

MATHEMATICS (HONOURS)

SEMESTER-I

CC-1 : CALCULUS-I

(Total Marks: 100)

Part-I (Marks:70 - End Sem: 50 Marks+Mid-Sem:20Marks)

04 Lectures, 1 Tutorial (per week) (Each Lecture: 1 hour)

Unit-I

Hyperbolic functions, higher order derivatives, Leibnitz rule and its application to problems of the type $e^{ax+bs}\sin x, e^{ax+bs}\cos x, (ax+b)^n \sin x, (ax+b)^n \cos x$, concavity and inflection points, asymptotes, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L-Hospital's rule and its applications in business, economics and life sciences.

Unit-II

Reduction formulae, derivations and illustration of reduction formulae of the type $\int \sin^n x dx, \int \cos^n x dx, \int \tan^n x dx, \int \sec^n x dx, \int (\log x)^n dx, \int \sin^n x \cos^n x dx$, volumes by slicing, disks and washers methods, volumes by cylindrical shells, parametric equations, parameterizing a curve, arc length, arc length of parametric curves, area of surface of revolution.

Unit-III

Techniques of sketching conics, reflection properties of conics, rotation of axes and second degree equations, classification into conics using the discriminant, polar equations of conics. Sphere, Cone, Cylinder.

Unit-IV

Triple product, introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions, tangent and normal components of acceleration.

Books Recommended:

1. H. Anton, I. Bivens and S. Davis, Calculus, 10th Ed., John Wiley and Sons (Asia) P. Ltd., Singapore, 2002. Chapters: 2(2.3), 3(3.1, 3.3), 5(5.2-5.5), 6(6.5, 6.8), 10(10.1, 10.4, 10.5), 11(11.1, 11.4), 12(12.1, 12.2, 12.6).
2. Analytical Geometry of Quadratic Surfaces, B.P. Acharya and D.C. Sahu, Kalyani Publishers, New Delhi, Ludhiana. Chapters: 2, 3.
3. Text Book of Calculus, Part-II- Shantin Narayan, S. Chand & Co., Chapters: 6, 7, 10 (Art. 33-36).
4. Text Book of Calculus, Part-III- Shantin Narayan, S. Chand & Co., Chapters: 1 (Art. 1, 2), 3 (Art. 7, 8), 6 (15 restricted).

Books for Reference:

1. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.
2. R. Courant and F. John, Introduction to Calculus and Analysis (Volumes I & II), Springer-Verlag, New York, Inc., 1989.
3. Shanti Narayan and P.K. Mittal- Analytical Solid Geometry, S. Chand & Company Pvt. Ltd., New Delhi.
4. M.J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2007.

Part-II(PRACTICAL)
Marks: 30 (Expt.: 15 + Viva: 10 + Record: 5)
Total Lectures: 20 (Each Lecture: 2 hours)
List of Practical using MATLAB

Practical/Labwork to be performed on a Computer.

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.
2. Plotting the graphs of the polynomial of degree 4 and 5.
3. Sketching parametric curves (Eg. Trochoid, cycloid, hypocycloid).
4. Obtaining surface of revolution of curves.
5. Tracing of conics in cartesian coordinates/polar coordinates.
6. Sketching ellipsoid, hyperboloid of one and two sheets (using Cartesian co-ordinates).
7. Matrix operation (addition, multiplication, inverse, transpose).

Books Recommended:

1. A.K.Singh, Matlab Programming with Practical, Kalyani Publishers, Ludhiana, 2017. Chapters : 0, 1.

SEMESTER-I

CC-2: ALGEBRA-I

Total Marks: 100 (End Sem: 80 Marks + Mid-Sem: 20 Marks)

5 Lectures, 1 Tutorial (per week) (Each Lecture: 1 hour)

Unit-I

Complex Numbers: The algebra of complex numbers, n-th roots of unity, Geometric Representation of Complex numbers, Polar representation of complex numbers, De-Moivre's theorem for rational indices and its applications.

Unit-II

Equivalence relations, Functions, Composition of functions, Invertible functions, One-to-one correspondence and cardinality of a set, Well-ordering property of positive integers, Division algorithm, Divisibility and Euclidean algorithm, Congruence relation between integers, Principles of Mathematical Induction, statement of Fundamental Theorem of Arithmetic.

Unit-III

Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation $Ax=b$, solution set of linear systems, application of linear systems, linear independence.

Unit-IV

Introduction to linear transformations, matrix of a linear transformation, inverse of a matrix, characterization of invertible matrices. Subspaces of R_n , dimension of subspaces of R_n and rank of a matrix, Eigen values, Eigen Vectors and Characteristic Equation of a matrix.

Books Recommended:

1. L.V. Ahlfors, Complex Analysis, McGraw-Hill (International Student Edn.) Chapters: 1(1.1 - 1.5, 2.1 - 2.3).
2. Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory, 3rd Ed., Pearson Education (Singapore) P.Ltd., Indian Reprint, 2005. Chapters: 2(2.4), 3, 4(4.1-4.4), 5(5.1-5.1.4).
3. David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007. Chapters: 1(1.1 - 1.9), 2(2.1 - 2.3, 2.8, 2.9), 5(5.1, 5.2).

Books for Reference:

1. Titu Andreescu and Dorin Andrica, Complex Numbers from A to Z, Birkhauser, 2006. Chapter: 2
2. James Ward Brown and Ruel V. Churchill, Complex Variables and Applications, 8th Ed., McGraw Hill International Edition, 2009. chapter: 1(1-10).

SEMESTER-II

CC-3: REAL ANALYSIS(ANALYSIS-I)

Total Marks: 100-(End Sem: 80 Marks+Mid-Sem: 20Marks)

5 Lectures, 1 Tutorial (per week)(Each Lecture: 1 hour)

Unit-I

Review of Algebraic and Order Properties of $\mathbb{R}$, Upper bound & Lower bound, Least upper bound (LUB), Greatest lower bound (GLB), LUB & GLB property of an ordered field, Completeness of an ordered field, Incompleteness of $\mathbb{Q}$, Supremum and Infimum, Roots, Archimedean property, Rational & Irrational density theorems, Decimal representations of real numbers.

Unit-II

Idea of countable, uncountable sets and theorems relating to these sets, Sequences, Convergence & divergence of sequences, Limit of a sequence & Limit Theorems, Monotonic sequences, Weierstrass completeness principle, Nested Intervals, Cantor's completeness principle, Idea about higher order cardinals (restricted).

Unit-III

Subsequences, Bolzano Weierstrass theorem for sequences, Cluster points, Cauchy (Fundamental) sequence, Cauchy's Convergence Criterion, Limit superior and Limit inferior, Convergence and divergence of infinite series, Series of positive terms, Tests of convergence.

Unit-IV

Absolute convergence, Rearrangement of terms of a series, Conditional convergence of a series, Open sets, Closed sets, Limit points, Closure, Interior and Boundary of sets. Bolzano Weierstrass theorem for sets.

Books Recommended:

1. G. Das and S. Pattanayak, *Fundamentals of Mathematical Analysis*, TMH Publishing Co., Chapters: 2(2.1-2.7), 3(3.1-3.4), 4(4.1-4.8, 4.11-4.13), 5(5.1-5.5).

Books for References:

1. R. G. Bartle and D. R. Sherbert, *Introduction to Real Analysis*, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
2. Gerald G. Bileau, Paul R. Thie, G. E. Keough, *An Introduction to Analysis*, 2nd Ed., Jones & Bartlett, 2010.
3. Brian S. Thomson, Andrew M. Bruckner and Judith B. Bruckner, *Elementary Real Analysis*, Prentice Hall, 2001.
4. S. K. Berberian, *A First Course in Real Analysis*, Springer Verlag, New York, 1994.
5. D. Somasundaram and B. Choudhury, *A First Course in Mathematical Analysis*, Narosa Publishing House.
6. S. L. Gupta and Nisha Rani, *Real Analysis*, Vikas Publishing House Pvt. Ltd., New Delhi.
7. S. C. Mallik and S. Arora, *Mathematical Analysis*, New Age International Publications, chapters: 1, 3, 4(1-8).

SEMESTER-II

CC-4: DIFFERENTIAL EQUATIONS

(Total Marks: 100)

Part-I (Marks: 70 - End Sem: 50 Marks + Mid Sem: 20 Marks)

4 Lectures, 1 Tutorial (per week) (Each Lecture: 1 hour)

Unit-I

Basic concepts of Differential equations and mathematical models. First order and first degree Ordinary differential equations (variables separable, homogeneous, exact, and linear). Application of first order differential equations (Growth, Decay and Chemical Reactions, Heat flow, Oxygen debt, Economics). Equations of first order but of higher degree.

Unit-II

Second order linear equations (both homogeneous and non-homogeneous) with constant coefficients, second order equations with variable coefficients, variation of parameters, method of undetermined coefficients, Euler's equation, Second order differential equations with variable coefficients, Equations reducible to linear equations with constant coefficients.

Unit-III

Power series solution of second order differential equations. Legendre Equation and Legendre Polynomial, Hermite Equation and Hermite Polynomial.

Unit-IV

Laplace transforms and its application to solutions of differential equations.

Book Recommended:

1. J. Sinha Roy and S. Padhy, A Course of Ordinary and Partial Differential Equations, Kalyani Publishers, New Delhi. Chapters: 1, 2, 3, 4 (4.1-4.8), 5, 7 (7.1-7.3), 9 (9.1-9.5), 9.10, 9.11, 9.13).

Books for References:

1. S.L. Ross, Differential Equations, John Wiley & Sons, India, 2004.
2. M.D. Raisinghania-Advanced Differential Equations, S. Chand & Company Ltd., New Delhi.
3. Martin Braun, Differential Equations and their Applications, Springer International.
4. G. Dennis Zill-A First Course in Differential Equations with Modelling Applications, Cengage Learning India Pvt. Ltd.

Part-II (PRACTICAL)

Marks: 30 (Expt.: 15 + Viva: 10 + Record: 5)

Total Lectures: 20 (Each Lecture: 2 hours)

List of Practical using MATLAB

Practical/Lab work to be performed on a Computer.

1. Plotting of second order solution of family of differential equations.
2. Plotting of third order solution of family of differential equations.
3. Growth model (exponential case only).
4. Decay model (exponential case only).
5. Oxygen debt model.
6. Economic model.
7. Vibration / Oscillation problems (undamped, damped, forced vibration).

Books Recommended:

1. A.K. Singh, Matlab Programming with Practical, Kalyani Publishers, Ludhiana, 2017. Chapters: 0, 2.

SEMESTER –III

CC-5:THEORY OF REAL FUNCTIONS (ANALYSIS-II)

Total Marks: 100-(End Sem: 80 Marks+Mid Sem: 20Marks)

5 Lectures, 1 Tutorial (per week)(Each Lecture: 1 hour)

Unit-I

Limitsoffunctions($\epsilon-\delta$ approach),,Sequentialcriterionforlimits,Divergencecriteria.Limit theorems, one-sided limits. Infinite limits and limit at infinity. Continuous functions,Sequentialcriterionforcontinuity,Algebraofcontinuousfunctionsandtheoremsrelatedtocontinuityoffunctions.

Unit-II

Discontinuityandkindsofdiscontinuity,Furtherpropertiesofcontinuity,Uniformcontinuity,Differentiable functions, Left hand & Right hand derivatives, Algebra of differentiablefunctions,Caratheodory'stheorem.

Unit-III

Mean value conditions, Global and local maximum & minimum, Rolle's theorem,Generalized mean value theorem, Cauchy mean value theorem, Lagrange's mean value theoremandtheir applications, Darboux's theorem, Indeterminant forms, Higher orderderivatives(Leibnitz theorem),Taylor'stheoremanditsapplicationstoapproximatingfunctionsbymeansofpolynomials.

Unit-IV

Maxima and Minima, Taylor's theorem with different forms of remainder, Maclaurin's theorem,DeductionofTaylor's theoremfrommeanvaluethorem,Taylor'sandMaclaurin'sinfinite series,TaylorsseriesandMaclaurin'sseriesexpansionsofexponentialandtrigonometricfunctions, $\ln(1+x)$, $1/(ax+b)$ and $(1+x)^n$.

BookRecommended:

1. G.DasandS.Pattanayak,FundamentalsofMathematicsAnalysis,TMHPublishingCo., Chapters:6(6.1-6.9), 7(7.1-7.7), 9(9.7).
2. S.C. Mallik and S. Arora-Mathematical Analysis, New Age International Publications.Chapters: 6(6.8).

Booksfor References:

1. R.BartleandD.R.Sherbert,IntroductiontoRealAnalysis,JohnWileyandSons,2003.
2. K.A.Ross,ElementaryAnalysis:TheTheoryofCalculus,Springer,2004.
3. A.Mattuck, IntroductiontoAnalysis,PrenticeHall,1999.
4. S.R.GhorpadeandB.V.Limaye,ACourseinCalculusandRealAnalysis,Springer,2006.

SEMESTER –III

CC-6: GROUP THEORY(ALGEBRA-II)

Total Marks: 100-(End Sem: 80 Marks+Mid Sem: 20Marks)5 Lectures, 1
Tutorial(per week)(Each Lecture: 1 hour)

Unit-I

Groups: definition and examples of groups including permutation groups and quaternion groups (illustration through matrices), elementary properties of groups. Finite Groups; Subgroups: subgroups and examples of subgroups, centralizer, normalizer, center of groups, product of two sub-groups.

Unit-II

Cyclic Groups: properties of cyclic groups, classification of subgroups of cyclic groups. Permutation Groups: cycle notation for permutations, properties of permutations, even and odd permutations. Cosets and Lagrange's Theorem: properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem.

Unit-III

External Direct Products: external direct product of a finite number of groups. Normal Subgroups and Factor Groups: normal subgroups, factor groups, Cauchy's theorem for finite abelian groups.

Unit-IV

Group Homomorphisms: definition and examples of group homomorphism, properties of homomorphisms. Isomorphisms: definition and examples of isomorphism, properties of isomorphisms, Cayley's theorem, First, Second and Third isomorphism theorems (statements only).

Book Recommended:

1. Joseph A. Gallian, Contemporary Abstract Algebra (8th Edn.), Narosa Publishing House, New Delhi, chapters (Part – 2: Groups): 2 – 4, 5 (excluding A check-Digit Scheme Based on D_5), 6 (excluding Automorphisms), 7 (up-to Theorem 7.3), 8 (up-to Corollary 2), 9 (up-to Theorem 9.5), 10.

Books for References:

1. I.N. Herstein, Topics in Algebra, Wiley Eastern Limited, India, 1975. Chapters: 2(2.1-2.7, 2.9, 2.10, 2.13, 2.14 restricted).
2. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
3. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
4. Joseph J. Rotman, An Introduction to the Theory of Groups, 4th Ed., Springer Verlag, 1995.

SEMESTER –III

C-7: PARTIAL DIFFERENTIAL EQUATIONS & SYSTEMS OF ORDINARY DIFFERENTIAL EQUATIONS

(Total Marks: 100)

Part-I (Marks: 70 - End Sem: 50 Marks + Mid Sem: 20 Marks)

04 Lectures, 1 Tutorial (per week) (Each Lecture: 1 hour)

Unit-I

Systems of Linear Differential Equations: Basic theory of linear systems, Trial solution method for linear system with constant co-efficients, Simultaneous linear first order equations in three variables, methods of solution, Pfaffian differential equations, methods of solution of Pfaffian differential equations in three variables.

Unit-II

Formation of first order partial differential equations, Linear and non-linear partial differential equations of first order, special types of first order equations, Solutions of partial differential equations of first order satisfying given conditions.

Unit-III

Linear partial differential equations with constant coefficients, Equations reducible to linear partial differential equations with constant coefficients, Partial differential equations with variable coefficients.

Unit-IV

Laplace equation, Solution of Laplace equation by separation of variables, One dimensional wave equation, Solution of the wave equation (method of separation of variables), Diffusion equation, Solution of one-dimensional diffusion equation, method of separation of variables.

Book Recommended:

1. J. Sinha Roy and S. Padhy, A Course on Ordinary and Partial Differential Equations, Kalyani Publishers, New Delhi, Ludhiana, 2012. Chapters: 8(8.1-8.3), 11, 12, 13(13.1-13.5), 15(15.1, 15.5), 16(16.1, 16.1.1), 17(17.1, 17.2, 17.3).

Books for References:

1. Tyn Myint-U and Lokenath Debnath, Linear Partial Differential Equations for Scientists and Engineers, 4th edition, Springer, Indian reprint, 2006.
2. S.L. Ross, Differential equations, 3rd Ed., John Wiley and Sons, India, 2004.

Part-II(PRACTICAL)**Marks: 30 (Expt.: 15 + Viva: 10 + Record: 5)****Total Lectures: 20 (Each Lecture: 2 hours)****List of Practical using MATLAB****Practical/Labwork to be performed on a Computer.**

1. To find the general solution of the non-homogeneous system of the form:

$$\frac{dx}{dt} = a_1x + b_1y + f_1(t), \quad \frac{dy}{dt} = a_2x + b_2y + f_2(t)$$

with given conditions.

2. Plotting the integral surfaces of a given first order PDE with initial data.

3. Solution of wave equation $\frac{\partial^2 u}{\partial t^2} - c^2 \frac{\partial^2 u}{\partial x^2} = 0$ for the following associated conditions:

- (a) $u(x,0) = \phi(x), u_t(x,0) = \psi(x), x \in \mathbb{R}, t > 0$.
 (b) $u(x,0) = \phi(x), u_t(x,0) = \psi(x), u_x(0,t) = 0, x \in (0, \infty), t > 0$.
 (c) $u(x,0) = \phi(x), u_t(x,0) = \psi(x), u(0,t) = 0, x \in (0, \infty), t > 0$.
 (d) $u(x,0) = \phi(x), u_t(x,0) = \psi(x), u(0,t) = 0, u(1,t) = 0, 0 < x < 1, t > 0$.

4. Solution of diffusion equation $\frac{\partial u}{\partial t} - k^2 \frac{\partial^2 u}{\partial x^2} = 0$ for the following associated conditions:

- (a) $u(x,0) = \phi(x), u(0,t) = a, u(l,t) = b, 0 < x < l, t > 0$.
 (b) $u(x,0) = \phi(x), x \in \mathbb{R}, 0 < t < T$.
 (c) $u(x,0) = \phi(x), u(0,t) = a, x \in (0, \infty), t \geq 0$

Books Recommended:

1. A.K. Singh, Matlab Programming with Practical, Kalyani Publishers, Ludhiana, 2017. Chapters : 0, 3

SEMESTER -IV

CC-8: NUMERICAL METHODS

(Total Marks: 100)

Part-I (Marks:70 - End Sem: 50 Marks+Mid Sem:20Marks)

4 Lectures, 1 Tutorial (per week)(Each Lecture: 1 hour)

Unit-I

Rate of convergence, Algorithms, Errors: Relative, Absolute, Round off, Truncation. Numerical solution of non-linear equations: Bisection method, Regular-Falsi method, Secant method, Newton-Raphson method, Fixed-point Iteration method, Rate of convergence of these methods.

Unit-II

System of linear algebraic equations: Gaussian Elimination and Gauss Jordan methods. Gauss Jacobi method, Gauss Seidel method and their convergence analysis.

Unit-III

Polynomial interpolation: Existence uniqueness of interpolating polynomials, Lagrange and Newton's divided difference interpolation, Error in interpolation, Central difference & averaging operators, Gauss-forward and backward difference interpolation.

Unit-IV

Numerical Integration: Some simple quadrature rules, Newton-Cotes rules, Trapezoidal rule, Simpson's rule, Simpson's $\frac{3}{8}$ th rule, compound quadrature rules, compound mid-point rule, compound trapezoidal rule, compound Simpson's rule, Gauss-Legendre 2-point and 3-point rules. Numerical solutions of Differential Equations: Euler's Method.

Book Recommended:

1. B.P. Acharya and R.N. Das, A Course on Numerical Analysis, Kalyani Publishers, New Delhi, Ludhiana. Chapters: 0(0.2, 0.8), 1(1.5 to 1.9), 2(2.1-2.4, 2.6 - 2.9, 2. 11, 2.12), 3(3.1 to 3.4, 3.6 to 3.8), 6(6.1 to 6.3, 6.5, 6.10, 6.11), 7(7.1, 7.3), 8(8.1 to 8.3, 8.8).

Books for References:

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. C.F. Gerald and P.O. Wheatley, Applied Numerical Analysis, Pearson Education, India, 2008.
3. Uri M. Ascher and Chen Greif, A First Course in Numerical Methods, 7th Ed., PHI Learning Private Limited, 2013.
4. John H. Mathews and Kurtis D. Fink, Numerical Methods using Matlab, 4th Ed., PHI Learning Private Limited, 2012.
5. Brian Bradie, A Friendly Introduction to Numerical Analysis, Pearson Education, India, 2007.

Part-II(PRACTICAL)

Marks: 30 (Expt.: 15 + Viva: 10 + Record: 5)

Total Lectures: 20 (Each Lecture: 2 hours)

List of Practical using MATLAB

Practical/Labwork to be performed on a Computer.

1. Bisection Method
2. Regula Falsi Method
3. Secant Method
4. Newton Raphson Method
5. LU decomposition Method
 - (a) Doolittle's Method
 - (b) Crout's Method
 - (c) Cholesky's Method
 - (d) Solution of system of linear equation
6. Gauss Jacobi Method
7. Gauss-Siedel Method ($\omega=1$), where ω is a parameter
8. Advanced Gauss-Siedel Method
 - (a) Successive Under Relaxation (SUR) Method, where $0 \leq \omega \leq 1$
 - (b) Successive Over Relaxation (SOR) Method, where $1 \leq \omega \leq 2$
9. Lagrange Interpolation
10. Newton Interpolation Method
11. Trapezoidal Rule
12. Simpson's Rule
13. Simpson's $\frac{3}{8}$ th Rule
14. Compound Trapezoidal Rule
15. Compound Simpson's Rule

Books Recommended:

1. A.K.Singh, Matlab Programming with Practical, Kalyani Publishers, Ludhiana, 2017. Chapters : 0, 4.

SEMESTER –IV

CC-9: RIEMANN INTEGRATION & SERIES OF FUNCTIONS (ANALYSIS-III)

Total Marks: 100-(End Sem: 80 Marks+Mid Sem: 20 Marks)

5 Lectures, 1 Tutorial (per week)(Each Lecture: 1 hour)

Unit-I

Riemann integration; inequalities of upper and lower sums; Riemann conditions of integrability. Riemann sum and definition of Riemann integral through Riemann sums; equivalence of two definitions; Riemann integrability of monotone and continuous functions, Properties of the Riemann integral; definition and integrability of piecewise continuous and monotone functions, Fundamental theorems of Calculus.

Unit-II

Improper integrals; Series and Integrals, Absolute convergence of integrals, Convergence of Beta and Gamma functions.

Unit-III

Point-wise and Uniform convergence of sequence of functions, Cauchy's criterion & Weierstrass M-test for uniform convergence, Dedekind test, Uniform convergence and Continuity, Term by term integration of series, Term by term differentiation of series.

Unit-IV

Power series (Cauchy Hadamard Theorem), Radius of convergence, Differentiation and integration of power series, Abel's Limit Theorem, Stirling's formula, More about Taylor's series, Weierstrass Approximation Theorem.

Book Recommended:

1. G. Das and S. Pattanayak-Fundamentals of Mathematics Analysis, TMH Publishing Co., Chapters: 4(4.14 only), 8(8.1-8.6), 9(9.1- 9.8).
2. S.C. Mallik and S. Arora-Mathematical Analysis, New Age International Ltd., New Delhi, chapters: 11(3.3, 4.3 only), 12 restricted.

Books for References:

1. K.A. Ross, Elementary Analysis, The Theory of Calculus, Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.
2. Shanti Narayan and M.D. Raisinghania-Elements of Real Analysis, S. Chand & Co. Pvt. Ltd.
3. R.G. Bartle D.R. Sherbert, Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
4. Charles G. Denlinger, Elements of Real Analysis, Jones & Bartlett (Student Edition), 2011.

SEMESTER –IV**CC-10: RING THEORY & LINEAR ALGEBRA (ALGEBRA-III)****Total Marks: 100-(End Sem: 80 Marks+Mid Sem: 20 Marks)****5 Lectures, 1 Tutorial (per week)(Each Lecture: 1 hour)****Unit-I**

Introduction to Rings: definition and examples of rings, properties of rings, subrings. Integral Domains: integral domains and fields, characteristic of a ring. Ideals and Factor Rings: ideals, ideal generated by a subset of a ring, factor rings, operations on ideals, prime and maximal ideals.

Unit-II

Ring Homomorphisms: definitions and examples of ring homomorphism, properties of ring homomorphisms, Isomorphism theorems I, II and III, the field of quotients.

Unit-III

Vector Spaces: Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces

Unit-IV

Linear Transformations and Matrices : Linear transformations, nullspace, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations, invertibility and isomorphisms, isomorphism theorems.

Book Recommended:

1. Joseph A. Gallian, Contemporary Abstract Algebra (8th Edn.), Narosa Publishing House, New Delhi. Chapters (Part – 3: Rings): 12, 13, 14, 15.
2. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, 4th Ed., Prentice-Hall of India Pvt. Ltd., New Delhi, 2004. Chapters: 1(1.2-1.6), 2(2.1-2.4).

Books for References:

1. I.N. Herstein-Topics in Algebra, Wiley Eastern Pvt. Ltd. chapters: 3(3.1-3.5).
2. David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007. Chapters: 4(4.1-4.7), 5(5.4).
3. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
4. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
5. S. Lang, Introduction to Linear Algebra, 2nd Ed., Springer, 2005.
6. Gilbert Strang, Linear Algebra and its Applications, Cengage Learning India Pvt. Ltd.
7. S. Kumaresan, Linear Algebra-A Geometric Approach, Prentice Hall of India, 1999.
8. Kenneth Hoffman, Ray Alden Kunze, Linear Algebra, 2nd Ed., Prentice-Hall of India Pvt. Ltd., 1971.

SEMESTER-V

CC-11: MULTIVARIATE CALCULUS(CALCULUS-II)

Total Marks: 100-(End Sem: 80 Marks+Mid Sem: 20 Marks)

5 Lectures, 1 Tutorial (per week)(Each Lecture: 1 hour)

Unit-I

Functions of several variables, limit and continuity of functions of two variables, Partial differentiation, Tangent planes, Approximation and Differentiability, Chain rule for one and two independent parameters.

Unit-II

Directional derivatives and gradient, Maximal property of the gradient, Normal property of the gradient, Tangent planes and the normal lines, Extrema of functions of two variables, Lagrange Multipliers: Method of Lagrange multipliers, Constrained optimization problems, Geometrical interpretation.

Unit-III

Multiple Integration: Double integration over rectangular region, double integration over non-rectangular region, Double integrals in polar coordinates, Triple integrals, Triple integral over a parallelepiped and solid regions. Volume by triple integrals, cylindrical and spherical coordinates. Change of variables in double integrals and triple integrals.

Unit-IV

Line integrals, Application of line integrals: Mass and Work. Fundamental theorem for line integrals, conservative vector fields, independence of path. Green's theorem, surface integrals, integral over parametrically defined surfaces. Stokes theorem, The Divergence theorem.

Books Recommended:

1. Santosh K. Sengar-Advanced Calculus, Cengage Learning India Pvt. Ltd. Chapters: 4, 7, 11(11.1-11.12), 13(13.1, 13.2, 13.5, 13.9), 14.

2. M.J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) Pvt. Ltd.

(Pearson Education), Delhi, 2007. Chapters: 11(11.1(Pages:541-543), 11.2-11.6, 11.7(Pages: 598-605), 11.8(Pages:610-616)), 12 (12.1, -12.3, 12.4(Pages:652-660), 12.5, 12.6), 13 (13.1-13.3, 13.4(Pages:712-716, 718-720), 13.5(Pages:723-726;729-730), 13.6 (Pages:733-737), 13.7(Pages:742-745)).

Books for Reference:

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

2. E. Marsden, A.J. Tromba and A. Weinstein, Basic Multivariable Calculus, Springer (SIE), Indian reprint, 2005.

SEMESTER –V

CC-12: PROBABILITY & STATISTICS

Total Marks:100-(End Sem: 80 Marks+Mid-Sem: 20 Marks)

4 Lectures, 1 Tutorial (perweek) (Each Lecture: 1 hour)

Unit-I

Sample space, Probability axioms, Independent events, Conditional probability & Bayes' theorem, Real and continuous random variables (discrete and continuous), Cumulative distribution function, Expectation of random variables, Some special expectations.

Unit-II

Multivariate distributions, Joint cumulative distribution functions, Joint probability distributions, Marginal & conditional distributions, Some probability distributions (Discrete case), Uniform distribution, Binomial distribution, Negative Binomial & Geometric distributions, Poisson distribution.

Unit-III

Some probability distributions (Continuous case), Uniform, Gamma, Exponential, Beta distributions, Normal distributions, Normal approximation to the Binomial distribution, Bivariate normal distribution. Distribution of two random variables, Expectation of function of two random variables, Moment generating functions, Conditional distributions & expectations, Correlation coefficient, Co-variance, Independent random variables, Linear regression for two variables.

Unit-IV

Limit theorems, Markov's inequality, Chebyshev's inequality, Statement and interpretation of Weak and Strong Law of Large Numbers, Central Limit theorem for independent and identically distributed random variables with finite variance, Markov Chains: Introduction, Chapman-Kolmogorov equations.

Books Recommended:

1. Irwin Miller and Mary Lee Miller, John E. Freund, Mathematical Statistics with Applications, 7th Ed., Pearson Education, Asia, 2006. Chapters: Chapters: 2 (excluding Art. 2.9), 3 (excluding Art. 8), 4 (4.1-4.8), 5 (5.1, 5.2, 5.4, 5.5, 5.7), 6 (6.1-6.7), 14 (14.1, 14.2).
2. Sheldon Ross, Introduction to Probability Models, 11th Ed., Academic Press, Indian Reprint, 2007. Chapters: 2 (2.8), 4 (4.1-4.2).

Books for References:

1. Alexander M. Mood, Franklin A. Graybill and Duane C. Boes, Introduction to the Theory of Statistics, 3rd Ed., Tata McGraw-Hill, Reprint 2007.
2. S.C. Gupta and V.K. Kapoor-Fundamentals of Mathematical Statistics, S. Chand and Company Pvt. Ltd., New Delhi.
3. S. Ross-A First Course in Probability, Pearson Education.
4. Kai Lai Chung, Elementary Probability Theory with Stochastic Processes, 3rd Ed., Springer International Student Edition.
5. Robert V. Hogg, Joseph W. McKean and Allen T. Craig: Introduction to Mathematical Statistics, Pearson Education, Asia, 2102.

SEMESTER-VI**CC-13: METRIC SPACES & COMPLEX ANALYSIS (ANALYSIS-IV)****Total Marks: 100-(End Sem: 80 Marks+Mid Sem: 20 Marks)****5 Lectures, 1 Tutorial(per week)(Each Lecture: 1 hour)****Unit-I**

Metric spaces: Definition and examples, Open & Closed spheres, Neighborhoods, Open sets, Interior points, Closed sets, Limit points & isolated points, Closure of a set, Boundary points, Distance between sets & diameter of a set, Sub-spaces. Completeness: Sequences in metric spaces, Convergent sequences, Cauchy sequences, Complete metric spaces, Cantor's theorem, Dense sets and Separable metric spaces. Continuous functions: Definition & characterizations, Sequential criterion and other characterizations of continuity, Uniform continuity, Homeomorphism. Connectedness: Separated sets, Disconnected sets and Connected sets, Connected subsets of $\mathbb{R}$. Fixed point theorems and their applications: Contraction mappings, Banach Fixed point theorem.

Unit-II

Properties of complex numbers, Regions in the complex plane, Functions of complex variable, Mappings, Limits & Continuity of complex functions, Derivatives, Differentiation formulas, Cauchy-Riemann equations, Sufficient conditions for differentiability, Polar Coordinates, Analytic functions, Examples of analytic functions.

Unit-III

Exponential function, Logarithmic function, Trigonometric function, Derivatives of these functions, Definite integrals of functions, Contours, Contour integrals and its examples, Upper bounds for moduli of contour integrals, Theorems on antiderivatives, Cauchy-Goursat theorem (statement only), Cauchy integral formula, Its extension and consequences.

Unit-IV

Liouville's theorem and the Fundamental theorem of Algebra, Convergence of sequences and series, Taylor series with examples, Laurent series (without proof) with examples, Absolute and uniform convergence of power series.

Books Recommended:

1. P.K.Jain and K.Ahmad: Metric Spaces, Narosa Publishing House, New Delhi, 2nd Edition 2004. Chapters: 2(2.1 – 2.4, 2.6 – 2.12), 3(3.1 – 3.4), 4(4.1, 4.3, 4.4), 6(6.1, 6.2, 6.4), 7(7.1 restricted).
2. James Ward Brown and Ruel V. Churchill: Complex Variables and Applications, 8th Ed., McGraw Hill International Edition, 2014. Chapters: 1(2, 11), 2(12, 13, 15-25), 3(29, 30, 34), 4(37-41, 43-46, 50-53), 5(55-57, 59, 60, 62, 63).

Books for References:

1. S.Arumugam, A.T.Isaac, A.Somasundaram-Complex Analysis, Scitech pub.(INDIA) pvt.ltd.
2. Satish Shirali and Harikishan L. Vasudeva, Metric Spaces, Springer Verlag, London, 2006.
3. S.Kumaresan, Topology of Metric Spaces, 2nd Ed., Narosa Publishing House, 2011.
4. S.Ponnusamy-Foundation of Complex Analysis, Alpha Science International Ltd.
5. J.B.Conway-Functions of one complex variable, Springer.
6. N.Das-Complex Function Theory, Allied Publishers Pvt.Ltd., Mumbai.

SEMESTER –VI

CC-14: LINEAR PROGRAMMING

**Total Marks: 100-(End Sem: 80 Marks+Mid Sem: 20Marks)5 Lectures, 1
Tutorial(per week)(Each Lecture: 1 hour)**

Unit-I

Introduction to linear programming problems(LPP), Mathematical formulation of the LPP with illustrations, Graphical method, General Linear programming problems, Canonical & standard form of LPP. Theory of Simplex method, Optimality and unboundedness, the Simplex algorithm, Simplex method in tableau format, Introduction to artificial variables, Two-phase method, Big-M method and their comparisons.

Unit-II

Duality in LPP: Introduction, General Primal-Dual pair, Formulation of the Dual problem, Primal-Dual relationships, Duality theorems, Complementary slackness theorem, Duality & Simplex method, Economic interpretation of the Duality.

Unit-III

Transportation Problem (TP): LP formulation of TP, Existence of solution and Duality in TP, Solution of Transportation problems, North-West corner method, Least-Cost method and Vogel approximation method for determination of starting basic solution, Algorithm for solving transportation problem, Assignment problem and its mathematical formulation, Solution methods of Assignment problem, Special cases in Assignment problems.

Unit-IV

Games and Strategies: Introduction, Formulation of two person zero sum games, solving two person zero sum games, Maximin-Minimax principle, Games without saddle points, Games with mixed strategies, Graphical solution procedure to $(2 \times n)$ and $(m \times 2)$ games.

Books Recommended:

1. Kanti Swarup, P.K. Gupta and Man Mohan: Operations Research, S. Chand and Co. Pvt. Ltd., Chapters: 2, 3, 4, 5(5.1-5.8), 10(10.1-10.10), 11(11.1-11.4), 17(17.1-17.6).

Books for Reference:

1. G. Hadley, Linear Programming, Narosa Publishing House, New Delhi, 2002.
2. N. V. R. Naidu, G. Rajendra and T. Krishna Rao - Operations Research, I.K. International Publishing House Pvt. Ltd., New Delhi, Bangalore.
3. R. Veerachamy and V. Ravi Kumar - Operations Research - I.K. International Publishing House Pvt. Ltd., New Delhi, Bangalore.
4. P. K. Gupta and D. S. Hira - Operations Research, S. Chand and Company Pvt. Ltd., New Delhi.
5. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, Linear Programming and Network Flows, 2nd Ed., John Wiley and Sons, India, 2004. Chapters: 3(3.2-3.3, 3.5-3.7), 4(4.1-4.4).
6. F. S. Hillier and G. J. Lieberman, Introduction to Operations Research, 9th Ed., Tata McGraw Hill, Singapore, 2009. Chapter: 14.
7. Hamdy A. Taha, Operations Research, An Introduction, 8th Ed., Prentice Hall India, 2006. Chapter: 5(5.1, 5.3, 5.4).

SKILL ENHANCEMENT COURSES (SEC)

(Credit: 6each, Total Marks:100-End Sem: 80+Mid.Sem:20)

SEMESTER-IV

SEC-2 : LOGIC AND SETS

Unit - I

Logic: Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contrapositive and inverse propositions and precedence of logical operators. Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.

Unit - II

Sets and Relations: Sets, subsets, Set operations and the laws of set theory and Venn diagrams. Examples of finite and infinite sets. Finite sets and counting principle. Empty set, properties of empty set. Standard set operations. Classes of sets. Power set of a set. Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections.

Unit - III

Relation: Product set, Composition of relations, Types of relations.

Unit - IV

Partitions, Equivalence Relations with example of congruence modulo relation, Partial ordering relations, linear (total) ordering relations.

Books Recommended:

1. Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory, 3rd Ed., Pearson Education (Singapore) P.Ltd., Indian Reprint, 2005. Chapters: 1, 2.

Books for References:

1. R.P. Grimaldi - Discrete Mathematics and Combinatorial Mathematics, Pearson Education, 1998.
2. P.R. Halmos - Naive Set Theory, Springer, 1974.
3. E. Kamke - Theory of Sets, Dover Publishers, 1950.

DISCIPLINE SPECIFIC ELECTIVES (DSE)

SEMESTER-V

DSE-I : Programming in C++ (Compulsory)

Total Marks: 100

Part-I (Marks: 70) - End Sem: 50 Marks + Mid Sem: 20 Marks

04 Lectures, 1 Tutorial (per week) (Each Lecture: 1 hour)

Unit-I

Introduction to structured programming: The Basics of a C++ program, data types: simple data types, floating data types, character data types, string data types, arithmetic operators and operators precedence, Variables and constant declarations, expressions, increment (++) and decrement (--) operators, preprocessor directives, Creating a C++ program.

Unit-II

Input/ Output: input using the extraction operator >> and cin, output using the insertion operator << and cout, using pre-defined functions in a program. Control Structures I: relational operators, logical operators and logical expressions, if and if-else statement, switch structure.

Unit-III

Control Structures II: while, for, do-while loops, break and continue statement, nested control structure.

Unit-IV

User Defined Functions: predefined functions, user-defined functions, value returning functions, value versus reference parameters, local and global variables. Arrays and Strings: one dimensional array, two dimensional array. Pointers, Classes, Virtual Functions and Abstract Classes: pointer data type and pointer variables, address of operators, dereferencing operators.

Book Recommended:

1. D.S. Malik: C++ Programming Language, 6th Edition, Course Technology, Cengage Learning, India Edition, 2015. Chapters: 2 (Pages: 27 - 84), 3 (Pages: 121 - 148), 4 (Pages: 183 - 230), 5 (Pages: 259 - 309), 6 (Pages: 335 - 394), 8 (Pages: 505 - 527, 542 - 558), 12 (Pages: 781-788).

Books for References:

1. E. Balaguruswami: Object oriented programming with C++, fifth edition, Tata McGraw Hill Education Pvt. Ltd.
2. R. Johnsonbaugh and M. Kalin: Applications Programming in ANSI C, Pearson Education.
3. S.B. Lippman and J. Lajoie, C++ Primer, 3rd Ed., Addison Wesley, 2000.
4. Bjarne Stroustrup, The C++ Programming Language, 3rd Ed., Addison Wesley.

Part-II (Practical)

Marks: 30

List of Practicals (Using Any C++ software)
Practical/Lab work to be performed on a Computer.

1. Calculate the Sum of the series
$$-\frac{1}{1} + \frac{1}{2} - \frac{1}{3} + \frac{1}{4} - \dots + \frac{1}{N}$$
 for any positive integer N.
2. Write a user-defined function to find the absolute value of an integer and use it to evaluate the function $(-1)^n / |n|$, for $n = -2, -1, 0, 1, 2$.
3. Calculate the factorial of any natural number.
4. Read floating numbers and compute two averages: the average of negative numbers and the average of positive numbers.
5. Write a program that prompts the user to input a positive integer. It should then output a message indicating whether the number is a prime number.
6. Write a program that prompts the user to input the value of a , b , and c involved in the equation $ax^2 + bx + c = 0$ and outputs the type of the roots of the equation. Also the program should output all the roots of the equation.
7. Write a program that generates random integer between 0 and 99. Given that first two Fibonacci numbers are 0 and 1, generate all Fibonacci numbers less than or equal to generated number.
8. Write a program that does the following:
 - a. Prompts the user to input five decimal numbers.
 - b. Prints the five decimal numbers.
 - c. Converts each decimal number to the nearest integer.
 - d. Adds these five integers.
 - e. Prints the sum and average of them
9. Write a program that uses while loops to perform the following steps:
 - a. Prompt the user to input two integers: first Num and second Num (first Num should be less than second Num).
 - b. Output all odd and even numbers between first Num and second Num.
 - c. Output the sum of all even numbers between first Num and second Num.
 - d. Output the sum of the square of the odd numbers first Num and second Num.
 - e. Output all uppercase letters corresponding to the numbers between first Num and second Num, if any
10. Write a program that prompts the user to input five decimal numbers. The program should then add the five decimal numbers, convert the sum to the nearest integer, and print the result.
11. Write a program that prompts the user to enter the lengths of three sides of a triangle and then outputs a message indicating whether the triangle is a right triangle or a scalene triangle.
12. Write a value returning function smaller to determine the smallest number from a set of numbers. Use this function to determine the smallest number from a set of 10 numbers.
13. Write a function that takes as a parameter an integer (as a long value) and returns the number of odd, even, and zero digits. Also write a program to test your function.
14. Enter 100 integers into an array and sort them in an ascending/ descending order and print the largest/smallest integers.
15. Enter 10 integers into an array and then search for a particular integer in the array.
16. Multiplication/ Addition of two matrices using two dimensional arrays.
17. Using arrays, read the vectors of the following type: $A = (12345678)$, $B = (02340156)$ and compute the product and addition of these vectors.
18. Write a function, reverse Digit, that takes an integer as a parameter and returns the number with its digits reversed. For example, the value of function reverse Digit 12345 is 54321 and the value of reverse Digit -532 is -235.

SEMESTER-V

DSE-II : DISCRETE MATHEMATICS

Total Marks: 100,

End Sem: 80 Marks + Mid-Sem: 20 Marks

5 Lectures, 1 Tutorial (per week) (Each Lecture: 1 hour)

Unit-I

The Foundations- Logic and Proofs: Propositional Logic, Propositional equivalences, Predicates and Quantifiers, Nested quantifiers, Rules of Inference, Methods of proof. Relations: Relations and their properties, n-ary relations and their applications. Counting: The basic counting, the Pigeon-hole principle, Generalized Permutations and Combinations.

Unit-II

Advanced Counting Techniques: Recurrence relations, counting using recurrence relations, solving linear homogeneous recurrence relations with constant coefficients, Generating functions, solving recurrence relations using generating functions.

Unit-III

Relations: Partially ordered sets, Hasse diagram of partially ordered sets, maps between ordered sets, duality principle. Lattices (definition and example only). Boolean Algebra: Boolean algebra (definition and example only)

Unit-IV

Graphs: Basic concepts and graph terminology, representing graphs and graph isomorphism. Distance in a graph, cut vertices and cut edges, connectivity, Euler and Hamiltonian path. Shortest-Path problems, Planar graphs, Graph coloring.

Book Recommended:

1. Kenneth H. Rosen, Discrete Mathematics and Applications, Tata McGraw Hill Publications, Chapters: 1(1.1 -1.6), 5(5.1, 5.2, 5.5), 6(6.1, 6.2, 6.4), 7(7.1, 7.2, 7.6), 8, 10(10.1, 10.2).

Books for References:

1. Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory (2nd Edition), Pearson Education (Singapore) Pte. Ltd., Indian Reprint 2003.
2. B A. Davey and H. A. Priestley, Introduction to Lattices and Order, Cambridge University Press, Cambridge, 1990.
3. Rudolf Lidland Gnter Pilz, Applied Abstract Algebra (2nd Edition), Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.
4. D.S. Malik-Discrete Mathematics: Theory & Applications, Cengage Learning India Pvt. Ltd.
5. Kevin Ferland-Discrete Mathematical Structures, Cengage Learning India Pvt. Ltd.

SEMESTER-VI

DSE-III SEM-VI, PAPER-III

Total Marks: 100

End Sem: 80 Marks + Mid Sem: 20 Marks

5 Lectures, 1 Tutorial (per week) (Each Lecture: 1 hour)

1-Differential Geometry

Unit-I

Theory of Space Curves: Space curves, Planar curves, tangent, Curvature, binormal, torsion and Serret - Frenet formulae, locus of center of curvature, curve determined by its intrinsic equation, helices, involutes, evolutes.

Unit-II

Developable Surfaces: Surfaces, tangent plane, normal, envelope and characteristics, Edge of regression, developable surfaces.

Unit-III

Curvilinear Co-ordinates on a Surface: Curvilinear co-ordinates (Parametric curves on surfaces), first order magnitudes, directions on a Surface, the normal, second order magnitude, derivatives of unit (principal) normal n , curvature of normal section.

Unit-IV

Theory of Surfaces: Principal directions and Gaussian curvatures, Lines of curvature, first and second curvature, Rodrigues formula, minimal surface, Euler's theorem, Conjugate directions, conjugate systems and Asymptotic lines.

Book Recommended:

1. C.E. Weatherburn, Differential Geometry of Three Dimensions, Cambridge University Press 2003.
Chapters: 1(1-4, 7, 8, 10, 11), 2(13 - 17), 3, 4(29 - 31, 35 - 37).

Books for References:

1. T.J. Willmore, An Introduction to Differential Geometry, Dover Publications, 2012.
2. S. Lang, Fundamentals of Differential Geometry, Springer, 1999.
3. B.O'Neill, Elementary Differential Geometry, 2nd Ed., Academic Press, 2006.
4. A.N. Pressley - Elementary Differential Geometry, Springer.
5. B.P. Acharya and R.N. Das - Fundamentals of Differential Geometry, Kalyani Publishers, Ludhiana, New Delhi.

SEMESTER-VI

DSE-IV:

PROJECT WORK/DISSERTATION(Compulsory)

TotalMarks:100(Project:80Marks+Viva-Voice:20Marks)

(Identification of problem-10, review of literature-10, Methodology-10, Finding-25, Analysis-25, viva-voce-20)

GENERIC ELECTIVES

(04 Papers, 02 papers each from two Allied disciplines)

(Credit: 06 each, Marks: 100- (End Sem: 80 + Mid Sem: 20))

Minor – I: GE(1) and GE(2) & Minor – II: GE(1) and GE(2)

SEMESTER-I & III

GE-1: CALCULUS & ORDINARY DIFFERENTIAL EQUATIONS

Total Marks: 100- (End Sem: 80 Marks + Mid-Sem: 20 Marks)

Unit-I

Curvature, Asymptotes, Tracing of Curves (Cartenary, Cycloid, Folium of Descartes), Rectification, Quadrature, Elementary ideas about Sphere, Cones, Cylinders and Conicoids.

Unit-II

Preliminaries: review of limits, continuity and differentiability of functions of one variable and their properties. Rolle's Theorem, Lagrange's Mean Value Theorem, Cauchy's Mean Value Theorem, Taylor's Theorem for a function of one variable. Partial Differentiation: introduction, function of two or more variables, Limit and Continuity of functions of several variables, Partial derivatives, Partial derivatives of higher orders, Homogeneous functions, Euler's Theorem on Homogeneous functions, Total Differential coefficients, Second Differential coefficients of implicit functions.

Unit-III

Extrema of functions of several variables: introduction, necessary condition for maxima and minima of functions of two variables (By second derivative test and using Lagrange's method of undetermined multipliers), Implicit functions, Lagrange's multipliers (Formulae & its applications). Multiple Integrals: Introduction, Double integrals, properties of double integrals, evaluation of double integrals.

Unit-IV

Ordinary Differential Equations of order one and degree one (variables separable, homogeneous, exact and linear). Equations of order one but higher degree. Second order linear equations with constant coefficients, homogeneous forms, Second order equations with variable coefficients, Variation of parameters.

Books Recommended:

1. S.K. Sengar and S.P. Singh: Advanced Calculus, Cengage Learning India Pvt.Ltd. (6th Indian Reprint), Chapters: 1(1.11-1.14), 2(2.1-2.13, 2.21-2.24), 4(4.1-4.11), 5, 7(7.1-7.3 restricted), 11(11.1-11.4).
2. Shantinayakan: Text Book of Calculus, Part-II, S. Chand and Co., Chapter-8 (Art.24,25,26)
3. Shantinayakan: Text Book of Calculus, Part-III, S. Chand and Co., Chapter-1 (Art.1,2), 3, 4(Art. 10 to 12 omitting Simpson's Rule), 5(Art-13) and 6(Art-15).
4. B.P. Acharya and D.C. Sahu: Analytical Geometry of Quadratic Surfaces, Kalyani Publishers, New Delhi, Ludhiana 2007. Chapters: 2, 3(3.1-3.3), 4(4.1-4.3).
5. J. Sinharoy and S. Padhy: A Course of Ordinary and Partial Differential Equations, Kalyani Publishers. Chapters: 2(2.1 to 2.7), 3, 4(4.1 to 4.7), 5.

Books for References:

1. Shanti Narayan and P.K. Mittal- Analytical Solid Geometry, S. Chand & Company Pvt. Ltd., New Delhi.
2. David V. Weider- Advanced Calculus, Dover Publications.
3. Martin Braun- Differential Equations and their Applications- Martin Braun, Springer International.
4. M.D. Raisinghania- Advanced Differential Equations, S. Chand & Company Ltd., New Delhi.
5. G. Dennis Zill- A First Course in Differential Equations with Modelling Applications, Cengage Learning India Pvt. Ltd

SEMESTER-II & IV

**GE-II: LINEAR ALGEBRA, ABSTRACT ALGEBRA
& NUMERICAL ANALYSIS**

Total Marks: 100 (End Sem: 80 Marks + Mid-Sem: 20 Marks)

Unit-I

Vectorspace, Subspace, Span of a set, Linear dependence and Independence, Dimensions and Basis. Linear transformations, Range, Kernel, Rank, Nullity, Inverse of a linear map, Rank-Nullity theorem (statements only).

Unit-II

Matrices and linear maps, Rank and Nullity of a matrix, Transpose of a matrix, Types of matrices. Elementary row operations, System of linear equations, Matrix inversion using row operations, Rank of matrices.

Unit-III

Group Theory: Definition and examples, Subgroups, Normal subgroups, Cyclic groups, Cosets, Quotient groups, Permutation groups, Homomorphism. Elementary ideas about Rings, Field (definitions, statements, and examples only).

Unit-IV

Convergence, Errors: Relative, Absolute, Roundoff, Truncation. Transcendental and Polynomial equations: Bisection method, Newton's method, Secant method. Rate of convergence of these methods. System of linear algebraic equations: Gaussian Elimination and Gauss-Jordan methods. Interpolation: Lagrange and Newton's methods. Error bounds. Finite difference operators. Gregory forward and backward difference interpolation (statements, definitions and uses/examples only).

Books Recommended:

1. V. Krishnamurty, V. P. Mainra, J. L. Arora - An introduction to Linear Algebra, Affiliated East-West Press Pvt. Ltd., New Delhi, Chapters: 3, 4 (4.1-4.7), 5 (except 5.3).
2. I. N. Herstein - Topics in Algebra, Wiley Eastern Pvt. Ltd. Chapters: 2 (2.1-2.7, 2.10), 3 (3.1, 3.2).
3. B. P. Acharya and R. N. Das, A Course on Numerical Analysis, Kalyani Publishers, New Delhi, Ludhiana. Chapters: 0 (0.2), 1 (1.5-1.9), 2 (2.1 to 2.4, 2.6, 2.8, 2.9), 3 (3.1, 3.2, 3.4, 3.6), 8 (8.1-8.3).

Books for References:

1. S. Kumaresan - Linear Algebra: A Geometric Approach, Prentice Hall of India.
2. Rao and Bhimasankaran - Linear Algebra, Hindustan Publishing House.
3. S. Singh - Linear Algebra, Vikas Publishing House Pvt. Ltd., New Delhi.
4. Gilbert Strang - Linear Algebra & its Applications, Cengage Learning India Pvt. Ltd.
5. Artin - Algebra, Prentice Hall of India.
6. V. K. Khanna and S. K. Bhambri - A Course in Abstract Algebra, Vikas Publishing House Pvt. Ltd., New Delhi.
7. I. H. Seth - Abstract Algebra, Prentice Hall of India Pvt. Ltd., New Delhi.
8. Joseph A. Gallian, Contemporary Abstract Algebra (8th Edn.), Narosa Publishing House, New Delhi.