

## **TEACHING PLAN for Academic Year 2021 – 2022**

**Course: B.Sc.(H) Mathematics**

**Paper: Multivariate Calculus**

**SEMESTER: III**

**SESSION: 2021– 2022 (Odd Semester)**

**TEACHER NAME: Meenakshi Gupta**

### **● SYLLABUS**

#### **Unit 1: Calculus of Functions of Several Variables**

Functions of several variables, Level curves and surfaces, Limits and continuity, Partial differentiation, Higher order partial derivative, Tangent planes, Total differential and differentiability, Chain rule, Directional derivatives, The gradient, Maximal and normal property of the gradient, Tangent planes and normal lines.

#### **Unit 2: Extrema of Functions of Two Variables and Properties of Vector Field**

Extrema of functions of two variables, Method of Lagrange multipliers, Constrained optimization problems; Definition of vector field, Divergence and curl.

#### **Unit 3: Double and Triple Integrals**

Double integration over rectangular and nonrectangular regions, Double integrals in polar coordinates, Triple integral over a parallelepiped and solid regions, Volume by triple integrals, Triple integration in cylindrical and spherical coordinates, Change of variables in double and triple integrals.

#### **Unit 4: Green's, Stokes' and Gauss Divergence Theorem**

Line integrals, Applications of line integrals: Mass and Work, Fundamental theorem for line integrals, Conservative vector fields, Green's theorem, Area as a line integral, Surface integrals, Stokes' theorem, Gauss divergence theorem.

### **LESSON PLAN 14 weeks (Approximately)**

**Week 1:** Definition of functions of several variables, Graphs of functions of two variables –

Level curves and surfaces, Limits and continuity of functions of two variables.

[1] Sections 11.1 and 11.2.

**Week 2:** Partial differentiation, and partial derivative as slope and rate, Higher order partial derivatives. Tangent planes, incremental approximation, Total differential.

[1] Chapter 11 (Sections 11.3 and 11.4).

**Week 3:** Differentiability, Chain rule for one parameter, Two and three independent parameters. [1] Chapter 11 (Sections 11.4 and 11.5).

**Week 4:** Directional derivatives, The gradient, Maximal and normal property of the gradient, Tangent and normal lines.

[1] Chapter 11 (Section 11.6).

**Week 5:** First and second partial derivative tests for relative extrema of functions of two variables, and absolute extrema of continuous functions.

[1] Chapter 11 [Section 11.7 (up to page 605)].

**Week 6:** Lagrange multipliers method for optimization problems with one constraint, Definition of vector field, Divergence and curl.

[1] Sections 11.8 (Pages 610-614)] and 13.1.

**Week 7:** Double integration over rectangular and nonrectangular regions. [1] Sections 12.1 and 12.2.

**Week 8:** Double integrals in polar co-ordinates, and triple integral over a parallelepiped. [1] Chapter 12 (Sections 12.3 and 12.4).

**Week 9:** Triple integral over solid regions, Volume by triple integrals, and triple integration in cylindrical coordinates.

[1] Chapter 12 (Sections 12.4 and 12.5).

**Week 10:** Triple integration in spherical coordinates, Change of variables in double and triple integrals.

[1] Chapter 12 (Sections 12.5 and 12.6).

**Week 11:** Line integrals and its properties, applications of line integrals: mass and work. [1] Chapter 13 (Section 13.2).

**Week 12:** Fundamental theorem for line integrals, Conservative vector fields and path independence. [1] Chapter 13 (Section 13.3).

**Week 13:** Green's theorem for simply connected region, Area as a line integral, Definition of surface integrals.

[1] Chapter 13 [Sections 13.4 (Pages 712 to 716), 13.5 (Pages 723 to 726)].

**Week 14:** Stokes' theorem and the divergence theorem.

[1] Chapter 13 [Sections 13.6 (Pages 733 to 737), 13.7 (Pages 742 to 745)].

## **ASSESSMENT**

**Internal Assessment: 25 Marks (Assignment and class test)**

## **Reference:**

1. Strauss, Monty J., Bradley, Gerald L., & Smith, Karl J. (2007). *Calculus* (3rd ed.). Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). Delhi. Indian Reprint 2011.

## **Additional Reading:**

- i. Marsden, J. E., Tromba, A., & Weinstein, A. (2004). *Basic Multivariable Calculus*. Springer (SIE). First Indian Reprint.

**Course: B.Sc.(H) Mathematics**

**Paper: SEC-1: LaTeX and HTML**

**SEMESTER: III**

**SESSION: 2021– 2022 (Odd Semester)**

**TEACHER NAME: Meenakshi Gupta**

## ● SYLLABUS

### **Unit 1: Getting Started with LaTeX**

Introduction to TeX and LaTeX, Typesetting a simple document, Adding basic information to a document, Environments, Footnotes, Sectioning and displayed material.

### **Unit 2: Mathematical Typesetting with LaTeX**

Accents and symbols, Mathematical typesetting (elementary and advanced): Subscript/Superscript, Fractions, Roots, Ellipsis, Mathematical Symbols, Arrays, Delimiters, Multiline formulas, Spacing and changing style in math mode.

### **Unit 3: Graphics and Beamer Presentation in LaTeX**

Graphics in LaTeX, Simple pictures using PSTricks, Plotting of functions, Beamer presentation.

### **Unit 4: HTML**

HTML basics, Creating simple web pages, Images and links, Design of web pages.

### **LESSON PLAN 14 weeks (Approximately)**

**Weeks 1 to 3:** Introduction to TeX and LaTeX, Typesetting a simple document, Adding basic information to a document, Environments, Footnotes, Sectioning and displayed material.

[1] Chapter 9 (9.1 to 9.5).

[2] Chapter 2 (2.1 to 2.5).

**Weeks 4 to 6:** Accents of symbols, Mathematical typesetting (elementary and advanced): Subscript/Superscript, Fractions, Roots, Ellipsis, Mathematical symbols, Arrays, Delimiters, Multiline formulas, Spacing and changing style in math mode.

[1] Chapter 9 (9.6 and 9.7).

[2] Chapter 3 (3.1 to 3.3).

**Weeks 7 and 8:** Graphics in LaTeX, Simple pictures using PSTricks, Plotting of functions. [1] Chapter 9 (Section 9.8). Chapter 10 (10.1 to 10.3).

[2] Chapter 7 (7.1 and 7.2).

**Weeks 9 and 10:** Beamer presentation.

[1] Chapter 11 (Sections 11.1 to 11.4).

**Weeks 11 and 12:** HTML basics, Creating simple web pages. [1] Chapter 15 (Sections 15.1 and 15.2).

**Weeks 13 and 14:** Adding images and links, Design of web pages.

[1] Chapter 15 (Sections 15.3 to 15.5).

## **ASSESSMENT**

**Internal Assessment: 25 Marks (Assignment and presentation)**

### **References:**

1. Bindner, Donald & Erickson, Martin. (2011). *A Student's Guide to the Study, Practice, and Tools of Modern Mathematics*. CRC Press, Taylor & Francis Group, LLC.
2. Lamport, Leslie (1994). *LaTeX: A Document Preparation System*, User's Guide and Reference Manual (2nd ed.). Pearson Education. Indian Reprint.

### **Additional Readings:**

- i. Dongen, M. R. C. van (2012). *LaTeX and Friends*. Springer-Verlag.
- ii. Robbins, J. N. (2018). *Learning Web Design: A Beginner's Guide to HTML* (5th ed.). O'Reilly Media Inc.

**Course: B.Sc.(H) Mathematics**

**Paper: SEC-1: Numerical Methods**

**SEMESTER: V**

**SESSION: 2021– 2022 (Odd Semester)**

**TEACHER NAME: Meenakshi Gupta/ Dr. Anuj Kumar**

## ● SYLLABUS

### **SYLLABUS**

#### **Unit 1: Methods for Solving Algebraic and Transcendental Equations**

Algorithms, Convergence, Bisection method, False position method, Fixed point iteration method, Newton's method and Secant method.

#### **Unit 2: Techniques to Solve Linear Systems**

Partial and scaled partial pivoting, LU decomposition and its applications, Iterative methods: Gauss–Jacobi, Gauss–Seidel and SOR methods.

#### **Unit 3: Interpolation**

Lagrange and Newton interpolation, Piecewise linear interpolation.

#### **Unit 4: Numerical Differentiation and Integration**

First and higher order approximation for first derivative, Approximation for second derivative, Richardson extrapolation method; Numerical integration by closed Newton–Cotes formulae: Trapezoidal rule, Simpson's rule and its error analysis; Euler's method to solve ODE's, Second order Runge–Kutta Methods: Modified Euler's method, Heun's method and optimal RK2 method

### **LESSON PLAN: 14 Weeks (Approximately)**

**Week 1:** Algorithms, Convergence, Order of convergence and examples.

[1] Chapter 1 (Sections 1.1 and 1.2).

**Week 2:** Bisection method, False position method and their convergence analysis, Stopping condition and algorithms.

[1] Chapter 2 (Sections 2.1 and 2.2).

**Week 3:** Fixed point iteration method, its order of convergence and stopping condition.

[1] Chapter 2 (Section 2.3).

**Week 4:** Newton's method, Secant method, their order of convergence and convergence analysis.

[1] Chapter 2 (Sections 2.4 and 2.5).

**Week 5:** Examples to understand partial and scaled partial pivoting. LU decomposition.

[1] Chapter 3 (Sections 3.5 up to Example 3.15).

**Weeks 6 and 7:** Application of LU decomposition to solve system of linear equations. Gauss–Jacobi method, Gauss–Seidel and SOR iterative methods to solve system of linear equations.

[1] Chapter 3 (Sections 3.5 and 3.8).

**Week 8:** Lagrange interpolation: Linear and higher order interpolation, and error in it.

[1] Chapter 5 (Section 5.1).

**Weeks 9 and 10:** Divided difference and Newton interpolation, finite difference operators.

[1] Chapter 5 (Sections 5.3).

[2]: Chapter 4 (Section 4.3).

**Weeks 11 and 12:** First and higher order approximation for first derivative and error in the approximation. Second order forward, Backward and central difference approximations for second derivative.

[1] Chapter 6 (Sections 6.2).

**Week 13:** Numerical integration: Trapezoidal rule, Simpson's rule and its error analysis.

[1] Chapter 6 (Section 6.4).

**Week 14:** Euler's method to solve ODE's, Second order Runge–Kutta methods: Modified Euler's method, Heun's method and optimal RK2 method.

[1] Chapter 7 (Section 7.2 up to Page 562 and Section 7.4, Pages 582-585).

## ASSESSMENT

**Internal Assessment: 25 Marks (Assignment and class test)**

## REFERENCES

### Reference:

1. Bradie, Brian. (2006). *A Friendly Introduction to Numerical Analysis*. Pearson Education, India. Dorling Kindersley (India) Pvt. Ltd. Third impression 2011.

### Additional Readings:

- i. Jain, M. K., Iyengar, S. R. K., & Jain, R. K. (2012). *Numerical Methods for Scientific and Engineering Computation*. (6th ed.). New Age International Publisher, India, 2016.
- ii. Gerald, C. F., & Wheatley, P. O. (2008). *Applied Numerical Analysis* (7th ed.). Pearson Education. India.