

SEMESTER- I
DIFFERENTIAL EQUATIONS

Theory: 5 hours /week and Tutorials: 1 hour /week

DSC-IA

Objective: The main aim of this course is to introduce the student to the techniques of solving Differential Equations and to apply their skills in solving some of the problems of Engineering and Science.

Outcome: After learning the course, the student will be equipped with various tools to solve few types of Differential Equations that arise in several branches of science.

UNIT- I

Differential Equations of First Order and First Degree: Introduction- Equations in Which Variables are Separable – Homogeneous Differential Equations - Differential Equations Reducible to Homogeneous Form – Linear Differential Equations - Differential Equations Reducible to Linear Form – Exact Differential Equations – Integrating Factors – Change in Variables (Text Book : 2.1 to 2.9)

UNIT- II

Equations of First Order But Not of The First Degree: Case I: Equations Solvable for p -Case II : Equations Solvable for y - Equations Solvable for x – Equations that do not Contain x (or y) - Equations Homogeneous in x and y – Equations of First Degree in x and y – Clairaut's Equation.

Applications of First Order Differential Equations: Growth and Decay – Dynamics of Tumor Growth – Radioactivity and Carbon Dating – Compound Interest – Orthogonal Trajectories.

(Text Book : 3.1 to 3.2 & 4.1 to 4.4 & 4.20)

UNIT- III

Higher Order Linear Differential Equations: Introduction - Solution of Homogeneous Linear Differential Equations of Order n with Constant Coefficients - Solution of the Non-Homogeneous Differential Equations with Constant Coefficients by Means of Polynomial Operators - Method of Undetermined Coefficients. (Text Book : 5.1 to 5.4)

UNIT- IV

Method of variation of Parameters – Linear Differential Equations with Non-Constant Coefficients – The Cauchy – Euler Equation – Legendre's Linear Equations – Miscellaneous Differential Equations.

Total Differential Equations – Simultaneous Total Differential Equations – Equations of the form $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$. (Text Book : 5.5 to 5.9 & 2.10 to 2.12)

TEXT BOOK:

Zafar Ahsan, Differential Equations and Their Applications (Second Edition)

REFERENCE BOOKS :

1. Frank Ayres Jr, Theory and Problems of Differential Equations.
2. Ford, L.R ; Differential Equations.
3. Daniel Murray, Differential Equations.
4. S. Balachandra Rao, Differential Equations with Applications and Programs.
5. Stuart P Hastings, J Bryce McLead; Classical Methods in Ordinary Differential Equations.


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SEMESTER- II
REAL ANALYSIS

Theory: 5 hours /week and Tutorials: 1 hour /week

DSC-IB

Objective: The course is aimed at exposing the student to the foundations of analysis which will be useful in understanding various physical phenomena.

Outcome: After the completion of the course the student will be in a position to appreciate the beauty and applicability of the course.

UNIT-I

Real Numbers: Field Structure and Order Structure-Bounded and Unbounded Sets- Completeness in the Set of Real Numbers- Absolute Value of a Real Number (Text Book : Chapter 1: 2 to 5)

Open Sets, Closed Sets and Countable Sets : Limit Points of a Set-Closed Sets-Countable and Uncountable Sets (Text Book : Chapter 2 : 2 to 4)

Real Sequences: Sequences-Limit points of a Sequence-Convergent Sequences-Non-Convergent Sequences (Definitions)-Cauchy's General Principle of Convergence- Algebra of Sequences- Some Important Theorems-Monotonic Sequences.(Text Book : Chapter 3: 1 to 2 & 4 to 9)

UNIT-II

Infinite Series : Introduction-Positive Term Series- Comparison Tests for Positive Term Series- Cauchy's Root test- D'Alembert's Ratio Test-Integral Test-Alternating Series(Leibnitz Test). (Text Book : Chapter 4 : 1 to 5, 8 & 10.1)

Functions of a Single Variable (I): Limits-Continuous Functions-Functions Continuous on Closed Intervals. (Text Book : Chapter 5: 1 to 3)

UNIT -III

Functions of a Single Variable (II):The Derivative-Increasing and Decreasing Functions- Rolle's Theorem-Lagrange's Mean Value Theorem- Cauchy's Mean Value Theorem- Higher Order Derivatives. (Text Book : Chapter 6: 1, 3 & 5 to 8)

UNIT -IV

The Riemann Integral: Definition and Existence of the Integral-Refinement of Partitions-Darboux's Theorem-Conditions of Integrability-Integrability of the Sum and Difference of Integrable Functions-The Integral as a Limit of Sums-Some Integrable Functions-Integration and Differentiation-The Fundamental Theorem of Calculus. (Text Book : Chapter 9: 1 to 9)

TEXT BOOK :

S.C. Malik and Savita Arora, Mathematical Analysis, Fourth Edition, New Age International Publishers

REFERENCE BOOKS:

1. Kenneth A Ross, Elementary Analysis-The Theory of Calculus
2. William F. Trench, Introduction to Real Analysis
3. Lee Larson, Introduction to Real Analysis I
4. Shanti Narayan and Mittal, Mathematical Analysis
5. Brian S. Thomson, Judith B. Bruckner, Andrew M. Bruckner; Elementary Real analysis


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SEMESTER- III
DIFFERENTIAL AND VECTOR CALCULUS
Theory: 5 hours /week and Tutorials: 1 hour /week

DSC-IC

Objective: The course is aimed at exposing the student to some basic notions in Differential Calculus.

Outcome: After the completion of the course the student realizes wide-ranging applications of the subject.

UNIT- I

Partial Differentiation: Introduction - Functions of Two Variables - Neighbourhood of a Point (a, b) - Continuity of a Function of Two Variables- Continuity at a Point - Limit of a Function of Two Variables - Partial Derivatives - Geometrical Representation of a Function of Two Variables - Homogeneous Functions. (Text Book 1 : 11.1 to 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 Function of Two variables- Lagrange's Method of Undetermined Multipliers- Jacobians . (Text Book 1 : 11.9 to 11.11 & 9.6, 9.7 & 12.1)

UNIT- III

Gradient, Divergence and Curl : Introduction-Gradient- Divergence-Curl -Formulas Involving ∇ - Invariance (Text Book 2: Chapter 4: 4.1 to 4.6)

Multiple Integrals : Double Integrals- Double Integrals in Polar Form (Book 3: 13.1 & 13.3)

Vector Integration : Introduction- Ordinary Integrals of Vector Valued Functions - Line Integrals-Surface Integrals- Volume Integrals. (Text Book 2: Chapter 5: 5.1 to 5.5)

UNIT- IV

The Divergence Theorem, Stoke's Theorem and Related Integral Theorems : Introduction-Main Theorems- Related Integral Theorems (Text Book 2: Chapter 6: 6.1 to 6.3)

TEXT BOOKS:

1. Shanti Narayan, P.K. Mittal Differential Calculus, S.CHAND, NEW DELHI, Fifteenth Edition
2. Vector Analysis , Second Edition (Schaum's Outlines) , By Murray R. Spiegel, Seymour Lipschutz, Dennis Spellman.
3. Calculus and Analytical Geometry by George B. Thomas, Ross. L. Finney (Ninth Edition)

REFERENCE BOOKS:

1. William Anthony Granville, Percy F Smith and William Raymond Longley; Elements of the Differential and Integral Calculus
2. Joseph Edwards, Differential calculus for Beginners
3. Smith and Minton, Calculus
4. Elis Pine, How to Enjoy Calculus


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SEMESTER – IV
ALGEBRA

Theory: 5 hours /week and Tutorials: 1 hour /week

DSC-ID

Objective: The course is aimed at exposing the student to learn some basic algebraic structures like groups, rings etc.,

Outcome: On successful completion of the course the student will be able to recognize algebraic structures that arise in matrix algebra, linear algebra and will be able to apply skills learnt in understanding various such subjects.

UNIT – I

Group Theory: Definition of a Group, Some Examples of Groups - Some Preliminary Lemmas – Subgroups - A Counting Principle. (Text Book : 2.1 to 2.5)

UNIT – II

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

UNIT – III

Ring Theory: Definition and Examples of Rings - Some Special Classes of Rings - Homomorphisms. (Text Book : 3.1 to 3.3)

UNIT – IV

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

TEXT BOOK :

I. N. Herstein : Topics in Algebra, John Wiley & Sons (Second Edition)

REFERENCE BOOKS :

1. Bhattacharya. P.B, Jain. S.K and Nagpaul. S.R : Basic Abstract Algebra
2. Fraleigh. J.B: A First Course in Abstract Algebra.
3. Joseph A Gallian: Contemporary Abstract Algebra (9th Edition).


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