SEMESTER- III

DIFFERENTIAL AND VECTOR CALCULUS

Theory: 4 hours per week and **Tutorials:** 1hour per week

DSC-III

Objectives: To introduce the concepts of functions of several variables, limits, continuity, and partial differentiation. To develop problem-solving skills in handling composite functions, implicit differentiation, and optimization with constraints. To provide a foundation in evaluating line, surface, and volume integrals and their applications. To familiarize students with vector calculus concepts such as gradient, divergence, curl, and fundamental integral theorems.

Outcomes: Understand and compute partial derivatives, limits, continuity, and homogeneous functions of several variables. Apply Taylor's theorem, Lagrange multipliers, and related techniques to solve optimization problems. Evaluate line, surface, and volume integrals in Cartesian and polar coordinates. Apply vector calculus operators and integral theorems (Divergence and Stokes) to solve mathematical and physical problems.

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.(**Book 1:**Sec. 11.1, 11.2, 11.3, 11.4, 11.5, 11.6, 11.7, 11.8)

UNIT-II

Theorem on Total Differentials–Composite Functions– Differentiation of Composite Functions–Implicit Functions–Equality of $f_{xy}(a, b)$ and $f_{yx}(a, b)$, Taylor' s theorem for a function of two Variables–Maxima and Minima of functions of two variables–Lagrange's Method of undetermined multipliers.(**Book 1:**Sec. 11.9, 11.10, 11.11, 9.6, 9.7)

UNIT-III

Line Integrals, Surface integrals, Volume integrals: Line Integrals–Double Integrals–Double Integrals in Polar Co-ordinates–Surface Integrals–Volume Integrals. (**Book 2:**Sec. 2.2, 2.3, 2.4) (**Book 3:**Sec. 13.1 and 13.3)

UNIT-IV

Gradient, Divergence and Curl : Gradient of scalar field–Divergence of vector field–Curl of a vector field–Combinations of grad, div and curl. (**Book 2:**Sec. 3.2, 3.3, 3.4, 4.6)

Integral theorems: Divergence theorem–Stokes theorem. (**Book 2:**Sec. 5.1, 5.2)

TEXTBOOKS:

1. Shanti Narayan and P.K. Mittal — *Differential Calculus*, S. Chand, New Delhi, 15th Edition.
2. P.C. Matthews — *Vector Calculus*, Springer London, 1998 .
3. G.B. Thomas & R.L. Finney — Calculus, Addison-Wesley Second Edition by Finney published in 1993.

REFERENCE BOOKS:

1. William A. Granville, Percy F. Smith & William R. Longley — *Elements of the Differential and Integral Calculus*, Ginn& Co., 1941.
2. G.B. Thomas & R.L. Finney — *Calculus*, Addison-Wesley.
3. Joseph Edwards — *Differential Calculus for Beginners*, Macmillan, London, 1893.
4. R.T. Smith & R. Minton — *Calculus*, McGraw-Hill Education, 4th Edition, 2012.
5. Eli S. Pine — *How to Enjoy Calculus*, Steinlitz-Hammacher Company, 5th Edition, 1984.

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SEMESTER – IV

ALGEBRA

Theory: 4 hours per week and **Tutorials:** 1hour per week

DSC-IV

Objectives: To introduce the fundamental concepts of groups and along with illustrative examples. To develop the ability to understand subgrou structures, quotient groups, normal subgroups, and their properties. To equip students with knowledge of ring theory including ideals homomorphisms, quotient rings, and special classes of rings. To provide problem-solving skills and logical reasoning needed for abstract algebra an its applications.

Outcomes: Understand the definitions and basic properties of groups, subgroups, and apply counting principles in group theory. Analyze an construct normal subgroups, quotient groups, homomorphisms, and apply Cayley's theorem and permutation groups in problem solving. Explain th structure of rings, recognize special classes of rings, and apply ring homomorphisms.

UNIT – I

Group Theory: Definition of a Group, Some Examples of Groups – Some Preliminary Lemmas – Subgroups – A Counting Principle. (Sec. 2.1, 2.2, 2.3, 2.4, 2.5)

UNIT – II

Group Theory: Normal Subgroups and Quotient Groups –Homomorphisms–Cayley's Theorem – Permutation Groups. (Sec. 2.6, 2.7, 2.9, 2.10)

UNIT – III

Ring Theory: Definition and Examples of Rings – Some Special Classes of Rings – Homomorphisms. (Sec. 3.1, 3.2, 3.3)

UNIT – IV

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

TEXT BOOK:

1. I.N. Herstein — *Topics in Algebra*, John Wiley & Sons, Second Edition, 1975.

REFERENCE BOOKS:

1. P.B. Bhattacharya, S.K. Jain & S.R. Nagpaul — *Basic Abstract Algebra*, Cambridge University Press (Indian Edition also by Hindustan Book Agency), Second Edition, 1994.
2. J.B. Fraleigh — *A First Course in Abstract Algebra*, Addison-Wesley, Seventh Edition, 2003.
3. Joseph A. Gallian — *Contemporary Abstract Algebra*, Cengage Learning, Ninth Edition, 2017.

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