 | | | | | 3.0 | 2.0 | 2.0 | 3.0 |

**\*High-3, Medium-2, Low-1**

# Course Outline

**Module-I**

Improper Integrals Definitions and Types; Convergence of Unbounded Functions with Finite Limit of Integration; Comparison Test For Convergence and Beta Function; General Test for Convergence and Absolute Convergence For Finite Range Integrals; Examining Convergence of Finite Range Integrals.

**Project 1:** A Report on Beta Function,its Properties and Application.

**Project 2:** A Report on Different types of Comparison Tests in Improper Integrals

**Project 3:** A Report on Convergence of Finite Range Integrals.

**Module-II**

Infinite Range Integrals and Convergence of Infinite Range of Integrals; Comparison Test For Convergence and Gamma Function; General Test for Convergence and Absolute Convergence For Infinite Range; Problems on Examining Convergence of Infinite Range Integrals.

**Project 4:** A Report on Gamma Function, its Properties and Application.

**Project 5:** A Report on Convergence of Infinite Range Integrals.

**Module-III**

Double Integrals Definition and Techniques of Evaluation; Double Integration Over a Rectangle; Condition Of Integrability and Some Theorems; Calculation Of Double Integral Over a Rectangle.

**Project 6:** A Report on Double Integrals with its Properties and Evaluation Techniques.

**Project 7:** A Report on Setting up Limits of Integration for Evaluating double Integrals

**Project 8:** A Report on Area calculated as A Double Integral and Finding Area of

Regions. **Module-IV**

Double Integral Over a Region(Closed Bounded Domain); Calculation Of Double Integral Over a Closed Domain; Calculation Of Double Integral by Changing the Order Of Integration; Change of Variable in Double Integrals; Computing Double Integrals by Change of variable Techniques.

**Project 9:** Test of Convergence of Improper Integral for Finite range of Integration

**Project 10:** Test of Convergence of Improper Integral for Infinite range of Integration

**Project 11:** A collection of Different Test Criteria for Convergence of Improper

Integrals

**Module-V**

Double Integrals in Polar Co-ordinates; Computing Double Integrals in Polar Co-ordinates ; Triple Integrals Concepts and Definitions ;Triple Integrals over a Parallelepiped; Calculation of a Triple integrals Over a Parallelepiped.

**Project 12:** A Report on Application of Double Integrals in Polar Co-ordinates.

**Project 13 :**A Reports on Triple Integrals and its Applications to Solve Problems.

**Project 14:** A Report on Some Important Theorems on Triple Integrals.

**Module-VI**

Triple Integral Over Regions(Bounded Domaines); Volume Of Solids by Triple Integrals; Calculation of a Triple Integrals Over any Region on R3.

**Project 15:** A Report on Solving Problems on Triple integrals over a Parallelepiped .

**Project 16:** A Study on Volume Calculated as A triple Integral and Calculating Volume Of Solids.

**Module-VII**

Triple Integrals in Cylindrical and Spherical Co-ordinates; Problems on Cylindrical and Spherical Co-ordinates; Change of variable in Triple integrals ; Computing Triple Integrals by Change of variable Techniques.

**Project 17:** A Report on Determining Limits of Integration for Cylindrical Co-ordinates in triple Integrals.

**Project 18:** A Report on Change of variable in Triple Integrals with the help of Jacobians.

**Text Book**:

1. S.C. Mallik& S. Arora,Mathematical Anyalysis, New Age Pub. House New Delhi.
   Chapters: 11, 17 (2.1 to 2.8, 3.1 to 3.4, 5.1 to 5.2), 18 (7.1 to 7.7)

**Reference Books**:

2. Calculus Early Transcendentals 10th Ed - Howard Anton, Iril Bivens & Stephen Davis
   John Wiley & Sons
     Chapter : 14 (Except 14.4 and 14.8).

3. Topics In Calculus By R.K Panda & P.K Satapathy, S.G Publication,Puri

# Course outline

## CUTM1516 MODERN ALGEBRA

| Subject Name | Code | Type of course | T-P-Pr (Credit) | Prerequisite |
|---|---|---|---|---|
| **MODERN ALGEBRA** | **CUTM1516** | **Theory+Project** | **3-0-3** | **Nil** |

### Objective

- To introduce students to the language and precision of modern algebra. This means that the course will be proof-based, in the sense that students will be expected to understand, construct, and write proofs.
- To balance the understanding with the communication of mathematical statement is true or false.
- To know how to construct a legitimate proof involves different skills and expertise than the discovery part of the process.

### Course outcome:

After completion of the course, students will be able to

| COs | Course outcomes |
|---|---|
| CO1 | explain about groups and subgroups. |
| CO2 | classify  subgroups of Cyclic group |
| CO3 | demonstrate ability to think critically by interpreting theorems on group theory |
| CO4 | differentiate among group homomorphism and isomorphism |
| CO5 | implement permutation groups and normal subgroups for solving problems |

**Course Outcome to Program Outcome Mapping:**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 1.00 | | | 2.0 | 2.0 | | 3 | | | | | 1.0 | 1.0 | 2.0 | 2.0 |
| **CO2** | 1.00 | 2.0 | | 2 | | | 2.0 | | | | | 2 | 3 | 1.0 | 2 |
| **CO3** | 1.00 | 1.0 | | 2 | | | 3 | | | | | 3.0 | 2 | 3.0 | 3.0 |
| **CO4** | | | | 3.0 | 1.0 | | 1.0 | | | | | 1.0 | 2.0 | 1.0 | 2.0 |
| **CO5** | | | | 1.0 | 1.0 | | 1.0 | | | | | 2.0 | 3.0 | 2.0 | 2.0 |

**\*High-3, Medium-2, Low-1**

# Course Outline

**Module-I**

Definition and examples of groups, Subgroups and examples of subgroups.

**Project-1** Collection of abelian groups using different properties.

**Project-2** Report on multiplication modulo and addition modulo groups.

**Project-3** Finding elements of $U_n(K)$

**Module-II**

Lagrange's Theorem and Consequences, Fermat's little theorem, Cyclic groups of Group G.

**Project-4** Finding order of a subgroup using Lagrange's Theorem

**Project-5** Uses of Fermat's little theorem

**Module-III**

Classification of Subgroups of Cyclic group, Cosets and Properties of Cosets

**Project-6** List of the elements of the groups $< n >$ in $Z_m$

**Project-7** Index of a subgroup H in G

**Module-IV**

Permutation Groups

**Project-8** A group model of $A_4$

**Project-9** Digit scheme based on $D_5$

**Project-10** Rotation of Tetrahedron

**Module-V**

Application of cosets to permutation groups, Normal subgroups

**Project-11** Collections of application of cosets to different groups

**Project-12** Application to public key cryptography

**Project-13** Reports on Stabilizer point and Orbit point

**Module-VI**

Quotient groups, Group Homomorphism, Properties of Homomorphism

**Project-14** Reports on Quotient groups

**Project-15** Properties of Homomorphism with examples.

**Project-16** Collection on examples of group Homomorphism.

**Module-VII**

Isomorphism: Definition and examples, Cayleys Theorem

**Project-17** First, second and third Isomorphism theorems

**Project-18** Uses of Cayleys Theorem

**Text Book:**
1. Joseph A. Gallian, Contemporary Abstract Algebra (4th Edn.), Narosa Publishing House, New Delhi.
   Chapters: I, II, III, IV, V, VI VII, IX

**Reference Books:**
1. University Algebra – N.S. Gopalkrishna (Wiley Eastern)
2. Modern Algebra – Vatsa and Vatsa (New Age International)
3. Topics in algebra - I. N. Herstein (Vikas Pub. House)

# CUTM1517 PARTIAL DIFFERENTIAL EQUATIONS AND SYSTEM OF ORDINARY DIFFERENTIAL EQUATIONS

| Subject Name | Code | Type of course | T-P-PJ (Credit) | Prerequisite |
|---|---|---|---|---|
| **PARTIAL DIFFERENTIAL EQUATIONS AND SYSTEM OF ORDINARY DIFFERENTIAL EQUATIONS** | **CUTM1517** | **Theory + Practice + Project** | **3-2-1** | **Nil** |

**Objective:**

- To understand the concept of partial differential equations.
- To familiarize the different types of Partial differential equations and solve the questions.
- To obtain the solutions of one dimension heat equation, wave equations and their applications.

**Course outcome:**

After completion of the course, students will be able to

| COs | Course outcomes |
|---|---|
| CO1 | understand the importance of Partial Differential Equations. |
| CO2 | analyze PDE techniques to predict the behavior of the equation and to differentiate Linear and nonlinear PDE. |
| CO3 | apply the concept of 2nd order PDE and their applications. |
| CO4 | use specific methodologies, techniques and resources to deal with real problems |
| CO5 | extract information from partial derivative models in order to interpret reality. |

**Course Outcome to Program Outcome Mapping:**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3.00 | | 2.0 | 1 | 2.0 | | 2.0 | 1.0 | | | | 2.0 | 3.0 | 3.0 | 2.0 |
| **CO2** | 3.00 | 1.0 | 2.0 | 2.0 | 3.0 | | 2.0 | 1.0 | | | | 2 | 2 | 1.0 | 2.0 |
| **CO3** | 2.00 | | 2.0 | 1 | | | 1.0 | 1.0 | | | | 2.0 | 2.0 | 2.0 | 1.0 |
| **CO4** | 2.00 | 2.0 | 1.0 | 1.0 | 2.0 | | 2.0 | 1.0 | | | | 2.0 | 2.0 | 2.0 | 2.0 |
| **CO5** | 3.00 | 2.0 | 1.0 | 1.0 | 3.0 | | 3.0 | 1.0 | | | | 3.0 | 1.0 | 2.0 | 1.0 |

**\*High-3, Medium-2, Low-1**

# Course Outline

**Module-I**

Linear Homogeneous and Non-homogeneous system of Differential Equations with constant coefficients.

**Practice-1**

To find the general solution of linear homogeneoussystem of differential equations by using Matlab.

**Practice-2**

To find the general solution of linear non-homogeneoussystem of differential equations by using Matlab.

**Project -1**

To make a report of an application of linear system of differential equation

**Module-II**(4h+4h+2h)

Simultaneous linear first order differential equations in three variables, Pfaffian differential equations, Methods of Solutions of Pfaffian differential equations in three variables.

**Practice-3**

To find the solution ofsimultaneous linear first order differential equations by using Matlab.

**Practice-4**

To find the Solutions of system of differential equations in three Variables by using Matlab.

**Project-2**

Tomake a report on simultaneous Linear Differential Equations.

**Module-III**(4h+4h)

Introduction to first order partial differential equations, formation of first order partial differential equations, linear Partial differential equations.

**Practice-5**

To find the solution of first order partial differential equations by using Matlab

**Practice-6**

To find the solution of first order Quasi-linear partial differential equations by using Matlab

**Module-IV**(5 h+4h+2h)

Non-linear partial differential equations, Special types of first-order equations, Charpit Equation, solutions of partial differential equations of first order satisfying given initial conditions.

**Practice-7**

To find the solution of 1-d Wave equation by using Matlab

**Practice-8**

To find the solution of 1-d Heat equation by using Matlab

**Project-3**

Summary of Special types of partial Differential Equations**.**

**Module-V**(4h+2h+2h)

First order homogeneous PDE with constant coefficients, higher order homogeneous PDE with constant coefficients.

**Practice-9**

To find the solution of first order homogeneous partial differential equations by using Matlab

**Project-4**

Briefly describe Homogeneous Partial differential Equations with suitable examples.

**Module-VI**(6h+2h+2h)

Higher order linear Non-homogeneous PDE with constant coefficients, general Solution of PDE by using inverse operators.

**Practice-10**

To find the solution of 2-d Wave equation by using Matlab

**Project-5**

Make a report onNon-homogeneous Partial differential Equations with constant coefficients.

**Module-VII**(3h+4h+2h)

Solution of homogeneous and non-homogeneous PDE with variable coefficients,

**Practice-11**

To find the solution of 2-d heat equation by using Matlab

**Practice-12**

To find the solution of 2-d Laplace equation by using Matlab

**Project-6**

Summary of Non-homogeneous Partial differential Equations with variable coefficients.

**Text Book:**
1. J. Sinha Roy and S.Padhy, A course on ordinary and partial differential equation, KalyaniPublisers, New Delhi, Ludhiana,2012

**Reference Books:**
1. LoknathSahoo, Calculus and ordinary differential equations, Kalyani Publication, Reprint-2017
2. TynMyint-U and LokenathDebnath, Linear Partial differential Equations for Scientists and Engineers, 4thEdition, Springer, Indian reprint, 2006
3. S.L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, India, 2004

## CUTM1518 NUMERICAL ANALYSIS

| Subject Name | Code | Type of course | T-P-PJ (Credit) | Prerequisite |
|---|---|---|---|---|
| **NUMERICAL ANALYSIS** | **CUTM1518** | **Theory + Practice** | **3-2-1** | **Nil** |

**Objective**

- To understand the limitations of analytical methods and the need for numerical methods and the ability to apply these numerical methods to obtain the approximate solutions to engineering and mathematical problems.
- To develop ability to decide derive appropriate numerical methods for approximating the solutions of various types of problems in engineering and science and analyze the error incumbent in any such numerical approximation.
- To enhance ability to report analysis, solution and results in a standard engineering format.

**Course outcome**

After completion of the course, students will be able to

| Cos | Course outcomes |
|---|---|
| CO1 | perform error analysis to select an appropriate numerical model and to estimate errors in numerical solution of a given problem. |
| CO2 | derive a variety of numerical algorithms/methods & compare the viability of different approaches to the numerical solutions of various mathematical problems arising in roots of linear and non-linear equations, interpolation and approximation, numerical differentiation and integration, system of linear algebraic equations and differential equations. |
| CO3 | provide different case study of numerical methods for solving the non-linear equations, interpolation, differentiation and integration |
| CO4 | improve the student's skills in numerical methods by using the numerical analysis software and computer facilities. |
| CO5 | analyze and evaluate the accuracy of common numerical methods. |

**Course Outcome to Program Outcome Mapping:**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2.00 | | 2.0 | 2 | 3.0 | | 1.0 | 1.0 | | | | 3.0 | 2.0 | 2.0 | 2.0 |
| **CO2** | 2.00 | 2.0 | 3.0 | 2.0 | 3.0 | | 2.0 | 2.0 | | | | 1.0 | 3.0 | 1.0 | 2.0 |
| **CO3** | 2.00 | 2.0 | 2.0 | 2.0 | 3.0 | | 1.0 | 2.0 | | | | 3.0 | 1.0 | 3.0 | 3.0 |
| **CO4** | | 1.0 | 3.0 | 1.0 | 2.0 | | 2.0 | 2.0 | | | | 3.0 | 2.0 | 2.0 | 3.0 |
| **CO5** | | | 2.0 | 2.0 | 2.0 | | 3.0 | 2.0 | | | | 2.0 | 2.0 | 3.0 | 2.0 |

**\*High-3, Medium-2, Low-1**

# Course Outline

### Module – I (5hr+6hr+0hr)

Introduction to Numerical Analysis, Concept of Number system: Binary numbers, octal numbers, hexa-decimal numbers. Floating point Arithmetic, K – digit Arithmetic, Dealing with Errors: Relative, absolute, roundoff, truncation.

Practice 1: Calculate the sum 1+1/2+1/3+1/4+ --------------+1/N. using python

Practice 2: To find the absolute value of an integer using python

Practice 3: Enter 100 integers into an array and sort them in an ascending order using python

### Module – II (7hr+8hr+4hr)

Numerical Solution of non-linear equations: method of bisection, Regula-falsi method, Secant method, Newton-Rapshon method, fixed point iteration method.

Practice 4: To find the approximate value of a polynomial using Bisection method.

Practice 5: To find the approximate value of a polynomial using Newton Rapshon method

Practice 6: To find the approximate value of a polynomial using Secant method

Practice 7: To find the approximate value of a polynomial using Regula Falsi method

Project 1: Numerical Methods for Solving Systems of Nonlinear Equations

Project 2: A Study on Transcendental and Polynomial equations.

**Module – III (3hr+2hr+2hr)**

Polynomial Interpolation, Existence and uniqueness of interpolating polynomials, Lagrange's interpolating polynomial.

Practice 8: To find the value of a function using Lagrange interpolation

Project 3: A study on Lagrange interpolation

**Module – IV (4hr+2hr+4hr)**

Newtons Divided Difference Interpolating Polynomial, Forward and backward Difference operators. Newton's Forward and backward Difference Interpolation formula

Practice 9: Solving problems on Newton forward/backward difference formula using python

Project 4: A study on Newton's Divided Difference Interpolation Formula

Project 5: A study to apply Newton forward difference/backward formula on solving numerical problems with MATLAB program

**Module – V ( 5hr+4hr+0hr)**

Numerical Integration, Newton-cotes rule, Trapezoidal Rule, Simpsons 1/3 rd rule, Simpsons 3/8 th rule.

Practice 10: Solving a problem on trapezoidal rule using python

Practice 11: Solving a problem on Simpson's 1/3 rd rule using python

**Module – VI (2hr+0hr+0hr)**

Compound Quadrature rules, Gauss-Legendre Rules,

**Module – VII (4hr+2hr+2hr)**

Numerical solution of Differential Equation, Euler's method, Runge-Kutta 4$^{th}$ order method

Practice 12: Solving Problems on 4th order Runge-Kutta method using python

Project 6: A Study on Runge-Kutta method

**Text Book:**

1. A Course on Numerical Analysis : B. P. Acharya & R. N. Das, Kalyani Publisher Chapters: 1, 2 (2.1 – 2.4, 2.6, 2.8, 2.9), 3 (3.1 to 3.4, 3.6 to 3.8). 6 (6.1- 6.3, 6.5, 6.10, 6.11), 7 (7.1, 7.2, 7.3, 7.4 & 7.7)

**Reference Books**:

1. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods For Scientific And Engineering Computation, 6th Ed., New Age International Publisher, India, 2007.

2. John H. Mathews and Kurtis D. Fink, Numerical Methods Using MatLab, 4th Ed., Phi Learning Private Limited, 2012.

# Course outline

## CUTM1519 ADVANCED ANALYSIS

| Subject Name | Code | Type of course | T-P-Pj (Credit) | Prerequisite |
|---|---|---|---|---|
| ADVANCEDANALYSIS | CUTM1519 | Theory | 3-0-3 | Nil |

### Objective

- To introduce the basic metric concepts, including convergence, completeness, compactness, and separability.

- To demonstrate the proofs of important theorems – including the Weierstrass, Peano, and Banach fixed-point theorems – and will learn to apply these results.

- To apply these concepts to key classes of spaces, including Rn, lp and Lp and learn to analyze mappings between spaces.

### Course outcome:

After completion of the course, students will be able to:

| COs | Course outcomes |
|---|---|
| CO1 | understand the Euclidean distance function on $R^n$ and appreciate its properties. |
| CO2 | explain the definition of continuity for functions from $R^n$ to $R^m$ and determine whether a given function from $R^n$ to $R^m$ is continuous. |
| CO3 | explain the geometric meaning of each of the metric space properties and be able to verify whether a given distance function is a metric. |
| CO4 | define convergence for sequences in a metric space and determine whether a given sequence in a metric space converges. |
| CO5 | distinguish between open and closed balls in a metric space and be able to determine them for given metric spaces. |

**Course Outcome to Program Outcome Mapping:**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| **CO1** | 3.00 | 2.0 | | 1.0 | | | 1.0 | 1.0 | | | | 3.0 | 1.0 | | 2.0 |
| **CO2** | 2.00 | | | 2.0 | 1.0 | | 3.0 | | | | | 1.0 | 1.0 | 2.0 | 2.0 |
| **CO3** | 2.00 | 1.0 | | 1.0 | | | 1.0 | | | | | 3.0 | 2.0 | 2.0 | 3.0 |
| **CO4** | 2.00 | | | 3.0 | 2.0 | | 3.0 | | | | | 2.0 | 2.0 | 1.0 | 2.0 |
| **CO5** | 1.00 | | | 3.0 | | | 2.0 | | | | | 3.0 | 2.0 | 2.0 | 2.0 |

**\*High-3, Medium-2, Low-1**

# Course Outline

**MODULE – I (5hr+0hr+6hr)**

Metric Spaces: Definition and examples, open and closed spheres.

Project-1: Write a report on applications of metric spaces.

Project-2: Show that the class denote a set of all bounded sequence of real numbers is a metric space.

Project-3: Show that the class of all sequences is a metric space.

**MODULE – II (3hr+0hr+4hr)**

Neighbourhoods, Interior points. Open set

Project-4: Write a report on limit points and their applications.

Project-5(Flip class): Prove theorems on Neighbourhoods, Interior points

**MODULE – III (5hr+0hr+6hr)**

Closed set, boundary points, limit points and isolated points, closure of a set, dense sets.

Project-6: Write a report on difference between open set closed set and limit point , interior point with appropriate examples.

Project-7: Write the difference between boundary points, limit points and isolated points explain through examples.

Project-8 (Flip class): Prove theorems on closed set and dense sets.


**MODULE – IV (4hr+0hr+6hr)**

Separable metric spaces, sequences in metric space, convergent sequences, Cauchy sequences Project-9: Write a report on applications of convergent sequences and Cauchy sequences.

Project-10: Every convergent sequence is bounded. Is the reverse true? Justify your answer with suitable example.

Project-11(Flip class): Prove theorems on convergent sequences and Cauchy sequences.

## MODULE – V (4hr+0hr+4hr)

Complete metric space, subspace, Cantor's theorem. Continuous functions,

Project- 12(Flip class): Prove theorems on Complete metric space, subspace.

Project-13(Flip class): Prove that addition, subtraction, multiplication and division (with condition) of continuous functions are continuous

## MODULE – VI (4hr+0hr+6hr)

Uniform continuity, Connectedness, connected subsets of separated sets.

Project-14(Flip class): Prove theorems on Uniform continuity and Connectedness.

Project- 15: Write the difference between continuity and uniform continuity and explain through a proper example..

Project-16 (Flip class): Prove theorems on connected subsets of separated sets.

## MODULE – VII (5hr+0hr+4hr)

Disconnected sets, contraction mappings, Banach fixed point theorem.

Project- 17(Flip class): Geometrical interpretation of connected and disconnected sets.

Project-18: Write some applications of Banach fixed point theorem.

## BOOK PRESCRIBED

1. K. Jain and K. Ahmad, Metric Spaces, Narosa Publishing House, New Delhi.

   Chapters :2 (2.1-2.4, 2.6-2.9), 3(3.1-3.4), 4(4.1-4.3), 6(6.1,6.2), 7(7.1)

2. Methods of Real analysis - R.G. Goldberg.

   Chapters: 4(4.2,and 4.3), 5,and 6 (up to 6.8)

**BOOKS FOR REFERENCE**

1. S.C. Malik and S. Arora – Mathematical Analysis (New Age International)

2. Principles of Mathematical Analysis – Walter Rudin, III Edition, McGRAW-Hill Book Co.

Centurion
UNIVERSITY

## CUTM1520 COMPLEX ANALYSIS

| Subject Name | Code | Type of course | T-P-Pj (Credit) | Prerequisite |
|---|---|---|---|---|
| **COMPLEX ANALYSIS** | **CUTM1520** | **Theory** | **3-1-2** | **Nil** |

### Objective

- To introduce complex analysis.
- To demonstrate different theorems on complex analysis.
- To acquire skill of evaluating contour integrals using Cauchy's integral formula and Cauchy's integral theorem.

### Course outcome

After completion of the course, students will be able to:

| COs | Course outcomes |
|---|---|
| CO1 | explain basic concepts of complex analysis. |
| CO2 | describe the fundamental concepts of functions of a complex variable along with the concepts of analyticity. |
| CO3 | solve different types of complex integrals using Cauchy's integral theorem |
| CO4 | examine the region of convergence using Taylor and Maclaurin series |
| CO5 | demonstrate conformal mapping and bilinear transformation |

**Course Outcome to Program Outcome Mapping:**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3.00 | 2.0 | | 1.0 | | | 1.0 | | | | | 3.0 | 2.0 | 2.0 | 3.0 |
| **CO2** | | 2.0 | | 2.0 | 1.0 | | 3.0 | | | | | 1.0 | 1.0 | 1.0 | 3.0 |
| **CO3** | | 1.0 | | 1.0 | | | 1.0 | | | | | 3.0 | 3.0 | 2.0 | 3.0 |
| **CO4** | | | | 2.0 | 2.0 | | 2.0 | | | | | 2.0 | 3.0 | 3.0 | 2.0 |
| **CO5** | 3.00 | | | | | | 2.0 | | | | | 3.0 | 3.0 | 3.0 | 2.0 |

**\*High-3, Medium-2, Low-1**

# Course Outline

**Module I** **( T-5 hrs-P-4 hrs-P-2 hrs )**

Complex numbers, Algebra of complex numbers, Modulus and argument, Roots of a complex number.

**Practice-1** : Plotting complex numbers in Matlab
**Practice-2** : Finding the modulus and argument of a complex number using Matlab
**Project-1** : Finding roots of different complex numbers

**Module II** **( T-3 hrs-P-2 hrs-P-2hrs )**

Functions of a complex variable, Limit and continuity, Differentiation, Cauchy-Riemann equations.

**Practice-3** : Plotting complex functions using Matlab

**Project-2** : Verifying Cauchy-Riemann equations for complex functions in cartesian form and polar form

**Module III** **( T-4 hrs-P-0 hrs-P-2 hrs )**

Analytic functions, Laplace equation, Harmonic and Conjugate harmonic functions, Method of finding out conjugate harmonic functions and the corresponding analytic function, Entire functions.

**Project-3** : Finding conjugate harmonics of different harmonic functions and the corresponding analytic functions

**Module IV** **( T-4 hrs-P-2 hrs-P-4 hrs )**

Complex exponential functions, Logarithmic functions, Trigonomertric functions, Hyperbolic functions.

**Practice-4** : Generate and plot Complex Exponential Signal Graph in Matlab

**Project-4** : Study on Complex Exponential and Logarithmic functions

**Project-5** : Studying properties of Complex trigonometric and hyperbolic functions

**Module V** **( T-3 hrs-P-2 hrs-P-4 hrs )**

Definite integrals of complex functions, Contours, Evaluation of Contour integrals using Cauchy's Integral Theorem.

**Practice-5** : Integrating complex functions using Matlab

**Project-6** : Evaluation of different types of Contour integrals using Cauchy's Integral Theorem

**Module VI** ( **T-6 hrs-P-2 hrs-P-6 hrs** )

Cauchy's Integral Formula for complex functions and their derivatives, Convergence of sequences and series, Taylor series, Maclaurin series.

**Practice-6** : Finding out the Taylor series expansion of a function using Matlab

**Project-7** : Evaluation of different types of Contour integrals using Cauchy's Integral Formula

**Project-8** : Study on Radius of convergence of a Power series

**Project-9** : Taylor series expansion of different complex functions

**Project-10** : Maclaurin series expansion of different complex functions

**Module VII** ( **T-5 hrs-P-0 hrs-P-4 hrs** )

Conformal mapping, Bilinear Transformation, Fixed points, Cross ratio.

**Project-11** : Study on Bilinear Transformations

**Project-12** : Study on Conformal mappings

**Text Book**:

1. James Ward Brown and Ruel V. Churchill, Complex Variables And Applications, 8th Ed., Mc-Graw Hill International Edition, 2014.

   Chapters: 1, 2(12, 13, 15 to 26), 3(29, 30, 34, 35), 4(37 to 41, 50 to 52), 5(55, 56, 57), 8(93, 94), 9(101).

**Reference Book**:

2. Complex Analysis – L. V. Ahlfors, Mc-Graw Hill International Editions (Vikas Publications – Second Edition)

# CUTM1521 INTEGRAL TRANSFORMS

| Subject Name | Code | Type of course | T-P-Pj (Credit) | Prerequisite |
|---|---|---|---|---|
| **INTEGRAL TRANSFORMS** | **CUTM1521** | **T+P+Pj** | **3-1-2** | **Nil** |

**Objective**

- To describe the ideas of Fourier and Laplace Transforms and indicate their applications in the fields such as application of PDE.
- To use Fourier series for solving boundary value problems appearing in scientific and engineering problems.
- To apply the concept of integral transform in the area of network analysis, theory of wave equations, Differential Equations and many others.

**Course outcome**

After completion of the course, students will be able to

| COs | Course outcomes |
|---|---|
| CO1 | define the concept of Laplace transform and Fourier Transform. |
| CO2 | understand the Properties of Laplace and Fourier Transform |
| CO3 | analyze the existing conditions for inverse Laplace Transform |
| CO4 | solve differential and integral equations with initial conditions using Laplace transform. |
| CO5 | learn the application of integral transform by using MATLAB programming. |

**Course Outcome to Program Outcome Mapping:**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3.00 | 2.0 | 2.0 | 1.0 | | | 1.0 | | | | | 3.0 | 2.0 | 3.0 | 3.0 |
| **CO2** | 2.00 | | 2.0 | 2.0 | 1.0 | | 2.0 | | | | | 1.0 | 2.0 | 1.0 | 2.0 |
| **CO3** | 3.00 | 1.0 | 2.0 | 2.0 | | | 3.0 | | | | | 3.0 | 3.0 | 3.0 | 2.0 |
| **CO4** | 3.00 | 2.0 | 2.0 | 2.0 | 2.0 | | 3.0 | | | | | 2.0 | 2.0 | 3.0 | 1.0 |
| **CO5** | 1.00 | | 2.0 | 2.0 | 2.0 | | 3.0 | | | | | 3.0 | 2.0 | 3.0 | 3.0 |

**\*High-3, Medium-2, Low-1**

# Course Outline

**Module-I(T-4 h + Pr-2 h+ Pj-4 h)**

Introduction to Integral Transforms, Laplace Transforms, and Properties of Laplace transforms, unit step function, second shifting theorem.

**Practice-1**
Laplace Transform and Inverse Laplace Transform Using Matlab.

**Project-1**
Make a short draft of properties of Laplace transform from memory. Then compare your notes with the text and write a report of 2-3 pages on these operations and their significance in applications.

**Project-2**

Find the Laplace transform of the following functions.

**Module-II(T-4 h + Pj-4 h)**

Unit impulse function, Laplace transforms of Derivatives and Integrals, Derivatives and Integrals of Transforms.

**Project-3**

Find the inverse Laplace transform of Derivative and integral properties.

**Project-4**

Find the Laplace transform of unit impulse function and unit step function.

**Module-III(T-4 h + Pr-2 h+ Pj-4 h)**

Evaluation of integrals, convolutiontheorem, inverse Laplace transform.

**Practice-2**

To solve integral equations by using Matlab.

**Project-5**

Evaluation of integrals by using Laplace transform.

**Project-6**

Find the inverse Laplace transform by using convolution theorem.

**Module-IV(T-4 h + Pr-2 h+ Pj-4 h)**

Solution of differential equations, integral equations.

**Practice-3**

Find the solution of differential equations by Laplace Transform Using Matlab.

**Project-7**

Solve the differential equation by using Laplace transform.

**Project-8**

Solve the integral equation by using Laplace transform.

**Module-V(T-4 h + Pr-2 h+ Pj-4 h)**

Periodic function, Fourierseries, Fourier series expansion of an arbitrary period, even and odd functions, half Range Expansions of a Fourier series.

**Practice-4**

Find the Fourier series expansion of a periodic function by using Matlab.

**Project-9**

Find the Fourier series expansion of a 2-pi periodic function.

**Project-10**

Find the Half range expansion of Fourier cosine and sine series.

**Module-VI(T-4 h + Pr-2 h+ Pj-2 h)**

Complex form of Fourier series, Fourier Integrals, Different forms of Fourier Integral Theorem.

**Practice-5**

Find the Fourier Series Coefficients by using Matlab.

**Project-11**

Find the Fourier sine and cosine integral of the following functions.

**Module-VII(T-4 h + Pr-2 h+ Pj-2 h)**

Fourier Transforms, Infinite Fourier Transforms, Finite Fourier transform, Properties Fourier Transform.

**Practice-6**

First Fourier transform by using Matlab.

**Project-12**

Make a short draft of properties of Fourier transform from memory. Then compare your notes with the text and write a report of 2-3 pages on these operations and their significance in applications.

**Text Book:**

M.D. Raisinghania, H.C. Saxena and H.K. Dass: Integral Transforms, S. Chand &amp; Company LTD.Chapters: 1(1.1-1.5,1.7 to 1.10,1.12) 2(2.2,2.4,2.5,2.6), 3(3.1 to 3.21), 4(4.1, 4.4, 4.5 to 4.13, 4.15 to 4.17), 5(5.1, 5.16), 6(6.1 to 6.3, 6.6 to 6.8, 6.11), 7(7.1 to 7.3).

**Reference Text Book:**

1. Higher Engineering Mathematics by B.V.Ramana.

2. An introduction to non-harmonic Fourier series,Author(s):Robert M. Young.

3. Advanced Engineering Mathematics by E.Kreyszig (10th edition).

## CUTM1522 DISCRETE MATHEMATICAL STRUCTURE

| Subject Name | Code | Type of course | T-P-Pj (Credit) | Prerequisite |
|---|---|---|---|---|
| **DISCRETE MATHEMATICAL STRUCTURE** | **CUTM1522** | **Theory** | **3-1-2** | **Nil** |

**Objective**

- To introduce the basic concepts of logic.
- To understand different types of relations.
- To work with different types of Sets, Lattices and Boolean Algebra.

**Course outcome:**

| COs | Course outcomes |
|---|---|
| CO1 | explain different types of logical connective. |
| CO2 | describe Universal Quantifiers and Existential Quantifiers |
| CO3 | classify different types of relations. |
| CO4 | solve recurrence relation using Generating functions |
| CO5 | demonstrate Lattices and Boolean Algebra. |

**Course Outcome to Program Outcome Mapping:**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3.00 | | 1.0 | 2 | | | 2.0 | | | | | 3.0 | 2.0 | 3.0 | 3.0 |
| **CO2** | 2.00 | | 2.0 | 2.0 | 1.0 | | 2.0 | | | | | 1.0 | 2.0 | 1.0 | 3.0 |
| **CO3** | 2.00 | 2.0 | 2.0 | 3.0 | 1.0 | | 3.0 | | | | | 3.0 | 3.0 | 2.0 | 1.0 |
| **CO4** | 1.00 | | 2.0 | 1.0 | | | 2.0 | | | | | 2.0 | 1.0 | 2.0 | 2.0 |
| **CO5** | 3.00 | 1.0 | 2.0 | 3.0 | | | 1.0 | | | | | 3.0 | 2.0 | 1.0 | 3.0 |

**\*High-3, Medium-2, Low-1**

# Course Outline

**Module-I    ( T-5 hrs-P-4 hrs-P-4 hrs )**

Introduction to Logic, Logical connectives, Converse, Inverse, Contrapositive, Proportional Equivalences, Propositional Calculus, Translating English sentences to Logical expressions.

**Practice-1** : Finding the truth values of compound propositions using Python

**Practice-2** : Writing conditional statements in Python

**Project-1** : Study on equivalent statements in Logic

**Project-2** : Study on Propositional Calculus

**Module-II ( T-5 hrs-P-0 hrs-P-4 hrs )**

Predicates, Quantifiers, Bound and free variables, Rules of inference, Derivation of Valid conclusion, Nested Quantifiers.

**Project-3** : Study on Universal Quantifiers and Existential Quantifiers

**Project-4** : Study on Valid arguments in Logic

**Module-III    ( T-4 hrs-P-0 hrs-P-4 hrs )**

Recurrence Relation and it's solution by using Generating function, Pigeon-Hole Principle.

**Project-5** : Study on different types of Recurrence relations

**Project-6** : Study on Pigeon-Hole Principle

**Module-IV    ( T-4 hrs-P-6 hrs-P-2 hrs)**

The basics of counting, Generalized Permutations, Combinations and their Applications.

**Practice-3** : Finding Factorial of a number using Python

**Practice-4** : Finding out the value of P(n,r) using Python

**Practice-5** : Finding out the value of C(n,r) using Python

**Project-7** : Study on permutations and combinations

**Module-V    ( T-4 hrs-P-2 hrs-P-2 hrs )**

Relations and their operations and properties, Equivalence relation, Representation of a relation, Closure of a relation.

**Practice-6** : Finding Composition of Relations using Python

**Project-8** : Study on different types of Relations

**Module-VI ( T-3 hrs-P-0 hrs-P-4 hrs)**

Partial order relation, Partially ordered set and totally ordered set, Hasse diagram, Maximal and minimal elements, Greatest and least elements, Supremum and infimum of a Poset.

**Project-9 :** Study on partially ordered sets and Totally ordered sets

**Project-10** : Study on Hasse Diagram

**Module-VII    ( T-5 hrs-P-0 hrs-P-4 hrs )**

Lattice and it's algebraic structure, Properties of a Lattice, De-Morgan's Law, Bounded and Distributive Lattices, Boolean Algebra, Boolean Function.

**Project-11** : Study on Lattices and Ordered Sets

**Project-12** : Study on Boolean Algebra

**Text Book:**

1.  Kenneth H. Rosen, Discrete Mathematics and Applications, Tata Mc-Graw Hill Publications,

Chapters: 1(1.1 To 1.5), 5(5.1, 5.2, 5.5), 6(6.1, 6.2, 6.4), 7, 10(10.1, 10.2).

**Reference Book**:

1. Discrete Mathematics with Graph Theory by Edgar G. Goodaire and Michael M. Parmenter

Centurion
UNIVERSITY

## Course Outline

## CUTM1523 LINEAR PROGRAMMING

| Subject Name | Code | Type of Course | T-P-Pj (Credit) | Prerequisite |
|---|---|---|---|---|
| **LINEAR PROGRAMMING** | **CUTM1523** | **T + P + Pj** | **3-2-1** | **Nil** |

### Course Objective

- To introduce a brief understanding about Linear Programming Problems.
- To cater the characteristics of Linear Programming Problems and its Applications.
- To demonstration of the utilization of Linear Programming Problems in industry and business.

### Course outcome:

After completion of the course, students will be able to

| COs | Course Outcomes |
|---|---|
| CO1 | explain the concept of extreme values of some real-world objective: the maximum (of profit, performance, or yield) or minimum (of loss, risk, or cost). |
| CO2 | solve the necessary and sufficient optimality conditions for linear programming and demonstrate the geometrical interpretation of these conditions. |
| CO3 | formulate new applications as optimal decision problems and seek appropriate solutions algorithms. |
| CO4 | use of duality theory to solve the real-life application problems by reducing the large number of constraints. |
| CO5 | examine various techniques to solve basic transportation and assignment problems. |

### Course Outcome to Program Outcome Mapping:

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3.00 | | 2.0 | 2 | | | 2.0 | 1.0 | | | | 3.0 | 2.0 | 2.0 | 3.0 |
| **CO2** | 2.00 | | 3.0 | 3.0 | 1.0 | | 2.0 | 2.0 | | | | 1.0 | 1.0 | 1.0 | 3.0 |
| **CO3** | 2.00 | 2.0 | 2.0 | 3.0 | | | 1.0 | 2.0 | | | | 2.0 | 3.0 | 3.0 | 3.0 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO4** | 3.00 | | 2.0 | 2.0 | 2.0 | | 3.0 | 2.0 | | | | 3.0 | 2.0 | 2.0 | 1.0 |
| **CO5** | 2.00 | 1.0 | | 2.0 | | | 1.0 | 2.0 | | | | 1.0 | 2.0 | 2.0 | 2.0 |

**\*High-3, Medium-2, Low-1**

## Course Outline

### CUTM1523 Linear Programming (3-2-1)

**Module I (5 Hours)**

Linear programming problems (LPP): Introduction to linear programming problems (LPP), Mathematical formulation of the linear programming problems with illustrations

**Practice 1: (2 Hours)**

Formulation of maximization type linear programming problem using excel solver

**Practice 2: (2 Hours)**

Formulation of minimization type linear programming problem using excel solver

**Assignment 1: (2 Hours)**

Formulation of Manufacturing/Production Problem to LPP

**Module II (4 Hours)**

Graphical method used for solving linear programming problem. Feasible region of LPP, unbounded solution to the LPP in graphical method, Canonical and standard form of LPP.

**Practice 3: (2 Hours)**

Solution of graphical method of LPP using excel solver

**Practice 4: (2 Hours)**

Solving manufacturing problem using excel solver

**Practice 5: (2 Hours)**

Solving diet problem using in excel solver

**Assignment 2: (2 Hours)**

Formulation of investment and diet problems to LPP and its graphical solution.

**Module III (5 Hours)**

Simplex Method: Basic and non basic variables, Theory of Simplex method, optimality and unboundlessness, Simplex algorithm, Simplex method in tableau format.

**Practice 6: (2 Hours)**

Solving Maximization problem using Simplex method in excel solver

**Practice 7: (2 Hours)**

Solving Minimization problem using Simplex method in excel solver

**Assignment 3: (2 Hours)**

Solution of linear programming problem using simplex method.

**Module IV: (5 Hours)**

Introduction to artificial variables, Two –phase simplex method, Big-M method, Degeneracy problem in simplex method

**Practice 8: (2 Hours)**

Solving linear-programming problem using Two Phase method in excel solver

**Practice 9: (2 Hours)**

Solving linear-programming problem using Big-M method in excel solver

**Assignment 4: (2 Hours)**

Solution of linear programming problem using penalty method.

**Module V: (4 Hours)**

Transportation Problem: Introduction to transportation problem, Initial basic feasible solution to transportation problem using North-West Corner, Least Cost Method and Vogel's approximation Method.

**Practice 10: (2 Hours)**

Solving Transportation problem using North West Corner method in excel solver

**Practice 11: (2 Hours)**

Solving Transportation problem using Least Cost method in excel solver

**Assignment 5:**

Initial basic feasible solution to transportation problem

**Module VI: (4 Hours)**

Optimal solution to transportation problem using MODI method, Unbalanced transportation problem, Degeneracy in transportation problem.

**Practice 12: (2 Hours)**

Solving Transportation problem using Vogel's Approximation method in excel solver

**Assignment 6: (2 Hours)**

Optimal solution to transportation problem using MODI method

**Module VII: ( 4 Hours)**

Assignment Problem: Introduction to assignment problem, Mathematical formulation of assignment problem, Solution to assignment problem using Hungarian method

**Assignment 7: (2 Hours)**

Solution to assignment problem using Hungarian method

**Text Books:**

Kanti Swarup, P.K. Gupta and Man Mohan-Operations Research, S. Chand and Co. Pvt.Ltd.

S. Kalavathy- Operations Research, Vikas Publishing House Pvt. Ltd.

**Reference Book**:
Mathematical Programming by N. S. Kambo, East West Press.

# Course Outline

## CUTM1524 PROBABILITY AND STATISTICS

| Code | Course Title | T-P-Pj (Credit) | Prerequisite |
|------|--------------|-----------------|--------------|
| CUTM1524 | PROBABILITY AND STATISTICS | 3-1-2 | NIL |

## Objective

- To understand the real-world problems into probability models.
- To recognize the role and application of probability theory in many different fields of science and engineering.
- To apply probability and statistics in engineering and science

## Course outcome

After completion of the course, students will be able to

| COs | Course outcomes |
|-----|-----------------|
| CO1 | explain the concepts of sample space, events and compute the probability of different events. |
| CO2 | describe discrete and continuous random variables. |
| CO3 | implement the concept of expectation, variance and covariance of random variables. |
| CO4 | solve problems related to correlation and regression. |
| CO5 | compare Binomial, Poisson and Normal distributions. |

## Course Outcome to Program Outcome Mapping:

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| CO1 | 3.00 | | 2.0 | 1 | | | 2.0 | 2.0 | | | | 3.0 | 3.0 | 3.0 | 3.0 |
| CO2 | 2.00 | 2.0 | 3.0 | 2.0 | 1.0 | | 1.0 | 2.0 | | | | 1.0 | 2.0 | 1.0 | 3.0 |
| CO3 | 2.00 | 1.0 | 3.0 | 1.0 | | | 2.0 | 2.0 | | | | 3.0 | 3.0 | 2.0 | 2.0 |
| CO4 | | | 2.0 | 1.0 | 3.0 | | 3.0 | 2.0 | | | | 3.0 | 1.0 | 2.0 | 2.0 |
| CO5 | | 1.0 | 2.0 | 1.0 | | | 2.0 | 2.0 | | | | 3.0 | 3.0 | 1.0 | 2.0 |

**\*High-3, Medium-2, Low-1**

## Course content

**Module I: (4 hrs+2 hrs+4hrs)**

Probability: Axiomatic definitions of probability, Sample Space, Probability axioms, Independent events, Mutually Exclusive Event, Equally Likely Events

**Practice-1(2 hrs)**

Bayes Theorem using MATLAB

**Project-1 (2hrs)**

Application of conditional probability analysis to the clinical diagnosis

**Project-2(2hrs)**

A Report on Bayes' Theorem and its Application in Different Fields


**Module II :(4 hrs+2 hrs+4hrs)**

Discrete random variables, Continuous random variables, Expectation of random variables, Variance and Standard Deviation

**Practice-2(2hrs)**

Probability Density Function using MATLAB

**Project-3(2hrs)**

A Report on Random Variables with Examples

**Project-4 (2hrs)**

A Report on Moment Generating Function of Distributions


**Module III:(6 hrs+4 hrs+4hrs)**

Binomial distribution, Poisson distribution, Poisson Distribution as the limiting case of Binomial Distribution

**Practice-3(2 hrs)**

Binomial distribution using MATLAB

**Practice-4(2 hrs)**

Poisson distribution - algorithm in Matlab

**Project-5(2hrs)**

Comparative study between Binomial distribution and Poisson distribution

**Project-6(2hrs)**

Report on Poisson distribution with their Business Applications in analyzing data sets

**Module IV:(4 hrs+2hrs+8hrs)**

Uniform distribution, Normal distributions, Normal approximation to the Binomial distributions

**Practice-5(2hrs)**

Gaussian distribution – how to plot it in Matlab

**Project -7(2hrs) Flip class**

A Report on Gamma, Exponential, Beta Distributions

**Project-8(2hrs)**

A Report on Central Limit Theorem (CLT) and its Applications in election polls

**Project-9(2hrs) Flip class**

A Report on Negative binomial Distribution

**Project-10(2hrs) Flip class**

A Report on Geometric distributions

**Module V:(4 hrs+0 hr+0 hr)**

Distribution of two random variables, Expectation of function of two random variables

**Module VI:(4 hrs)**

Conditional distributions and expectations.

**Module VII:(4 hrs+2 hrs+4hrs)**

Correlation coefficient, Co-variance independent random variables, linear regression of two variables

**Practice-6(2hrs)**

Covariance & Correlation Coefficient calculation in MATLAB

**Project-11 (2hrs) Flip Class**

A Report on Markov's inequality

**Project -12(2hrs) Flip Class**

A Report on Chebyshev's inequality

**Total Hrs=T(30hrs+P(12hrs)+Pj(24hrs)) Text Books:**

1.    Irwin Miller and Marylees Miller, John E. Freund, Mathematical Statistics with Applications, 7th Ed., Pearson Education, Asia, 2006.

2.    Sheldon Ross, Introduction to Probability Models, 9th Ed., Academic Press, Indian Reprint, 2007.

**Reference Books:**

1.    Statistical Methods By S.P. Gupta (31st Edition) ; Publisher: Sultan Chand & Sons

2.    Mathematical Statistics By S.C. Gupta & V.K. Kapur(10th Edition); Publisher: Sultan Chand & Sons.