SEMESTER – I

Differential & Integral Calculus

(w. e. f. academic year 2019 – 20)

DSC – 1A **BS: 101**

Theory: 5 credits and Tutorials: 0 credits

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

Objective: The course is aimed at exposing the students to some basic notions in differential calculus.

Outcome: By the time students complete the course they realize 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.

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.

Unit – III:

Curvature and Evolutes: Introduction – Definition of Curvature – Radius of Curvature – Length of Arc as a Function, Derivative of arc – Radius of Curvature –

Cartesian Equations – Newtonian Method – Centre of Curvature – Chord of Curvature.

Evolutes: Evolutes and Involutes – Properties of the Evolutes.

Envelopes: One Parameter Family of Curves – The family of straight lines – Definition – Determination of Envelope.

Unit – IV:

Lengths of Plane Curves: Introduction – Expression for the lengths of curves $y = f(x)$ – Expressions for the length of arcs $x = f(y)$; $x = f(t)$, $y = \phi(t)$; $r = f(\theta)$

Volumes and Surfaces of Revolution: Introduction – Expression for the volume obtained by revolving about either axis – Expression for the volume obtained by revolving about any line – Area of the surface of the frustum of a cone – Expression for the surface of revolution – Pappus Theorems – Surface of revolution.

Text Books:

- Shanti Narayan, P.K. Mittal *Differential Calculus, S.CHAND, NEW DELHI*
- Shanti Narayan, *Integral Calculus, S.CHAND, NEW DELHI.*

References:

- William Anthony Granville, Percey F Smith and William Raymond Longley; *Elements of the differential and integral calculus*
- Joseph Edwards , *Differential calculus for beginners*
- Smith and Minton, *Calculus*
- Elis Pine, *How to Enjoy Calculus*
- Hari Kishan, *Differential Calculus*

SEMESTER – II

Differential Equations

(w. e. f. academic year 2019 – 20)

DSC – 1B **BS: 201**

Theory: 5 credits and Tutorials: 0 credits

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

Objective: The main aim of this course is to introduce the students to the techniques of solving differential equations and to train to apply their skills in solving some of the problems of engineering and science.

Outcome: After learning the course the students will be equipped with the various tools to solve few types 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 – Total Differential Equations – Simultaneous Total Differential Equations – Equations of the form $\frac{dx}{P}=\frac{dy}{Q}=\frac{dz}{R}$.

Unit – II:

Differential Equations first order but not of first degree: Equations Solvable for p – Equations Solvable for y – Equations Solvable for x – Equations that do not contain x (or y) – Equations Homogeneous in x and y – Equations of the First Degree in x and y – Clairaut's equation.

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

Unit – III:

Higher order Linear Differential Equations: Solution of homogeneous linear differential equations with constant coefficients – Solution of non-homogeneous differential equations $P(D)\ y = Q(x)$ with constant coefficients by means of polynomial operators when $Q(x) = be^{ax}$, $b\sin ax/b\cos ax$, bx^k, Ve^{ax} – Method of undetermined coefficients.

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.

Partial Differential Equations: Formation and solution – Equations easily integrable – Linear equations of first order.

Text Book:

- Zafar Ahsan, *Differential Equations and Their Applications*

References:

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

SEMESTER – III

Real Analysis

(w. e. f. academic year 2020 – 21)

DSC – 1C **BS: 301**

Theory: 5 credits and Tutorials: 0 credits

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

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

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

Unit – I:

Sequences: Limits of Sequences – A Discussion about Proofs – Limit Theorems for Sequences – Monotone Sequences and Cauchy Sequences – Subsequences – Lim sup's and Lim inf's – Series – Alternating Series and Integral Tests .

Unit – II:

Continuity: Continuous Functions – Properties of Continuous Functions – Uniform Continuity – Limits of Functions

Unit – III:

Differentiation: Basic Properties of the Derivatives – The Mean Value Theorems – L'Hospital Rule – Taylor's Theorem.

Unit – IV:

Integration: The Riemann Integral – Properties of Riemann Integral – Fundamental Theorem of Calculus.

Text Book:

- Kenneth A Ross, *Elementary Analysis – The Theory of Calculus*

References:

- S. C. Malik and Savita Arora, *Mathematical Analysis, Second Edition, Wiley Eastern Limited, New Age International (P) Limited, New Delhi, 1994.*
- William F. Trench, *Introduction to Real Analysis*
- Lee Larson , *Introduction to Real Analysis I*
- Shanti Narayan and Mittal, *Mathematical Analysis*
- Brian S. Thomson, Judith B. Bruckner, Andrew M. Bruckner; *Elementary Real analysis*
- Sudhir R., Ghorpade, Balmohan V., Limaye; *A Course in Calculus and Real Analysis*

SEMESTER – IV

Algebra

(w. e. f. academic year 2020 – 21)

DSC – 1D **BS: 401**

Theory: 5 credits and Tutorials: 0 credits

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

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

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

Unit – I:

Groups: Definition and Examples of Groups – Elementary Properties of Groups – Finite Groups – Subgroups – Terminology and Notation – Subgroup Tests – Examples of Subgroups.

Cyclic Groups: Properties of Cyclic Groups – Classification of Subgroups Cyclic Groups.

Unit – II:

Permutation Groups: Definition and Notation – Cycle Notation – Properties of Permutations – A Check Digit Scheme Based on D_5. Isomorphisms; Motivation – Definition and Examples – Cayley's Theorem Properties of Isomorphisms – Automorphisms – Cosets and Lagrange's Theorem Properties of Cosets – Lagrange's Theorem and Consequences – An Application of Cosets to Permutation Groups – The Rotation Group of a Cube and a Soccer Ball.

Unit – III:

Normal Subgroups and Factor Groups: Normal Subgroups – Factor Groups – Applications of Factor Groups – Group Homomorphisms – Definition and Examples – Properties of Homomorphisms – The First Isomorphism Theorem.

Introduction to Rings: Motivation and Definition – Examples of Rings – Properties of Rings – Subrings.

Integral Domains: Definition and Examples – Fields – Characteristics of a Ring.

Unit – IV:

Ideals and Factor Rings: Ideals – Factor Rings – Prime Ideals and Maximal Ideals.

Ring Homomorphisms: Definition and Examples – Properties of Ring – Homomorphisms.

Text Book:

- Joseph A Gallian, *Contemporary Abstract algebra (9th edition)*

References:

- Bhattacharya, P.B Jain, S.K.; and Nagpaul, S.R,*Basic Abstract Algebra*
- Fraleigh, J.B, *A First Course in Abstract Algebra.*
- Herstein, I.N, *Topics in Algebra*
- Robert B. Ash, *Basic Abstract Algebra*
- I Martin Isaacs, *Finite Group Theory*
- Joseph J Rotman, *Advanced Modern Algebra*

SEMESTER – V

Linear Algebra

(w. e. f. academic year 2021 – 22)

DSC – E **BS: 501**

Theory: 5 credits and Tutorials: 0 credits

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

Objective: The students are exposed to various concepts like vector spaces, bases, dimension, Eigen values etc.

Outcome: After completion of this course, students appreciate its interdisciplinary nature.

Unit – I:

Vector Spaces: Vector Spaces and Subspaces – Null Spaces, Column Spaces, and Linear Transformations – Linearly Independent Sets; Bases – Coordinate Systems – The Dimension of a Vector Space

Unit – II:

Rank – Change of Basis – Eigen values and Eigenvectors – The Characteristic Equation.

Unit – III:

Diagonalization – Eigenvectors and Linear Transformations – Complex Eigen values – Applications to Differential Equations.

Unit – IV:

Orthogonality and Least Squares: Inner Product, Length, and Orthogonality – Orthogonal Sets – Orthogonal Projections – The Gram – Schmidt Process.

Text Book:

- David C Lay, *Linear Algebra and its Applications* 4*e*

References:

- S Lang, *Introduction to Linear Algebra*
- Gilbert Strang, *Linear Algebra and its Applications*
- Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence; *Linear Algebra*
- Kuldeep Singh; *Linear Algebra*
- Sheldon Axler; *Linear Algebra Done Right*

SEMESTER – VI

Numerical Analysis

(w. e. f. academic year 2021 – 22)

DSE – 1F/A **BS: 601/A**

Theory: 5 credits and Tutorials: 0 credits

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

Objective: Students will be made to understand some methods of numerical analysis.

Outcome: Students realize the importance of the subject in solving some problems of algebra and calculus.

Unit – I:

Errors in Numerical Calculations – **Solutions of Equations in One Variable**: The Bisection Method – The Iteration Method – The Method of False Position – Newton's Method – Muller's Method – Solution of Systems of Nonlinear Equations.

Unit – II:

Interpolation and Polynomial Approximation: Interpolation – Finite Differences – Differences of Polynomials – Newton's formula for Interpolation – Gauss's central differences formulae – Stirling's and Bessel's formula – Lagrange's Interpolation Polynomial – Divided Differences – Newton's General Interpolation formula – Inverse Interpolation.

Unit – III:

Curve Fitting: Least Square Curve Fitting: Fitting a Straight Line – Nonlinear Curve Fitting.

Numerical Differentiation and Integration: Numerical Differentiation – Numerical Integration: Trapezoidal Rule – Simpson's 1/3rd – Rule and Simpson's 3/8th – Rule – Boole's

and Weddle's Rule – Newton's Cotes Integration Formulae.

Unit – IV:

Numerical Solutions of Ordinary Differential Equations: Taylor's Series Method – Picard's Method – Euler's Methods – Runge Kutta Methods.

Text Book:

- S. S. Sastry, *Introductory Methods of Numerical Analysis, PHI*

References:

- Richard L. Burden and J. Douglas Faires, *Numerical Analysis* (9*e*)
- M. K. Jain, S. R. K Iyengar and R. K. Jain, *Numerical Methods for Scientific and Engineering computation*
- B. Bradie, *A Friendly introduction to Numerical Analysis*

Text Book:

- Shanti Narayan and P. K. Mittal, *Analytical Solid Geometry* (17*e*)

References:

- Khaleel Ahmed, *Analytical Solid Geometry*
- S L Loney *Solid Geometry*
- Smith and Minton, *Calculus*

SEMESTER – III:

Theory of Equations

(w. e. f. academic year 2020 – 21)

SEC – I:

Theory: 2 credits

Theory: 2 hours/week

Objective: Students learn the relation between roots and coefficients of a polynomial equation, Descartes' rule of signs in finding the number of positive and negative roots if any of a polynomial equation besides some other concepts.

Outcome: By using the concepts learnt the students are expected to solve some of the polynomial equations.

Unit – I:

Graphic representation of a polynomial – Maxima and minima values of polynomials – Theorems relating to the real roots of equations – Existence of a root in the general equation – Imaginary roots – Theorem determining the number of roots of an equation – Equal roots – Imaginary roots enter equations in pairs – Descartes' rule of signs for positive roots – Descartes' rule of signs for negative roots.

Unit – II:

Relations between the roots and coefficients – Theorem – Applications of the theorem – Depression of an equation when a relation exists between two of its roots – The cube roots of unity Symmetric functions of the roots – examples.

Text Book:

- W. S. Burnside and A. W. Panton, *The Theory of Equations*

References:

- C. C. Mac Duffee, *Theory of Equations*
- Hall and Knight, *Higher Algebra*

SEMESTER – III

Logic & Sets

(w. e. f. academic year 2020 – 21)

SEC – II

Theory: 4 credits and Tutorials: 0 credits

Theory: 4 hours/week and Tutorials: 1 hours/week

Objective: Students learn some concepts in set theory and logic.

Outcome: After the completion of the course students appreciate its importance in the development of computer science.

Unit – I:

Basic Connectives and truth tables – Logical equivalence: Laws of Logic – Logical Implication: Rules of Inference: The Use of Quantifiers – Quantifiers, Definitions and proofs of Theorems.

Unit – II:

Sets and Subsets – Set Operations and the Laws of Set Theory – Counting and Venn Diagrams – A First Word on Probability – The axioms of Probability – Conditional Probability: Independence – Discrete Random variables .

Text Book:

- Ralph P Grimaldi, *Discrete and Combinatorial Mathematics* (5*e*)

References:

- P. R. Halmos, *Naïve Set Theory*
- E. Kamke, *Theory of Sets*

SEMESTER – IV

Number Theory

(w. e. f. academic year 2020 – 21)

SEC – III

Theory: 2 credits and Theory: 2 hours/week

Objective: Students will be exposed to some of the jewels like Fermat's theorem, Euler's theorem in the number theory.

Outcome: Student uses the knowledge acquired solving some divisor problems.

Unit – I:

The Goldbach conjecture – Basic properties of congruences – Binary and Decimal Representation of lntegers – Number Theoretic Functions; The Sum and Number of divisors – The Mobius Inversion Formula – The Greatest integer function.

Unit – II:

Euler's generalization of Fermat's Theorem: Euler's Phi function – Euler's theorem – Some Properties of the Euler's Phi function.

Text Book:

- David M Burton, *Elementary Number Theory* (7*e*)

References:

- Thomas Koshy, *Elementary Number Theory and its Applications*
- Kenneth H Rosen, *Elementary Number Theory*

SEMESTER – IV

Vector Calculus

(w. e. f. academic year 2020 – 21)

SEC – IV

Theory: 2 credits and Theory: 2 hours/week

Objective: Concepts like gradient, divergence, curl and their physical relevance will be taught.

Outcome: Students realize the way vector calculus is used to addresses some of the problems of physics.

Unit – I:

Line Integrals: Introductory Example – Work done against a Force – Evaluation of Line Integrals – Conservative Vector Fields.

Surface Integrals: Introductory Example: Flow Through a Pipe – Evaluation of Surface Integrals.

Unit – II:

Volume Integrals: Evaluation of Volume integrals

Gradient, Divergence and Curl: Partial differentiation and Taylor series – Partial differentiation – Taylor series in more than one variable – Gradient of a scalar field – Gradients, conservative fields and potentials – Physical applications of the gradient.

Text Book:

- P. C. Matthews, *Vector Calculus*

References:

- G. B. Thomas and R. L. Finney, *Calculus*
- H. Anton, I. Bivens and S. Davis; *Calulus*
- Smith and Minton, *Calculus*