COURSE STRUCTURE
B.Sc.(Honours)-Mathematics

- Core Courses:6 credit each, Max. Marks:100
- Ability Enhancement Compulsory Courses (AECC-MIL/Alt.English):2 credit each, Max. Marks:50
- Ability Enhancement Compulsory Courses (AECC-Environmental science):4 credit each, Max. Marks:100
- Skill Enhancement Courses (SEC):2 credit each, Max. Marks:50
- Discipline Specific Elective (DSE):6 credit each, Max. Marks:100
- Generic Electives (GE):6 credit each, Max. Marks:100
- For papers with practical component:Theory: 70(Mid-Sem:20+End Sem: 50)Marks, Practical(End Sem):30Marks (expt.-10, viva-10, record-10).
- For papers with no practical/practical component:Theory 100(Mid-Sem.:20+End Sem.:80) Marks
- For papers with 50 Marks:Mid-Sem.:10 Marks+End Sem.:40 Marks.

CORE COURSES
B.SC.(HONOURS)-MATHEMATICS

SEMESTER-I

C-1: CALCULUS-I
(Total Marks: 100)
Part-I(Marks: 70)
4 Lectures, 1 Tutorial (per week)

Unit-I

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

Unit-II

Reduction formulae, derivations and illustrations 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.

Part-II(PRACTICAL)

(Marks: 30)

List of Practical (Using any software/MATLAB)

Practical/Lab work 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. 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-Shantinarayan, S. Chand & Co., Chapters: 6, 7, 10(Art. 33-36).

4. Text Book of Calculus, Part-III- Shantinarayan, 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.

<h1 align="center">C:2-ALGEBRA-I</h1>

<p align="center">Total Marks: 100-(Theory: 80 Marks+Mid-Sem: 20 Marks)</p>

<p align="center">5 Lectures, 1 Tutorial (per week)</p>

Unit-I

Polar representation of complex numbers, n-th roots of unity, De Moivres 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 sets of linear systems, applications of linear systems, linear independence.

Unit-IV

Introduction to linear transformations, matrix of a linear transformation, inverse of a matrix, characterizations 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. Titu Andreescu and Dorin Andrica, Complex Numbers from A to Z, Birkhauser, 2006. Chapter:2

3. 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(4.1-4.1.6, 4.2-4.2.11, 4.4(4.1-4.4.8),4.3-4.3.9, 5(5.1-5.1.4).

4. 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).

5. James Ward Brown and Ruel V. Churchill, Complex Variables and Applications, 8th Ed., McGraw Hill International Edition, 2009.chapter:1(1-10).

SEMESTER –II

C:3-REAL ANALYSIS (ANALYSIS-I)

Total Marks: 100-(Theory: 80 Marks+Mid-Sem: 20 Marks)
5 Lectures, 1 Tutorial (per week)

Unit-I

Review of Algebraic and Order Properties of R, Upper bound & Lower bound, Least upper bound (LUB), Greatest lower bound (GLB), LUB & GLB property of an ordered field, Com- pleteness of an ordered field, Incompleteness of 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, Weier- strass 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, Cauchys 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 Weier- strass theorem for sets.

Books Recommended:
1. G. Das and S. Pattanayak, Fundamentals of Mathematical Analysis, TMH Publishing Co., Chap- ters: 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. Bilodeau , 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).

C-4: DIFFERENTIAL EQUATIONS
(Total Marks:100)

Part-I(Marks: 70)
4 Lectures, 1 Tutorial (per week)

Unit-I

Basic concepts of Differential equations and mathematical models. First order and first degree Ordinary differential equations(variables separable, homogeneous, exact, and linear). Applica- tions 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 coef- ficients, 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 solutions of second order differential equations. Legendre Equation and Legendre Polynomial, Hermite Equation and Hermite Polynomial.

Unit-IV

Laplace transforms and its applications to solutions of differential equations.

Part-II(PRACTICAL)
(Marks: 30)
List of Practical (Using any software/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).

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.

SEMESTER -III
C-5: THEORY OF REAL FUNCTIONS (ANALYSIS-II)
Total Marks: 100-(Theory: 80 Marks+Mid-Sem: 20 Marks)
5 Lectures, 1 Tutorial (per week)

Unit-I

Limits of functions ($\in-\delta$ approach),, Sequential criterion for limits, Divergence criteria. Limit theorems, one-sided limits. Infinite limits and limit at infinity. Continuous functions, Sequential criterion for continuity, Algebra of continuous functions and theorems related to continuity of functions.

Unit-II

Discontinuity and kinds of discontinuity, Further properties of continuity, Uniform continuity, Differentiable functions, Left hand & Right hand derivatives, Algebra of differentiable functions, Caratheodory's theorem.

Unit-III

Mean value conditions, Global and local maximum & minimum, Rolle's theorem, General- ized mean value theorem, Cauchy mean value theorem, Lagrange's mean value theorem and their applications, Darbouxs theorem, Indeterminant forms, Higher order derivatives(Leibnitz theorem), Taylor's theorem and its applications to approximating functions by means of poly- nomials.

Unit-IV

Maxima and Minima, Taylor's theorem with different forms of remainder, Maclaurin's theorem, Deduction of Taylor's theorem from mean value theorem, Taylor's and Maclaurin's infinite se- ries, Taylors series and Maclaurins series expansions of exponential and trigonometric functions, $\ln(1 + x)$, $1/(ax + b)$ and $(1 + x)^n$.

Book Recommended:

1. G. Das and S. Pattanayak, Fundamentals of Mathematics Analysis, TMH Pub-lishing Co., 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

Books for References:

1. R. Bartle and D.R. Sherbert, Introduction to Real Analysis, John Wiley and Sons, 2003.

2. K.A. Ross, Elementary Analysis: The Theory of Calculus, Springer, 2004.

3. A. Mattuck, Introduction to Analysis, Prentice Hall, 1999.

4. S.R. Ghorpade and B.V. Limaye, A Course in Calculus and Real Analysis, Springer, 2006.

C-6: GROUP THEORY (ALGEBRA-II)

Total Marks: 100-(Theory: 80 Marks+Mid-Sem: 20 Marks)
5 Lectures, 1 Tutorial (per week)

Unit-I

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

Unit-II

Properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, properties of cosets, Lagranges theorem and consequences including Fermats Little theorem.

Unit-III

External direct product of a finite number of groups, normal subgroups, factor groups, Cauchys theorem for finite abelian groups.

Unit-IV

Group homomorphisms, properties of homomorphisms, Cayleys theorem, properties of isomorphisms, First, Second and Third isomorphism theorems (statements only).

Book Recommended:

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. Joseph A. Gallian, Contemporary Abstract Algebra(8th Edn.), Narosa Publishing House, New Delhi, chapters: 2-11(up to theorem-6.2).

Books for References:

1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.

2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.

3. Joseph J. Rotman, An Introduction to the Theory of Groups, 4th Ed., Springer Verlag, 1995.

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

(Total Marks: 100)
Part-I(Marks: 70)
04 Lectures(per week)

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 solutions 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.

Part-II(PRACTICAL)
(Marks: 30)

List of Practical (Using any Software/MATLAB)
Practical/Lab work to be performed on a Computer.

1. To find the general solution of the non-homogeneous system of the form:
$$\frac{dx}{dt} = a_1 x + b_1 y + f_1(t), \frac{dy}{dt} = a_2 x + b_2 y + f_2(t)$$
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) $u(x, 0) = \varphi(x)$, $u_t(x, 0) = \psi(x)$, $x \in R, t > 0$.
   (b) $u(x, 0) = \varphi(x)$, $u_t(x, 0) = \psi(x)$, $u_x(0, t) = 0, x \in (0, \infty), t > 0$.
   (c) $u(x, 0) = \varphi(x)$, $u_t(x, 0) = \psi(x)$, $u(0, t) = 0, x \in (0, \infty), t > 0$.
   (d) $u(x, 0) = \varphi(x)$, $u_t(x, 0) = \psi(x)$, $u(0, t) = 0, u(1, t) = 0, 0 < x < l, t > 0$.

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) $u(x, 0) = \varphi(x)$, $u(0, t) = a, u(l, t) = b, 0 < x < l, t > 0$.
   (b) $u(x, 0) = \varphi(x)$, $x \in R, 0 < t < T$.
   (c) $u(x, 0) = \varphi(x)$, $u(0, t) = a, x \in (0, \infty), t \geq 0$.

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.

SEMESTER –IV

C-8: NUMERICAL METHODS

(Total Marks: 100)

Part-I(Marks: 70)
04 Lectures(per week)

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 Newtons 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, Simpsons rule, Simpsons $\frac{3}{8}$ th rule, compound quadrature rules, compound mid-point rule, compound trapezoidal rule, compound Simpsons rule, Gauss-Legendre 2-point and 3-point rules. Numerical solutions of Differential Equations : Euler's Method.

Part-II(PRACTICAL)

(Marks: 30)

List of Practical (Using any Software/MATLAB)
Practical/Lab work to be performed on a Computer.

1. Bisection Method.

2. Newton Raphson Method.

3. Secant Method.

4. Regulai Falsi Method.

5. LU decomposition Method.

6. Gauss-Jacobi Method.

7. SOR Method or Gauss-Siedel Method.

8. Lagrange Interpolation or Newton Interpolation method.

9. Compound Trapezoidal rule & Simpson's rules.

Book Recommended:

1. B.P. Acharya and R.N. Das, A Course on Numerical Analysis, Kalyani Publishers, New Delhi, Ludhiana. Chapters: 1, 2(2.1 to 2.4, 2.6, 2.8, 2.9), 3(3.1 to 3.4, 3.6 to 3.8, 3.10), 4(4.1, 4.2), 5(5.1, 5.2, 5.3), 6(6.1, 6.2, 6.3, 6.10, 6.11), 7(7.1, 7.2, 7.3, 7.4 &7.7).

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.

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

Total Marks: 100-(Theory: 80 Marks+Mid-Sem: 20 Marks)
5 Lectures, 1 Tutorial (per week)

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 inte- gration of power series, Abels 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(9.1-9.6, 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.

C-10: RING THEORY & LINEAR ALGEBRA (ALGEBRA-III)

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

5 Lectures, 1 Tutorial (per week)

Unit-I

Definition and examples of rings, properties of rings, subrings, integral domains and fields, characteristic of a ring. Ideal, ideal generated by a subset of a ring, factor rings.

Unit-II

Ring homomorphisms, properties of ring homomorphisms, more ideals and quotient rings.

Unit-III

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, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations. Isomorphisms, Isomorphism theorems, invertibility and isomorphisms.

Book Recommended:

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: 6.

3. Joseph A. Gallian, Contemporary Abstract Algebra(8th Edn.), Narosa Publishing House, New Delhi. Chapters:12, 13, 14(restricted), 15(restricted).
4. 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(2.1-2.5).

Books for References:

1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.

2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.

3. S. Lang, Introduction to Linear Algebra, 2nd Ed., Springer, 2005.

4. Gilbert Strang, Linear Algebra and its Applications, Cengage Learning India Pvt. Ltd.

5. S. Kumaresan, Linear Algebra- A Geometric Approach, Prentice Hall of India,1999.

6. Kenneth Hoffman, Ray Alden Kunze, Linear Algebra, 2nd Ed., Prentice-Hall of India Pvt. Ltd., 1971.

SEMESTER-V

C-11: MULTIVARIATE CALCULUS (CALCULUS-II)

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

5 Lectures, 1 Tutorial (per week)

Unit-I

Functions of several variables, limit and continuity of functions of two variables, Partial dif- ferentiation, 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, Method of Lagrange multipliers, Lagrange Multipliers, Constrained optimization problems, A geometrical interpretation.

Unit-III

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

Unit-IV

Line integrals, Applications of line integrals: Mass and Work. Fundamental theorem for line integrals, conservative vector fields, independence of path. Greens theorem, surface integrals, integrals 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:610-614)), 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.

C-12: PROBABILITY & STATISTICS

Total Marks:100-(Theory: 80 Marks+Mid-Sem: 20 Marks)
4 Lectures, 1 Tutorial (per week)

Unit-I

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

Unit-II

Multivariate distributions, Joint cumulative distribution functions, Joint probability distribu- tions, Marginal & conditional distributions, Some probability distributions(Discrete case), Uni- form distribution, Binomial distribution, Negative Binomial & Geometric distributions, Poisson distribution.

Unit-III

Some probability distributions(Continuous case), Uniform, Gamma, Exponential, Beta distri- butions, 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, Chebyshevs 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 Marylees Miller, John E. Freund, Mathematical Statistics with Applications, 7th Ed., Pearson Education, Asia, 2006. Chapters: Chapters: 2 (excluding Art.9), 3 (excluding Art.8), 4, 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(4.1-4.3).

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
C-13: METRIC SPACES & COMPLEX ANALYSIS (ANALYSIS-IV)
Total Marks: 100-(Theory: 80 Marks+Mid-Sem: 20 Marks)
5 Lectures, 1 Tutorial (per week)

Unit-I

Metric spaces: Definition and examples, Open & Closed spheres, Neighborhoods, Interior points, Open set, Closed set, Boundary points, Limit points & isolated points, Closure of a set, Dense sets, Separable metric spaces, Sequences in metric spaces, Convergent sequences, Cauchy sequences, Complete metric spaces, Distance between sets & diameter of a set, Sub- spaces, Cantor's theorem. Continuous functions: Definition & characterizations, Sequential criterion and other character- izations of continuity, Uniform continuity, Homeomorphism, Connectedness, Connected subsets of R, Separated sets, Disconnected sets, 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 Co-ordinates, An- alytic functions, Examples of analytic functions.

Unit-III

Exponential function, Logarithmic function, Trigonometric function, Derivatives of these func- tions, 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

Liouvilles 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. Chapters: 2(1-9, 12), 3(1-4), 4(1-4), 6(1-2, 4), 7(1 only).

2. James Ward Brown and Ruel V. Churchill: Complex Variables and Applications, 8th Ed., McGraw Hill International Edition, 2009. Chapters: 1(11 only), 2(12, 13, 15-25), 3(29, 30, 34), 4(37-41, 43-46, 50-53), 5(55-60, 62, 63, 66).

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-Foundations 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.

C-14: LINEAR PROGRAMMING

Total Marks: 100-(Theory: 80 Marks+Mid-Sem: 20 Marks)
5 Lectures, 1 Tutorial (per week)

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 trans- portation 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., PrenticeHall India, 2006. Chapter:5(5.1, 5.3, 5.4).

Discipline Specific Electives (DSE)

DSE-I, SEM-V, PAPER-I
Programming in C++ (Compulsory)
Total Marks:100

Part-I(Marks:70)
(Theory:50 Marks+Mid-Sem:20 Marks)
04 Lectures (per week)

Unit-I

Introduction to structured programming: data types- simple data types, floating data types, character data types, string data types, arithmetic operators and operators precedence.

Unit-II

Variables and constant declarations, expressions, input using the extraction operator ¿¿ and cin, output using the insertion operator ¡¡ and cout, preprocessor directives, increment(++) and decrement(−) operations.

Unit-III

Creating a C++ program, input/ output, relational operators, logical operators and logical expressions, if and if-else statement, switch and break statements. for, while and do-while loops and continue statement, nested control statement.

Unit-IV

Value returning functions, value versus reference parameters, local and global variables, one dimensional array, two dimensional array, pointer data and pointer variables.

Book Recommended:

1. D. S. Malik: C++ Programming Language, Edition-2009, Course Technology, Cengage Learning, India Edition. Chapters: 2(Pages:37-95), 3(Pages:96-129), 4(Pages:134-178), 5(Pages:181-236), 6, 7(Pages:287-304), 9 (pages: 357-390), 14(Pages:594-600).

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 Welsley.

Part-II(Practical: Marks:30)

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

1. Calculate the Sum of the series $\frac{1}{1} + \frac{1}{2} + \frac{1}{3}.. + \frac{1}{N}$ 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 outputs 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 whileloops to perform the following steps:

   a. Prompt the user to input two integers :first Num and second Num (first Num shoul 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 firs tNum 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 triangleor 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 short 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. Read from a text file and write to a text file.

19. 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 Digit12345 is 54321 and the value of reverse Digit −532 is −235.

DSE-II, SEM-V, PAPER-II
Total Marks:100,
Theory:80 Marks+Mid-Sem:20 Marks
5 Lectures, 1 Tutorial (per week)

Discrete Mathematics

Unit-I

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

Unit-II

Recurrence relations, counting using recurrence relations, solving linear homogeneous recurrence re- lations with constant coefficients, Generating functions, solving recurrence relations using generating functions.

Unit-III

Partially ordered sets, Hasse diagram of partially ordered sets, maps between ordered sets, duality principle. Lattices (definition and example only), 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, Chap- ters: 1(1.1 -1.6), 4(4.1, 4.2, 4.5), 5(5.1, 5.2, 5.5), 6(6.1, 6.2, 6.5, 6.6), 7(7.1, 7.2), 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 Lidl and 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.

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DSE-III   SEM-VI, PAPER-III
Total Marks:100
Theory:80 Marks+Mid-Sem:20 Marks
5 Lectures, 1 Tutorial (per week)

1-Differential Geometry

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Unit-I

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Theory of Space Curves: Space curves, Planer curves, Curvature, torsion and Serret-Frenet formulae.

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Unit-II

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Osculating circles, Osculating circles and spheres. Existence of space curves. Evolutes and involutes of curves.

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Unit-III

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Developables: Developable associated with space curves and curveson surfaces, Minimal surfaces.

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Unit-IV

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Theory of Surfaces: Parametric curves on surfaces. Direction coefficients. First and second Fundamental forms. Principal and Gaussian curvatures. Lines of curvature, Eulers theorem. Rodrigues formula, Conjugate 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), 2(13, 14, 16, 17), 3, 4(29-31, 35, 37, 38).

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.

DSE-IV, SEM-VI
PROJECT WORK/DISSERTATION(Compulsory)

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

(Identification of problem-10, review of literature-10, Methodology-10, finding-25, analysis-25, viva-voce-20)

Skill Enhancement Courses(SEC)
(Credit: 2 each, Total Marks:50-Theory:40+Mid.Sem:10) SEC-I to SEC-IV

SEC-I SEM-III

Communicative English and Writing Skill(Compulsory)

SEC-II SEM-IV

Logic and Sets

Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, bicondi- tional propositions, converse, contrapositive and inverse propositions and precedence of logical op- erators. Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations. 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. Relation: Prod- uct set, Composition of relations, Types of relations, 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.

Generic Electives/Interdisciplinary
(04 Papers, 02 papers each from two Allied disciplines)
(Credit: 06 each, Marks:100)
GE-I to GE-IV

GE-1 : CALCULUS & ORDINARY DIFFERENTIALEQUATIONS
Total Marks:100-(Theory: 80 Marks+Mid-Sem: 20 Marks)

Unit-I
Curvature, Asymptotes, Tracing of Curves (Cartenary, Cycloid, Folium of Descartes), Rectifi- cation, Quardrature, Elementary ideas about Sphere, Cones, Cylinders and Conicoids.

Unit-II
Review of limits, continuity and differentiability of functions of one variables and their proper- ties, Limit and Continuity of functions of several variables, Partial derivatives, Partial deriva- tives of higher orders, Homogeneous functions, Change of variables, Mean value theorem, Tay- lors theorem and Maclaurins theorem for functions of two variables(statements & applications).

Unit-III
Maxima and Minima of functions of two and three variables, Implicit functions, Lagranges multipliers (Formulae & its applications), Concepts of Multiple integrals & its applications.

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 coeffi- cients, 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 restricted), 2(2.1-2.13 restricted), 4(4.1-4.11), 5, 7(7.1-7.3 restricted), 11(resticted).

2. Shantinarayan: Text Book of Calculus, Part-II, S. Chand and Co., Chapter-8 (Art. 24, 25, 26)

3. Shantinarayan: Text Book of Calculus, Part-III, S. Chand and Co., Chapter-1 (Art 1,2), 3, 4(Art. 10 to 12 ommitting Simpsons Rule), 5(Art-13) and 6(Art-15).

4. B.P. Acharya and D.C. Sahu: Analytical Geometry of Quadratic Surfaces, Kalyani Pub- lishers, New Delhi, Ludhiana.

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.

GE-II: LINEAR ALGEBRA, ABSTRACT ALGEBRA & NUMERICAL ANALYSIS
Total Marks:100-(Theory: 80 Marks+Mid-Sem: 20 Marks)

Unit-I
Vector space, 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, Round off, Truncation. Transcendental and Polyno- mial equations: Bisection method, Newtons method, Secant method. Rate of convergence of these methods. System of linear algebraic equations: Gaussian Elimination and Gauss Jordan methods. Interpolation: Lagrange and Newtons 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), 6(6.1, 6.2, 6.5, 6.6, 6.8), 7(7.4 only).

2. I.N. Herstein-Topics in Algebra, Wiley Eastern Pvt. Ltd. Chapters: 2(2.1-2.7), 3(3.1, 3.2).

3. B.P. Acharya and R.N. Das, A Course on Numerical Analysis, Kalyani Publishers, New Delhi, Ludhiana. Chapters: 1, 2(2.1 to 2.4, 2.6, 2.8, 2.9), 3(3.1 to 3.4, 3.6 to 3.8, 3.10), 4(4.1, 4.2), 5(5.1, 5.2, 5.3), 6(6.1, 6.2, 6.3, 6.10, 6.11).

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.