COURSES OF STUDIES

Courses of Studies (Choice Based Credit System)

B.A/B.Sc. (Hons.) Mathematics

SESSION 2016-17

CORE COURSES

B.Sc.(Honours)-Mathematics

CREDIT : 06 each

KHALLIKOTE UNIVESITY

&

KHALLIKOTE AUTONOMOUS COLEGE

BERHAMPUR,GANJAM, ODISHA-760001

COURSE STRUCTURE

B.A/B.Sc (Honours) – Mathematics

- **Core Courses:6 credit each, Max. Marks:100**
- **Ability Enhancement Compulsory Courses (AECC):2 credit each, Max. Marks:50**
- **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: 75(Mid-Sem:15+End Sem: 60)Marks, Practical(End Sem):25 Marks.
- **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.

Semester-I

Core Courses (C)	**Ability Enhancement Compulsory Courses (AECC)**	**Skill Enhancement Courses (SEC)**	**Discipline Specific Elective (DSE)**	**Generic Electives (GE)**
C-1.1: Calculus & 3 D-I(P) C-1.2: Algebra-I	MIL/Alt. English	X	X	GE-I PAPER-I

Semester-II

Core Courses (C)	**Ability Enhancement Compulsory Courses (AECC)**	**Skill Enhancement Courses (SEC)**	**Discipline Specific Elective (DSE)**	**Generic Electives (GE)**
C-2.1: Real Analysis (Analysis-I) C-2.2: Differential Equations(P)	Environmental Science		**X**	GE-II PAPER-I

Semester-III

Core Courses (C)	Ability Enhancement Compulsory Courses (AECC)	Skill Enhancement Courses (SEC)	Discipline Specific Elective (DSE)	Generic Electives (GE)
C-3.1: Theory of Real Functions (Analysis-II) C-3.2: Group Theory (Algebra-II) C-3.3: Partial Differential Equations and Systems of Ordinary Differential Equations (P)	**X**	**SEC-I**	**X**	**GE-I PAPER-II**

Semester-IV

Core Courses (C)	Ability Enhancement Compulsory Courses (AECC)	Skill Enhancement Courses (SEC)	Discipline Specific Elective (DSE)	Generic Electives (GE)
C-4.1: Numerical Methods(P) C-4.2: Riemann Integration and Series of Functions (Analysis-III) C-4.3: Ring Theory and Linear Algebra-I (Algebra-III)	**X**	**SEC-II**	**X**	**GE-II PAPER-II**

Semester-V

Core Courses (C)	Ability Enhancement Compulsory Courses (AECC)	Skill Enhancement Courses (SEC)	Discipline Specific Elective (DSE)	Generic Electives (GE)
C-5.1: Multivariate Calculus (Calculus-II) C-5.2: Probability and Statistics	X	X	DSE-I DSE-II	X

Semester-VI

Core Courses (C)	Ability Enhancement Compulsory Courses (AECC)	Skill Enhancement Courses (SEC)	Discipline Specific Elective (DSE)	Generic Electives (GE)
C-6.1: Metric Spaces andComplex Analysis (Analysis-IV) C-6.2: Linear Programming	X	X	DSE-III DSE-IV	X

Semester – I

C-1.1: Calculus–I & 3-D

Part -I (Theory)

(Total Marks; 60+15)
5 Lectures, 1 Tutorial per week

Unit-I

Hyperbolic functions, higher order derivatives, Leibnitz Theorem and its applications , asymptotes, curvature, concavity, inflection points and multiple points, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves and parametric curves.

Unit-II

Reduction formulae, derivations and illustrations of reduction formulae of the, area of curves, area of polar curves, length of plane curves, volumes and surfaces of solid of revolution.

Unit-III

Sphere, Cone, Cylinder, Central Conicoids

Unit-IV

Multiple product, introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation of vectors, Differential operator, integration of vector functions.

Part -II (Practical) Total Mark-25

(Using any software)
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, the derivative graph, the second derivative graph and comparing them.
3. Sketching parametric curves (Eg. cycloid, asroid, cissoids, cardiod).
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, elliptic cone, elliptic, paraboloid, hyperbolic paraboloid using cartesian coordinates.
7. Matrix operation (addition, multiplication, inverse, transpose)

Books Prescribed

1. Mathematics for Degree students by Dr. P K Mittal, S. Chand & Co.(2014th Edn.)

   Differential Calculus, Chapters: 3(3.3), 5,6(excluding 6.5),7(7.1-7.5),8.
   Integral Calculus, Chapters: 3(3.1-3.14),5(5.1-5.6), 6(6.1-6.4),7
   Geometry (3-D) Chapter 4,5, 6
   Vector analysis- Chapter 1,2,3,4.

Books for reference

1. Text book of Calculus, Part-II by Shantinarayan, S Chand & Co.
2. Text book of Calculus, Part-III by Shantinarayan, S Chand & Co.
3. Elementary Calculus by Panda and Satapathy.
4. Calculus by G.B.Thomas, Pearson Education, Delhi

5. Analytical Solid Geometry by S.Narayan and Mittal, S.Chand Co.
6. Analytical Geometry of Quadratic Surfaces by B.P.Acharya and D.P.Sahu, Kalyani Publishers

C-1.2: Algebra-I
Total Marks:100

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

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, Divisibility & Euclidean algorithm, Primes, Principles of Mathematical Induction, statement of Fundamental Theorem of Arithmetic.

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: Definition, Range and Kernel of a linear map, Rank and nullity, Inverse of a Linear Transformation, Rank nullity theorem, The Space L(U, V), Composition of Linear Map

Books Prescribed

1. Mathematics for Degree students by Dr. P K Mittal, S. Chand & Co.(2014th Edn.)

   Trigonometry, Chapters:1 (1.1-1.4)
2. An introduction to the Theory of Number by Ivan Niven & H S Zuckerman, Wilea Eastern ltd. Chapter 1(1.1-1.3)
3. An Introduction to Linear Algebra by V Krishna Murthy, V P Mainra, J L Arora, Affiliated East-West Press Pvt. Ltd. Chapter 3, 4(4.1-4.7)

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.
7. I.N. Herstein-Topics in Algebra, Wiley Eastern Pvt. Ltd.
8. D. K Dalai, B.Sc Mathematics, Algebra-1, Kalyani Publishers.

Semester – II

C-2.1: Analysis –I
(Total Marks; 80+20)
5 Lectures, 1 Tutorial per week

Unit-I

Field structure and order structure, Bounded and unbounded sets, (excluding Dedikinds form of completeness property), completeness in the set of real numbers, Absolute value of a real number.

Unit-II

Neighborhood of a point, Interior point, Limit point, Open set, Closed set, Dense set, Perfect set, Bolzano-Weierstrass's theorem, Countable and Uncountable sets.

Unit-III

Sequences, Limit points function a sequence, Limit inferior and superior, Convergent sequence, Non-convergent sequence, Cauchy's general principle of convergence. Algebra of sequences, Some important theorems, Monotonic sequence.

Unit-IV

Infinite series, Positive term series, Comparison test for positive term series, Cauchy's root test, D'Alemberts root test, Raabe's test, Logarithemic test, Integral test, Series with arbitrary terms, Rearrangement of the terms.

Books Prescribed

Mathematical Analysis by S.C.Malik and Savita Arora, New-Age Pvt. Ltd.

Chapters: 1(2, 3,4.1,4.2,5),2,3,4(1-8,10.1,10.2.

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. Santi Narayan And P K Mittal, A Course of Mathematical Analysis, S Chand Publication.
3. Gerald G. Bilodeau , Paul R. Thie, G.E. Keough, An Introduction to Analysis, 2nd Ed., Jones & Bartlett, 2010.
4. Brian S. Thomson, Andrew. M. Bruckner and Judith B. Bruckner, Elementary Real Analysis, Prentice Hall, 2001.
5. S.K. Berberian, A First Course in Real Analysis, Springer Verlag, New York, 1994. 5. S.C. Mallik and S. Arora-Mathematical Analysis, New Age International Publications.
6. D. Smasundaram and B. Choudhury-A First Course in Mathematical Analysis, Narosa Publishing House.
7. S.L. Gupta and Nisha Rani-Real Analysis, Vikas Publishing House Pvt. Ltd., New Delhi.
8. G. Das and S. Pattanayak, Fundamentals of Mathematics Analysis, TMH Pub-lishing Co.

C-2.2: Differential Equations

(Total Marks:100) Part-I(Marks:75)
Theory:60 Marks+Mid-Sem:15 Marks
04 Lectures(per week per student)

Unit-I

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

Unit-II

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

Unit-III

Power series solutions of second order differential equations.

Unit-IV

Laplace transforms and its applications to solutions of differential equations.

Part-II (Practical: Marks:25)

List of Practicals (Using any Software) 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 problems.

Book Recommended:

1. J. Sinha Roy and S. Padhy, A Course of Ordinary and Partial Differential Equations, Kalyani Publishers, New Delhi. Chapters: 1, 2(2.1 to 2.7), 3, 4(4.1 to 4.7), 5, 7(7.1-7.4), 9(9.1, 9.2, 9.3, 9.4, 9.5, 9.10, 9.11, 9.13).

Books for References:

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

Semester-III

C-3.1: Theory of Real Functions (Analysis-II)

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

Unit-I
Limits of function ($\epsilon - \delta$ approach), Limit theorems, sequential approach of limits, Couchy's criterion for finite limit, Infinite limits and limits at infinity. Continuous functions, sequential criterion for continuity and discontinuity.
Ch.5(Art.1,2)

Unit-II
Algebra of continuous functions. Continuous functions on an interval, intermediate value theorem, Fixed point theorem, location of roots. Uniform continuity, uniform continuity theorem. Differentiability of a function at a point and in an interval, algebra of differentiable functions.
Ch.5(Art.3,4), Ch.6(Art.1,2)

Unit-III
Increasing functions,
Relative extrema, interior extremum theorem. Rolle's theorem, Mean value theorem, intermediate value Theorems of derivatives, Darbouxs theorem. Applications of mean value theorem to inequalities and approximation of polynomials, Taylors theorem and Maclaurin's theorem to inequalities.
Ch.6(Art.3-8(8.1-8.3))

Unit-IV
Taylors and Maclaurin's infinite series, Power series expansion, Taylors series and Maclaurins series expansions of exponential and trigonometric functions, ln(1 + x); 1/(ax + b) and $(1+x)^n$,extreme values, Indeterminate forms.
Ch.6(Art. 8(8.4-8.6)), Ch.7

Book Recommended:
Mathematical Analysis by S.C.Malik and Savita Arora, New-Age Pvt. Ltd.

Books for References:

1. G. Das and S. Pattanayak, Fundamentals of Mathematics Analysis, TMH Pub-lishing Co., Chapters:6(6.1-6.8), 7(7.1-7.7).
2. Shanti Narayan and M.D. Raisinghania-Elements of Real Analysis, S. Chand & Co. Pvt. Ltd.
3. R. Bartle and D.R. Sherbert, Introduction to Real Analysis, John Wiley and Sons, 2003.
4. K.A. Ross, Elementary Analysis: The Theory of Calculus, Springer, 2004.
5. A. Mattuck, Introduction to Analysis, Prentice Hall, 1999.
6. S.R. Ghorpade and B.V. Limaye, A Course in Calculus and Real Analysis, Springer, 2006.

C-3.2: Group Theory(Algebra-II)

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

Unit-I
Symmetries of a square, Dihedral groups, 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 a group.

Unit-II
Properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, 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.

Book Recommended:

1. Joseph A. Gallian, Contemporary Abstract Algebra(8th Edn.), Narosa Publishing House, New Delhi.

Books for References:

1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
2. Vijay K Khanna and S K Bhambri, A course in Abstract Algebra (Vikash Publication).
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.
5. I.N. Herstein, Topics in Algebra, Wiley Eastern Limited, India, 1975.

C-3.3: Partial Differential Equations and Systems of Ordinary Differential Equations

(Total Marks:100)
Part-I(Marks:75)
Theory:60 Marks+Mid-Sem:15 Marks
04 Lectures(per week per student)

Unit-I
Systems of linear differential equations, types of linear systems, differential operators, an operator
method for linear systems with constant coefficients, Basic Theory of linear systems in normal form,
homogeneous linear systems with constant coefficients(Two Equations in two unknown functions). Simultaneous linear first order equations in three variables, methods of solution, Pfaffan differential
equations, methods of solutions of Pfaffan 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,
Separation of variables, Non-linear equation of the second order.

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:25)

List of Practical's (Using any Software)

Practical/Lab work to be performed on a Computer.

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

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

   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) $u(x,0) = \phi(x), u_t(x,0) = \psi(x), x\epsilon R,\ t > 0$
b) $u(x,0) = \phi(x), u_t(x,0) = \psi(x),\ u_x(0,t) = 0,\ x\epsilon(0,\infty),\ t > 0$
c) $u(x,0) = \phi(x), u_t(x,0) = \psi(x),\ u(0,t) = 0,\ x\epsilon(0,\infty),\ t > 0$
d) $u(x,0) = \phi(x),\ u_t(x,0) = \psi(x),\ u(0,t) = 0, u(1,t) = 0,\ 0 < x < l,\ t > 0$

4. Solution of wave equation

$$\frac{\partial u}{\partial t} - k^2\frac{\partial^2 u}{\partial x^2} = 0$$

for the following associated conditions:

2. $u(x;\ 0) = \phi(x);\ u(0;\ t) = a;\ u(l;\ t) = b;\ 0 < x < l;\ t > 0$:
3. $u(x;\ 0) = \phi(x);\ x\,\epsilon\, R;\ 0 < t < T$:
4. $u(x;\ 0) = \phi(x);\ u(0;\ t) = a;\ x\epsilon\ (0;\infty);\ t \geq 0$:

Book Recommended:

1. J.Sinha Roy and S. Padhy, A Course on Ordinary and Partial Differential Equations, Kalyani, Publishers, New Delhi, Ludhiana, 2012.
   Chapters: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:

Tyn Myint-U and Lokenath Debnath, Linear Partial Differential Equations for Scientists and Engineers, 4th edition, Springer, Indian reprint, 2006.

S.L. Ross, Differential equations, 3rd Ed., John Wiley and Sons, India, 2004.

Dr. M D Raisinghania, Ordinary and Partial Differential Equation, **S. Chand Publication.**

Semester-IV

C-4.1: Numerical Methods

(Total Marks:100)
Part-I(Marks:75)

Theory:60 Marks+Mid-Sem:15 Marks
04 Lectures(per week per student)

Unit-I

Algorithms, Convergence, Errors: Relative, Absolute, Round o_, Truncation. Transcendental and Polynomial equations: Bisection method, Newtons method, Secant 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

Interpolation: Lagrange and Newtons methods. Error bounds. Finite di_erence operators. Gregory forward and backward di_erence interpolation.

Unit-IV

Numerical Integration: Trapezoidal rule, Simpsons rule, Simpsons 3/8th rule, Booles Rule. Midpoint rule, Composite Trapezoidal rule, Composite Simpsons rule. Ordinary Di_erential Equations: Eulers method. Runge-Kutta methods of orders two and four.

Part-II(Practical: Marks:25)

List of Practicals (Using any Software)

Practical/Lab work to be performed on a Computer.

1. Calculate the sum $\frac{1}{1}+\frac{1}{2}+\cdots\cdots\cdots\cdots+\frac{1}{N}$
2. To find the absolute value of an integer.
3. Enter 100 integers into an array and sort them in an ascending order.
4. Bisection Method.
5. Newton Raphson Method.
6. Secant Method.
7. Regulai Falsi Method.
8. LU decomposition Method.
9. Gauss-Jacobi Method.
10. SOR Method or Gauss-Siedel Method.
11. Lagrange Interpolation or Newton Interpolation.
12. Simpsons rule.

Note: For any of the CAS (Computer aided software) Data types-simple data types, floating data types, character data types, arithmetic operators and operator precedence, variables and constant declarations, expressions, input/output, relational operators, logical operators and logical expressions, control statements and loop statements, Arrays should be troduced to the students.

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).

2. **Brian Bradie,** A Friendly Introduction to Numerical Analysis, Pearson Education, India, 2007.
3. S. Ranganatham, Dr. M. V. S. S. N. Prasad, Numaerical Analysis, S. Chand Publication.

Books for References:

1. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scienti_c 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. Numerical Methods, P. Kandasamy, K. Thilagavathy, K. Gunavathi, S. Chand Publication.

C-4.2: Riemann Integration and Series of Functions (Analysis-III)

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

Unit-I

Riemann integration; Refinement of partitions, Darboux Theorem, Conditions of Integrebility, Integrability of sum and difference of integrable functions. Integral as a limit of sum, some integrable functions, integration and differention. Fundamental theorem of integral calculus and mean value theorem of integral calculus.

Unit-II

Improper integrals; Convergence of Beta and Gamma functions, Integration of unbounded functions with finite limits of integration, comparison test for convergence at a of $\int_a^b f(x)dx$. Infinite range of integration.

Unit-III

Point-wise convergence and Uniform convergence of sequence of functions on an interval, Couchy's criterion for uniform convergence and Weierstrass M-Test test for uniform convergence, Properties of uniformly convergence sequences and series.

Unit-IV

Power series, Definitions, some theorems, properties of functions expressible as power series, Abels theorem, Taylors theorems, Weierstrass Approximation Theorem.

Book Recommended:

Mathematical Analysis by S.C.Malik and Savita Arora, New-Age Pvt. Ltd.
Ch. 9(Art. 1-10), Ch. 11(Art.1-4), Ch. 12, Ch. 13(Art.1-4)

Books for References:

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

C-4.3: Ring Theory and Linear Algebra-(ALGEBRA-III)

Total Marks:100

Theory:80 Marks+Mid-Sem:20 Marks

5 Lectures, 1 Tutorial (per week per student)

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, operations on ideals, prime and maximal ideals.

Unit-II

Ring homeomorphisms, properties of ring homeomorphisms, Isomorphism theorems I, II and III, field of quotients.

Unit-III

Matrix associated with a Linear Map, Linear map associated with a matrix, Matrix multiplication, Rank and Nullity of a Matrix, Transpose of a Matrix, Special types of matrices, Elementary Row operation, System of Linear Equations, Matrix Inversion.

Unit-IV

Determinant: Definition, fundamental properties, Minors, Product of determinants, Application to Linear equations, Eigen Values, Eigen Vectors and Characteristic equation of a matrix

Book Recommended:

1. Joseph A. Gallian, Contemporary Abstract Algebra(4th Edn.), Narosa Publishing House, New Delhi. Chapters:12, 13, 14, 15.
2. An Introduction to Linear Algebra by V Krishna Murthy, V P Mainra, J L Arora, Affiliated East-West Press Pvt. Ltd. Chapter 5, 6(6.1, 6.2, 6.5-6.8).

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 Ho_man, Ray Alden Kunze, Linear Algebra, 2nd Ed., Prentice-Hall of India Pvt. Ltd., 1971.
7. I.N. Herstein-Topics in Algebra, Wiley Eastern Pvt. Ltd.
8. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, 4th Ed., Prentice- Hall of India Pvt. Ltd., New Delhi, 2004.
9. Linear Algebra, Surjeet Singh, VIKAS Publishing House Ltd.

Semester-V

C-5.1: Multivariate Calculus (Calculus-II)

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

Unit-I
Functions of several variables, Explicitly and Implicitly functions, limit and continuity of functions of two variables Partial differentiation, differentiability, Partial derivative of Higher Order, Differentiability of Higher Order, Functions of a Functions, Change of Variable.
Unit-II
Extreme Values: Maxima and Minima, Implicitly Functions, Definition, Jacobians, Stationary Values under Subsidiary Conditions.

Unit-III
Integration on $\boldsymbol{R^2}$, Line Integrals, Double Integrals, Double integration over a Region, Greens Theorem, Change of variables.
Unit-IV
Integration on $\boldsymbol{R^3}$, Rectifiable curve, Line integrals, Surface integrals, Stokes theorem, The volume of a cylindrical solid by Double Integrals, Volume integrals, The Divergence theorem.

Books Recommended:
Mathematical Analysis by S.C.Malik and Savita Arora, New-Age Pvt. Ltd.

Chapter 15 (1- 8, 10), Ch. 16 (1 - 3), Ch. 17 (1 -5), Ch. 18 (1- 8)
Books for Reference:

1. M.J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) Pvt. Ltd.
2. . G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.
3. . E. Marsden, A.J. Tromba and A. Weinstein, Basic Multivariable Calculus, Springer (SIE), Indian reprint, 2005.
4. . Santosh K. Sengar-Advanced Calculus, Cengage Learning India Pvt. Ltd.

C-5.2: Probability and Statistics

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

Unit-I
Sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function, Certain Probability Model.

Unit-II
Conditional Probability, Marginal and conditional distributions, correlation coefficient and Sticstochastic Independece,
Unit-III
The binomial, Trinomial and Multinomial distribution, Poisson distribution, Gamma and Chi-Square distribution, Normal Distribution, bivariate normal distribution .

Unit-IV

Chebyshevs inequality, statement and interpretation of (weak) law of large numbers and strong law of large numbers, Central Limit theorem for independent and identically distributed random variables with finite variance, Markov Chains, Chapman-Kolmogorov equations, classification of states.

Books Recommended:

1. Robert V. Hogg, Joseph W. McKean and Allen T. Craig, Introduction to Mathematical Statistics, Pearson Education, Asia, 2007. Chapters: 1(1.1, 1.3 -1.9), 2(2.1-2.4), 3 (3.1-3.5).
2. Sheldon Ross, Introduction to Probability Models, 9th Ed., Academic Press, Indian Reprint, 2007. Chapters:2(2.7), 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. Irwin Miller and Marylees Miller, John E. Freund, Mathematical Statistics with Applications, 7th Ed., Pearson Education, Asia, 2006. Chapters: 4, 5(5.1-5.5, 5.7), 6(6.2,6.3, 6.5-6.7), 14(14.1, 14.2)

4. S. Ross-A First Course in Probability, Pearson Education.

Semester-VI

C-6.1: Metric Spaces and Complex Analysis (Analysis-IV)

Total Marks:100

Theory:80 Marks+Mid-Sem:20 Marks

5 Lectures, 1 Tutorial (per week per student)

Unit-I

Metric spaces: definition and examples. Sequences in metric spaces, Cauchy sequences. Complete Metric Spaces. Open and closed balls, neighbourhood, open set, interior of a set. Limit point of a set, closed set, diameter of a set, Cantors theorem. Subspaces, dense sets, separable spaces. Continuous mappings, sequential criterion and other characterizations of continuity. Uniform continuity. Homeomorphism, Contraction mappings, Banach Fixed point Theorem.

Unit-II

Compactness and Connectedness, connected subsets of R:

Unit-III

Properties of complex numbers, regions in the complex plane, functions of complex variable, mappings. Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability.

Unit-IV

Analytic functions, examples of analytic functions, exponential function, Logarithmic function, Branches and derivative of Logarithmic function, trigonometric function, derivatives of functions, definite integrals of functions. Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals. Cauchy- Goursat theorem, Cauchy integral formula.

Books Recommended:

1. Mathematical Analysis by S.C.Malik and Savita Arora, New-Age Pvt. Ltd. Chapter 19
2. James Ward Brown and Ruel V. Churchill, Complex Variables and Applications, 7th Ed., McGraw Hill International Edition,. Chapters: 1(2,3,10,), 2(11, 12,18-21,23,24), 3(28, 29, 30,33) 4(36-41, 44, 45,47)

.

2. Books for References:

1. Satish Shirali and Harikishan L. Vasudeva, Metric Spaces, Springer Verlag, London, 2006.
2. S. Kumaresan, Topology of Metric Spaces, 2nd Ed., Narosa Publishing House, 2011.
3. S. Ponnusamy-Foundations of Complex Analysis, Alpha Science International Ltd.
4. J.B. Conway-Functions of one complex variable, Springer.

5. N. Das- Complex Function Theory, Allied Publishers Pvt. Ltd., Mumbai.
6. P.K. Jain and K. Ahmad, Metric Spaces, Narosa Publishing House, New Delhi

C-6.2: Linear Programming

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

Unit-I

Introduction to linear programming problem, Fundamental Properties of solutions, The computational Procedure, Use of Artificial Variables, Solution of Simultaneous Linear equations, Inverting a matrix using Simplex method, .

Unit-II

Introduction, General Primal- Dual pair, formulating a dual problem, Primal- Dual pair in Matrix form, Duality Theorem, Complementary Slackness theorem, Duality and Simplex Method, Dual simplex method, economic interpretation of the dual.

Unit-III

Introduction ,General Transportation Problem, Transportation table, Duality in Transportation problem, Loops in Transportation Tables, LP- formulation of Transportation Problem, Triangular Basis in a Transportation problem, Solution of a Transportation problem, Finding an initial basic feasible solution, Test for optimality, Degeneracy in Transportation problem, Modi Method of Transportation algorithm, Stepping stone solution method, Time minimization transportation problem, Transhipment problems.

Unit-IV

Introduction to Assignment problem, Mathematical Formulation of the Problem, Assignment Method, Special cases in assignment problems, A typical assignment problem, The travelling sales man problem.

Recommended Books:

1. Kanti Swarup, P.K. Gupta and Man Mohan-Operations Research, S. Chand and Co. Pvt. Ltd. Ch. 4(1-6), Ch. 5(1-5), Ch.10 (1-13,15,16), Ch. 11 (1-6)

Books for Reference:

1. G. Hadley, Linear Programming, Narosa Publishing House, New Delhi, 2002.
2. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, Linear Programming and Network Flows, 2nd Ed., John Wiley and Sons, India, 2004.
3. N.V.R. Naidu, G. Rajendra and T. Krishna Rao-Operations Research, I.K. International Publishing House Pvt. Ltd., New Delhi, Bangalore.
4. R. Veerachamy and V. Ravi Kumar-Operations Research- I.K. International Publishing House Pvt. Ltd., New Delhi, Bangalore.
5. P.K. Gupta and D.S. Hira-Operations Research, S. Chand and Company Pvt. Ltd., New Delhi.
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:
8. Operation Research(4^{th} Edn.) S Kalavathy, Vikas Publishing House.

Discipline Specific Ecectives(DES)

DSE-1

Programming in C++ (Compulsory)

Part-I(Marks:75)

(Theory:60 Marks+Mid-Sem:15 Marks)

Introduction to structured programming: data types- simple data types, floating data types, character data types, string data types, arithmetic operators and operators precedence, variables and constant declarations, expressions, input using the extraction operator and cin, output using the insertion operator and cout, pre-processor directives, increment(++) and decrement({) operations, 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, 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, 6TH Edition, Course Technology, Cengage Learning, India Edition. Chapters: 2(Pages:37-95), 4(Pages:183-206), 5(Pages:259-303), 6(Pages 335-361), 8(Pages 505-527), 12 (Pages 781-792)

Books for References:

1. E. Balaguruswami: Object oriented programming with C++, _fth 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

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Part-II(Practical, Marks:25)

List of Practicals (Using any software)

Practical/Lab work to be performed on a Computer.

1. Calculate the Sum of the series

$$\frac{1}{1}+\frac{1}{2}+\frac{1}{3}\ldots\ldots\ldots+\frac{1}{N}$$

for any positive integer N:

2. Write a user de_ned function to _nd the absolute value of an integer and use it to evaluate the function $\frac{(-1)n}{|n|},\ for\ n=-2,-1,0,1,2$

3. Calculate the factorial of any natural number.

4. Read oating 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 _rst 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 (_rst 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 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 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 _le 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 Digit 12345 is 54321 and the value of reverse Digit -532 is -235:

DSE-II

Total Marks:100
Theory:80 Marks+Mid-Sem:20 Marks
5 Lectures, 1 Tutorial (per week per student.
(Any one of the following)

1-Discrete Mathematics

Unit-I

Logic, proportional equivalence, predicates and quantifiers, nested quantifiers, 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 relations 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 as ordered sets, Lattices as algebraic structures, sub-lattices, Boolean algebra and its properties, Boolean functions and their representation..

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.

Book Recommended:

1. Kenneth H. Rosen, Discrete Mathematics and Applications, Tata McGraw Hill Publications, Chapters: 1(1.1 to 1.4), 4(4.1, 4.2, 4.5), 6(6.1, 6.2, 6.4), 7(7.1, 7.2,7.6), 8,10(10.1,10.2).

Books for References:

1. B A. Davey and H. A. Priestley, Introduction to Lattices and Order, Cambridge University Press, Cambridge, 1990.
2. Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory (2nd Edition), Pearson Education (Singapore) Pte. Ltd., Indian Reprint 2003.
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.
N C h S N Iyengar, V M Chandrasekharan, K A Venkatesh, P S Arunachalam, Discrete Mathematics, Vikas Publishing House.

2-Mathematical Modelling

Unit-I

Simple situations requiring Mathematical modeling. The technique of Mathematical modeling, Mathematical modeling through differential equations, linear growth and decay models, non-linear growth and decay models, compartment models, Mathematical modeling of geometrical problems through ordinary differential equations of first order.

Unit-II

Mathematical modeling in population dynamics, Mathematical modeling of epidemics through systems of ordinary differential equations of first order, compartment models through systems of ordinary differential equations, Mathematical modeling in economics through systems of ordinary differential equations of first order.

Unit-III

Mathematical models in medicine, arms race, battles and international trade in terms of systems of ordinary differential equations, Mathematical modeling of planetary motions, Mathematical modelling of circular motion and motion of satellites, mathematical modeling through linear differential equations of second order.

Unit-IV

Situation giving rise to partial differential equations models, mass balance equations: First method of getting PDE models, momentum balance equations. The second method of obtaining partial differential models, variation principles , third function, fourth method of obtaining partial differential equation models, models for traffic flow of a highway. Situation that can be modelled through graphs, mathematical models in terms of directed graphs, optimization principles and techniques, Mathematical modeling through calculus of variations.

Books Recommended:

1. J.N. Kapur-Mathematical Modeling, Chapters: 1(1.1 and 1.2), 2(2.1 to 2.4, 2.6), 3(3.1 to 3.5), 4(4.1 to 4.3), 6(6.1 to 6.6), 7(7.1 to 7.2), 9(9.1 and 9.2).

3-Number Theory

Unit-I

Divisibity theorem in integers, Primes and their distributions, Fundamental theorem of arithmetic, Greatest common divisor, Euclidean algorithms, Modular arithmetic, Linear Diophantine equation, prime counting function, statement of prime number theorem, Goldbach conjecture.

Unit-II

Introduction to congruence, Linear Congruencies, Chinese Remainder theorem, Polynomial congruence, System of linear congruence, complete set of residues, Chinese remainder theorem, Fermats little theorem, Wilsons theorem.

Unit-III

Number theoretic functions, sum and number of divisors, totally multiplicative functions, definition and properties of the Dirichlet product, the Mobius inversion formula, the greatest integer function, Eulers phi function, Eulers theorem, reduced set of residues, some properties of Eulers phi-function.

Unit-IV
Order of an integer modulo n, primitive roots for primes, composite numbers having primitive roots, Eulers criterion, the Legendre symbol and its properties, quadratic reciprocity, quadratic congruence with composite moduli.

Book Recommended:
1. D.M. Burton-Elementary Number Theory, McGraw Hill, Chapters: 2(2.1 to 2.4), 3(3.1 to 3.3), 4(4.1 to 4.4), 5(5.1 to 5.4), 6(6.1 to 6.3), 7(7.1 to 7.3), 8(8.1 to 8.2), 9(9.1 to 9.3).

Books for References:

1. K.H. Rosen-Elementary Number Theory & its Applications, Pearson Addition Wesley.
2. I. Niven and H.S. Zuckerman-An Introduction to Theory of Numbers, Wiley Eastern Pvt. Ltd.
3. Tom M. Apostol-Introduction to Analytic Number Theory, Springer International Student Edn.
4. Neville Robinns, Beginning Number Theory (2nd Edition), Narosa Publishing House Pvt. Limited, Delhi, 2007.
5. Basic Number Theory, S B Mallik, 2nd Revised Edn. Vikas Publishing House.

DSE-III

Total Marks:100
Theory:80 Marks+Mid-Sem:20 Marks
5 Lectures, 1 Tutorial (per week per student.
(Any one of the following)

1-Differential Geometry

Unit-I
Theory of Space Curves: Space curves, Planer curves, Curvature, torsion and Serret-Frenet formulae. Osculating circles, Osculating circles and spheres. Existence of space curves. Evolutes and involutes of curves.

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

Unit-III
Developable: Developable associated with space curves and curve son surfaces, Minimal surfaces.

Unit-IV
Theory of Surfaces: Parametric curves on surfaces. Direction coefficients. First and second Fundamental forms. Principal and Gaussian curvatures. Lines of curvature, Euler's 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 Di_erential Geometry, Dover Publications, 2012.
2. S. Lang, Fundamentals of Di_erential Geometry, Springer, 1999.
3. B. O'Neill, Elementary Di_erential Geometry, 2nd Ed., Academic Press, 2006.
4. A.N. Pressley-Elementary Di_erential Geometry, Springer.
5. B.P. Acharya and R.N. Das-Fundamentals of Differential Geometry, Kalyani Publishers, Ludhiana, New Delhi.

2-Mechanics

Unit-I
Moment of a force about a point and an axis, couple and couple moment, Moment of a couple about a line, resultant of a force system, distributed force system, free body diagram, free body involving

interior sections, general equations of equilibrium, two point equivalent loading, problems arising from structures, static indeterminacy.

Unit-II

Laws of Coulomb friction, application to simple and complex surface contact friction problems, transmission of power through belts, screw jack, wedge, first moment of an area and the centroid, other centres, Theorem of Pappus-Guldinus, second moments and the product of area of a plane area, transfer theorems, relation between second moments and products of area, polar moment of area, principal axes.

Unit-III

Conservative force field, conservation for mechanical energy, work energy equation, kinetic energy and work kinetic energy expression based on center of mass, moment of momentum equation for a single particle and a system of particles.

Unit-IV

Translation and rotation of rigid bodies, Chasles theorem, general relationship between time derivatives of a vector for different references, relationship between velocities of a particle for different references, acceleration of particle for different references.

Book Recommended:

1. I.H. Shames and G. Krishna Mohan Rao, Engineering Mechanics: Statics and Dynamics, (4^{th} Ed.), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2009. Chapters:3, 4, 5, 6(6.1-6.7), 7, 11, 12(12.5, 12.6), 13.

Books for References:

1. R.C. Hibbeler and Ashok Gupta, Engineering Mechanics: Statics and Dynamics, 11th Ed., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi.
2. Grant R Fowles, Analytical Mechanics, Cengage Learning India Pvt. Ltd. a line, resultant of a force system, distributed force system, free body diagram, free body involving
   interior sections, general equations of equilibrium, two point equivalent loading, problems arising from structures, static indeterminacy.
3. Mecanics, P Duraipandian, Laxmi Duraipandian, M Jayapragasam, S Chand Publication.

3-Ring Theory and Linear Algebra-II

Unit-I

Polynomial rings over commutative rings, division algorithm and consequences, principal ideal domains, factorization of polynomials, reducibility tests, irreducibility tests, Eisenstein criterion, unique factorization in $Z[x]$:

Unit-II

Divisibility in integral domains, irreducible, primes, unique factorization domains, Euclidean domains.

Unit-III

Dual spaces, dual basis, double dual, transpose of a linear transformation and its matrix in the dual basis, annihilators, Eigen spaces of a linear operator, diagonalizability, invariant subspaces and Cayley-Hamilton theorem, the minimal polynomial for a linear operator.

Unit-IV

Inner product spaces and norms, Gram-Schmidt orthogonalisation process, orthogonal complements, Bessels inequality, the adjoint of a linear operator, Least Squares Approximation, minimal solutions to systems of linear equations, Normal and self-adjoint operators, Orthogonal projections and Spectral theorem.

Books Recommended:

1. Joseph A. Gallian, Contemporary Abstract Algebra (4th Ed.), Narosa Publishing House, 1999. Chapters: 16, 17, 18.

2. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra (4th Edition), Prentice-Hall of India Pvt. Ltd., New Delhi, 2004. Chapters: 2(2.6 only), 5(5.1, 5.2, 5.4), 6(6.1, 6.4, 6.6), 7(7.3 only).

Books for References:

(For Linear Algebra)

1. S Lang, Introduction to Linear Algebra (2nd edition), Springer, 2005
2. Gilbert Strang, Linear Algebra and its Applications, Thomson, 2007
3. S. Kumaresan, Linear Algebra- A Geometric Approach, Prentice Hall of India, 1999.
4. Kenneth Ho_man, Ray Alden Kunze, Linear Algebra 2nd Ed., Prentice-Hall Of India Pvt. Limited, 1971.

(For Ring Theory)

1. John B.Fraleigh, A first course in Abstract Algebra, 7th Edition, Pearson Education India, 2003.
2. Herstein, Topics in Algebra (2nd edition), John Wiley & Sons, 2006
3. M ichael Artin, Algebra (2nd edition), Pearson Prentice Hall, 2011
4. Robinson, Derek John Scott., An introduction to abstract algebra, Hindustan book agency, 2010.

DSE-IV

Project Work(Compulsory)
Total Marks:100 (Project:75 Marks+Viva-Voce:25 Marks)

Skill Enhancement Courses(SEC)
(Credit: 2 each, Total Marks:50)
SEC-I to SEC-IV

SEC-I

Communicative English and Writing Skill(Compulsory)

SEC-II
(Any one of the following)

1-Logic and Sets

Introduction, propositions, Compound Proposition, truth table, negation, conjunction and disjunction. Implications, bi-conditional propositions, converse, contra-positive and inverse propositions and precedence of logical operators. Algebra of proposition, Negation of Compound Statement Propositional equivalence: Logical equivalences. Tautologies and Contrapositive, Mathematical Introduction, Method of Proof, Normal form, Predicate Calculus, 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. Power set of a set. Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections, Fuzzy sets. Product set, Relation: Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation, Partial ordering relations.

Books Recommended:

A Text Book of Discrete Mathematics**, S K Sarkar, S Chand, Publication.,** Chapter 2 (2.1-2.14,2.16,2.17) Ch. 4, Ch.7(7.1-7.7).

Books Reference:

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.

2-Information Security

Overview of Security: Protection versus security; aspects of security data integrity, data availability, privacy; security problems, user authentication, Orange Book. Security Threats: Program threats, worms, viruses, Trojan horse, trap door, stack and buffer over flow; system threats- intruders; communication threats- tapping and piracy. Security Mechanisms: Intrusion detection, auditing and logging, tripwire, system-call monitoring.

Books Recommended:

1. C. Peeger and S.L. Peeger-Security in Computing , 3rd Ed., Prentice-Hall of India, 2007.
2. D. Gollmann-Computer Security, John Wiley and Sons, NY, 2002.
3. J. Piwprzyk, T. Hardjono and J. Seberry-Fundamentals of Computer Security, Springer- Verlag Berlin, 2003.
4. J.M. Kizza-Computer Network Security, Springer, 2007.
5. M. Merkow and J. Breithaupt-Information Security: Principles and Practices, Pearson Education, 2006.

3-Combinartorial Mathematics

Basic counting principles, Permutations and Combinations (with and without repetitions), Binomial theorem, Multinomial theorem, Counting subsets, Set-partitions, Stirling numbers Principle of Inclusion and Exclusion, Derangements, Inversion formulae Generating functions: Algebra of formal power series, Generating function models, Calculating generating functions, Exponential generating functions. Recurrence relations: Recurrence relation models, Divide and conquer relations, Solution of recurrence relations, Solutions by generating functions. Integer partitions, Systems of distinct representatives.

Books Recommended:

1. J.H. van Lint and R.M. Wilson-A Course in Combinatorics, 2nd Ed., Cambridge University Press, 2001.
2. V. Krishnamurthy-Combinatorics, Theory and Application, A_liated East-West Press 1985.
3. P.J. Cameron-Combinatorics, Topics, Techniques, Algorithms, Cambridge University Press, 1995.
4. M. Jr. Hall-Combinatorial Theory, 2nd Ed., John Wiley & Sons, 1986.
5. S.S. Sane-Combinatorial Techniques, Hindustan Book Agency, 2013.
6. R.A. Brualdi-Introductory Combinatorics, 5th Ed., Pearson Education Inc., 2009.

GE (Paper-1)

Calculus and Ordinary Differential Equations
(GE-I for 1st SEM. Or GE-II for 2nd SEM.)

Total Marks:100

Theory:80 Marks+Mid-Sem:20 Marks

5 Lectures, 1 Tutorial (per week per student)

Unit-I

Curvature, Asymptotes, Tracing of Curves (Cartenary, Cycloid, Folium of Descartes, Astroid, Limacon, Cissoid & loops), Rectication, Quardrature, Volume and Surface area of solids of revolution.

Unit-II

Sphere, Cones and Cylinders, Conicoid.

Unit-III

Explicit and Implicit functions, Limit and Continuity of functions of several variables, Partial derivatives, Partial derivatives of higher orders, Homogeneous functions,

Change of variables, Taylors theorem and Maclaurins theorem for functions of two variables. Extreme values of functions of two and three variables, Implicit functions, Lagranges multipliers.

Unit-IV

Ordinary Differential Equations of 1st order and 1st degree (Variables separable, homogenous, exact and linear). Equations of 1st order but higher degree. Second order linear equations with constant coefficients, homogeneous forms, Second order equations with variable coefficients, Variation of parameters.

Books Recommended:

1. Shantinarayan-Text Book of Calculus, Part-II, S. Chand and Co., Chapter-8 (Art. 24, 25, 26)
2. Shantinarayan-Text Book of Calculus, Part-III, S. Chand and Co., Chapter-1 (Art 1,2), 3, 4(Art.10 to 12 omitting Simpsons Rule), 5(Art-13) and 6(Art-15).
3. B.P. Acharya and D.C. Sahu-Analytical Geometry of Quadratic Surfaces, Kalyani Publishers, New Delhi, Ludhiana.
4. Mathematical Analysis by S C Malik & S Arora, New Age International Publisher, Chapters: (Statements and applications only) 15,16.
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. L N Sahoo, Calculus and Ordinary Differential Equations(Generic Elective), Kalyani Publishers.
5. M.D. Raisinghania-Advanced Differential Equations, S. Chand & Company Ltd., New Delhi.
6. Santosh K. Sengar-Advanced Calculus.

GE (Paper-2)

(GE-I for 3rd SEM. Or GE-II for 4th SEM.)

Total Marks:100

Theory:80 Marks+Mid-Sem:20 Marks

5 Lectures, 1 Tutorial (per week per student)

GE-: Linear Algebra and Advanced Algebra

Unit-I

Group Theory: Definition and examples, Subgroups, Normal subgroups, Cyclic groups, Cosets, Quotient groups, Permutation groups, Homomorphism.

Unit-II

Ring Theory: Definition and examples, Some special classes of Rings, Ideals, Quotient rings, Ring homomorphism, More Ideals and Quotient Rings, The field of integral Domain .

Unit-III

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.

Unit-IV

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, Determinant and Rank of matrices, Eigen values, Eigen vectors, Quadratic forms.

Books Recommended:

1. V. Krishnamurty, V. P. Mainra, J. L. Arora-An introduction to Linear Algebra, Affialiated East-West Press Pvt. Ltd., New Delhi, Chapters: 3, 4(4.1 to 4.7), 5(except 5.3), 6(6.1, 6.2, 6.5, 6.6, 6.8),7(7.4 only).
2. Topics in Algebra by I N Herstein, Wiley Eastern ltd, New Age international Publication. Chapters:2(2.1-2.72.10), 3(3.1-3.6).

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. I.N. Herstein-Topics in Algebra, Wiley Eastern Pvt. Ltd.
6. Gallian-Contemporary Abstract Algebra, Narosa publishing House.
7. Artin-Algebra, Prentice Hall of India.
8. V.K. Khanna and S.K. Bhambri-A Course in Abstract Algebra, Vikas Publishing House Pvt. Ltd. New Delhi.
9. Algebra, M Artin,, Pearson(2^{nd} Edition).

COURSES OF STUDIES

Courses of Studies (Choice Based Credit System)

B.A/B.Sc. (Hons.) Mathematics

SESSION 2016-17

CORE COURSES

B.Sc.(Honours)-Mathematics

CREDIT : 06 each

KHALLIKOTE UNIVESITY

&

KHALLIKOTE AUTONOMOUS COLEGE

BERHAMPUR,GANJAM, ODISHA-760001

COURSE STRUCTURE

B.A/B.Sc (Honours) – Mathematics

- **Core Courses:6 credit each, Max. Marks:100**
- **Ability Enhancement Compulsory Courses (AECC):2 credit each, Max. Marks:50**
- **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: 75(Mid-Sem:15+End Sem: 60)Marks, Practical(End Sem):25 Marks.
- **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.

Semester-I

Core Courses (C)	**Ability Enhancement Compulsory Courses (AECC)**	**Skill Enhancement Courses (SEC)**	**Discipline Specific Elective (DSE)**	**Generic Electives (GE)**
C-1.1: Calculus & 3 D-I(P) C-1.2: Algebra-I	MIL/Alt. English	X	X	GE-I PAPER-I

Semester-II

Core Courses (C)	**Ability Enhancement Compulsory Courses (AECC)**	**Skill Enhancement Courses (SEC)**	**Discipline Specific Elective (DSE)**	**Generic Electives (GE)**
C-2.1: Real Analysis (Analysis-I) C-2.2: Differential Equations(P)	Environmental Science		**X**	GE-II PAPER-I

Semester-III

Core Courses (C)	Ability Enhancement Compulsory Courses (AECC)	Skill Enhancement Courses (SEC)	Discipline Specific Elective (DSE)	Generic Electives (GE)
C-3.1: Theory of Real Functions (Analysis-II) C-3.2: Group Theory (Algebra-II) C-3.3: Partial Differential Equations and Systems of Ordinary Differential Equations (P)	**X**	**SEC-I**	**X**	**GE-I PAPER-II**

Semester-IV

Core Courses (C)	Ability Enhancement Compulsory Courses (AECC)	Skill Enhancement Courses (SEC)	Discipline Specific Elective (DSE)	Generic Electives (GE)
C-4.1: Numerical Methods(P) C-4.2: Riemann Integration and Series of Functions (Analysis-III) C-4.3: Ring Theory and Linear Algebra-I (Algebra-III)	**X**	**SEC-II**	**X**	**GE-II PAPER-II**

Semester-V

Core Courses (C)	Ability Enhancement Compulsory Courses (AECC)	Skill Enhancement Courses (SEC)	Discipline Specific Elective (DSE)	Generic Electives (GE)
C-5.1: Multivariate Calculus (Calculus-II) C-5.2: Probability and Statistics	X	X	DSE-I DSE-II	X

Semester-VI

Core Courses (C)	Ability Enhancement Compulsory Courses (AECC)	Skill Enhancement Courses (SEC)	Discipline Specific Elective (DSE)	Generic Electives (GE)
C-6.1: Metric Spaces andComplex Analysis (Analysis-IV) C-6.2: Linear Programming	X	X	DSE-III DSE-IV	X

Semester – I

C-01: Calculus–I & 3-D

Part -I (Theory)

(Total Marks; 60+15)
5 Lectures, 1 Tutorial per week

Unit-I

Hyperbolic functions, higher order derivatives, Leibnitz Theorem and its applications , asymptotes, curvature, concavity, inflection points and multiple points, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves and parametric curves.

Unit-II

Reduction formulae, derivations and illustrations of reduction formulae of the, area of curves, area of polar curves, length of plane curves, volumes and surfaces of solid of revolution.

Unit-III

Sphere, Cone, Cylinder, Central Conicoids

Unit-IV

Multiple product, introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation of vectors, Differential operator, integration of vector functions.

Part -II (Practical) Total Mark-25

(Using any software)
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, the derivative graph, the second derivative graph and comparing them.
3. Sketching parametric curves (Eg. cycloid, asroid, cissoids, cardiod).
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, elliptic cone, elliptic, paraboloid, hyperbolic paraboloid using cartesian coordinates.
7. Matrix operation (addition, multiplication, inverse, transpose)

Books Prescribed

1. Mathematics for Degree students by Dr. P K Mittal, S. Chand & Co.(2014th Edn.)

   Differential Calculus, Chapters: 3(3.3), 5,6(excluding 6.5),7(7.1-7.5),8.
   Integral Calculus, Chapters: 3(3.1-3.14),5(5.1-5.6), 6(6.1-6.4),7
   Geometry (3-D) Chapter 4,5, 6
   Vector analysis- Chapter 1,2,3,4.

Books for reference

1. Text book of Calculus, Part-II by Shantinarayan, S Chand & Co.
2. Text book of Calculus, Part-III by Shantinarayan, S Chand & Co.
3. Elementary Calculus by Panda and Satapathy.
4. Calculus by G.B.Thomas, Pearson Education, Delhi

5. Analytical Solid Geometry by S.Narayan and Mittal, S.Chand Co.
6. Analytical Geometry of Quadratic Surfaces by B.P.Acharya and D.P.Sahu, Kalyani Publishers

C-02: Algebra-I
Total Marks:100
Theory:80 Marks+Mid-Sem:20 Marks
5 Lectures, 1 Tutorial (per week per student)

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, Divisibility & Euclidean algorithm, Primes, Principles of Mathematical Induction, statement of Fundamental Theorem of Arithmetic.

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: Definition, Range and Kernel of a linear map, Rank and nullity, Inverse of a Linear Transformation, Rank nullity theorem, The Space L(U, V), Composition of Linear Map

Books Prescribed

1. Mathematics for Degree students by Dr. P K Mittal, S. Chand & Co.(2014th Edn.)

   Trigonometry, Chapters:1 (1.1-1.4)
2. An introduction to the Theory of Number by Ivan Niven & H S Zuckerman, Wilea Eastern ltd. Chapter 1(1.1-1.3)
3. An Introduction to Linear Algebra by V Krishna Murthy, V P Mainra, J L Arora, Affiliated East-West Press Pvt. Ltd. Chapter 3, 4(4.1-4.7)

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.
7. I.N. Herstein-Topics in Algebra, Wiley Eastern Pvt. Ltd.
8. D. K Dalai, B.Sc Mathematics, Algebra-1, Kalyani Publishers.

Semester – II

C-03: Analysis –I
(Total Marks; 80+20)
5 Lectures, 1 Tutorial per week

Unit-I

Field structure and order structure, Bounded and unbounded sets, (excluding Dedikinds form of completeness property), completeness in the set of real numbers, Absolute value of a real number.

Unit-II

Neighborhood of a point, Interior point, Limit point, Open set, Closed set, Dense set, Perfect set, Bolzano-Weierstrass's theorem, Countable and Uncountable sets.

Unit-III

Sequences, Limit points function a sequence, Limit inferior and superior, Convergent sequence, Non-convergent sequence, Cauchy's general principle of convergence. Algebra of sequences, Some important theorems, Monotonic sequence.

Unit-IV

Infinite series, Positive term series, Comparison test for positive term series, Cauchy's root test, D'Alemberts root test, Raabe's test, Logarithemic test, Integral test, Series with arbitrary terms, Rearrangement of the terms.

Books Prescribed

Mathematical Analysis by S.C.Malik and Savita Arora, New-Age Pvt. Ltd.

Chapters: 1(2, 3,4.1,4.2,5),2,3,4(1-8,10.1,10.2.

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. Santi Narayan And P K Mittal, A Course of Mathematical Analysis, S Chand Publication.
3. Gerald G. Bilodeau , Paul R. Thie, G.E. Keough, An Introduction to Analysis, 2nd Ed., Jones & Bartlett, 2010.
4. Brian S. Thomson, Andrew. M. Bruckner and Judith B. Bruckner, Elementary Real Analysis, Prentice Hall, 2001.
5. S.K. Berberian, A First Course in Real Analysis, Springer Verlag, New York, 1994. 5. S.C. Mallik and S. Arora-Mathematical Analysis, New Age International Publications.
6. D. Smasundaram and B. Choudhury-A First Course in Mathematical Analysis, Narosa Publishing House.
7. S.L. Gupta and Nisha Rani-Real Analysis, Vikas Publishing House Pvt. Ltd., New Delhi.
8. G. Das and S. Pattanayak, Fundamentals of Mathematics Analysis, TMH Pub-lishing Co.

C-04: Differential Equations

(Total Marks:100) Part-I(Marks:75)
Theory:60 Marks+Mid-Sem:15 Marks
04 Lectures(per week per student)

Unit-I

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

Unit-II

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

Unit-III

Power series solutions of second order differential equations.

Unit-IV

Laplace transforms and its applications to solutions of differential equations.

Part-II (Practical: Marks:25)

List of Practicals (Using any Software) 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 problems.

Book Recommended:

1. J. Sinha Roy and S. Padhy, A Course of Ordinary and Partial Differential Equations, Kalyani Publishers, New Delhi. Chapters: 1, 2(2.1 to 2.7), 3, 4(4.1 to 4.7), 5, 7(7.1-7.4), 9(9.1, 9.2, 9.3, 9.4, 9.5, 9.10, 9.11, 9.13).

Books for References:

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

Semester-III

C-05: Theory of Real Functions (Analysis-II)

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

Unit-I
Limits of function ($\epsilon - \delta$ approach), Limit theorems, sequential approach of limits, Couchy's criterion for finite limit, Infinite limits and limits at infinity. Continuous functions, sequential criterion for continuity and discontinuity.
Ch.5(Art.1,2)

Unit-II
Algebra of continuous functions. Continuous functions on an interval, intermediate value theorem, Fixed point theorem, location of roots. Uniform continuity, uniform continuity theorem. Differentiability of a function at a point and in an interval, algebra of differentiable functions.
Ch.5(Art.3,4), Ch.6(Art.1,2)

Unit-III
Increasing functions,
Relative extrema, interior extremum theorem. Rolle's theorem, Mean value theorem, intermediate value Theorems of derivatives, Darbouxs theorem. Applications of mean value theorem to inequalities and approximation of polynomials, Taylors theorem and Maclaurin's theorem to inequalities.
Ch.6(Art.3-8(8.1-8.3))

Unit-IV
Taylors and Maclaurin's infinite series, Power series expansion, Taylors series and Maclaurins series expansions of exponential and trigonometric functions, ln(1 + x); 1/(ax + b) and $(1+x)^n$,extreme values, Indeterminate forms.
Ch.6(Art. 8(8.4-8.6)), Ch.7

Book Recommended:
Mathematical Analysis by S.C.Malik and Savita Arora, New-Age Pvt. Ltd.

Books for References:

1. G. Das and S. Pattanayak, Fundamentals of Mathematics Analysis, TMH Pub-lishing Co., Chapters:6(6.1-6.8), 7(7.1-7.7).
2. Shanti Narayan and M.D. Raisinghania-Elements of Real Analysis, S. Chand & Co. Pvt. Ltd.
3. R. Bartle and D.R. Sherbert, Introduction to Real Analysis, John Wiley and Sons, 2003.
4. K.A. Ross, Elementary Analysis: The Theory of Calculus, Springer, 2004.
5. A. Mattuck, Introduction to Analysis, Prentice Hall, 1999.
6. S.R. Ghorpade and B.V. Limaye, A Course in Calculus and Real Analysis, Springer, 2006.

C-06: Group Theory(Algebra-II)

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

Unit-I
Symmetries of a square, Dihedral groups, 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 a group.

Unit-II
Properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, 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.

Book Recommended:

1. Joseph A. Gallian, Contemporary Abstract Algebra(8th Edn.), Narosa Publishing House, New Delhi.

Books for References:

1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
2. Vijay K Khanna and S K Bhambri, A course in Abstract Algebra (Vikash Publication).
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.
5. I.N. Herstein, Topics in Algebra, Wiley Eastern Limited, India, 1975.

C-07: Partial Differential Equations and Systems of Ordinary Differential Equations

(Total Marks:100)
Part-I(Marks:75)
Theory:60 Marks+Mid-Sem:15 Marks
04 Lectures(per week per student)

Unit-I
Systems of linear differential equations, types of linear systems, differential operators, an operator
method for linear systems with constant coefficients, Basic Theory of linear systems in normal form,
homogeneous linear systems with constant coefficients(Two Equations in two unknown functions). Simultaneous linear first order equations in three variables, methods of solution, Pfaffan differential
equations, methods of solutions of Pfaffan 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,
Separation of variables, Non-linear equation of the second order.

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:25)

List of Practical's (Using any Software)

Practical/Lab work to be performed on a Computer.

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

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

   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) $u(x,0) = \phi(x), u_t(x,0) = \psi(x), x\epsilon R,\ t > 0$

b) $u(x,0) = \phi(x), u_t(x,0) = \psi(x),\ u_x(0,t) = 0,\ x\epsilon(0,\infty),\ t > 0$

c) $u(x,0) = \phi(x), u_t(x,0) = \psi(x),\ u(0,t) = 0,\ x\epsilon(0,\infty),\ t > 0$

d) $u(x,0) = \phi(x),\ u_t(x,0) = \psi(x),\ u(0,t) = 0, u(1,t) = 0,\ 0 < x < l,\ t > 0$

4. Solution of wave equation

$$\frac{\partial u}{\partial t} - k^2\frac{\partial^2 u}{\partial x^2} = 0$$

for the following associated conditions:

2. $u(x;\ 0) = \phi(x);\ u(0;\ t) = a;\ u(l;\ t) = b;\ 0 < x < l;\ t > 0$:
3. $u(x;\ 0) = \phi(x);\ x \epsilon R;\ 0 < t < T$:
4. $u(x;\ 0) = \phi(x);\ u(0;\ t) = a;\ x\epsilon\ (0;\infty);\ t \geq 0$:

Book Recommended:

1. J.Sinha Roy and S. Padhy, A Course on Ordinary and Partial Differential Equations, Kalyani, Publishers, New Delhi, Ludhiana, 2012.
   Chapters: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:

Tyn Myint-U and Lokenath Debnath, Linear Partial Differential Equations for Scientists and Engineers, 4th edition, Springer, Indian reprint, 2006.

S.L. Ross, Differential equations, 3rd Ed., John Wiley and Sons, India, 2004.

Dr. M D Raisinghania, Ordinary and Partial Differential Equation, **S. Chand Publication.**

Semester-IV

C-08: Numerical Methods

(Total Marks:100)
Part-I(Marks:75)

Theory:60 Marks+Mid-Sem:15 Marks
04 Lectures(per week per student)

Unit-I

Algorithms, Convergence, Errors: Relative, Absolute, Round o_, Truncation. Transcendental and Polynomial equations: Bisection method, Newtons method, Secant 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

Interpolation: Lagrange and Newtons methods. Error bounds. Finite di_erence operators. Gregory forward and backward di_erence interpolation.

Unit-IV

Numerical Integration: Trapezoidal rule, Simpsons rule, Simpsons 3/8th rule, Booles Rule. Midpoint rule, Composite Trapezoidal rule, Composite Simpsons rule. Ordinary Di_erential Equations: Eulers method. Runge-Kutta methods of orders two and four.

Part-II(Practical: Marks:25)

List of Practicals (Using any Software)

Practical/Lab work to be performed on a Computer.

1. Calculate the sum $\frac{1}{1}+\frac{1}{2}+\cdots\cdots\cdots\cdots+\frac{1}{N}$
2. To find the absolute value of an integer.
3. Enter 100 integers into an array and sort them in an ascending order.
4. Bisection Method.
5. Newton Raphson Method.
6. Secant Method.
7. Regulai Falsi Method.
8. LU decomposition Method.
9. Gauss-Jacobi Method.
10. SOR Method or Gauss-Siedel Method.
11. Lagrange Interpolation or Newton Interpolation.
12. Simpsons rule.

Note: For any of the CAS (Computer aided software) Data types-simple data types, floating data types, character data types, arithmetic operators and operator precedence, variables and constant declarations, expressions, input/output, relational operators, logical operators and logical expressions, control statements and loop statements, Arrays should be troduced to the students.

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).

2. **Brian Bradie,** A Friendly Introduction to Numerical Analysis, Pearson Education, India, 2007.
3. S. Ranganatham, Dr. M. V. S. S. N. Prasad, Numaerical Analysis, S. Chand Publication.

Books for References:

1. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scienti_c 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. Numerical Methods, P. Kandasamy, K. Thilagavathy, K. Gunavathi, S. Chand Publication.

C-09: Riemann Integration and Series of Functions (Analysis-III)

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

Unit-I

Riemann integration; Refinement of partitions, Darboux Theorem, Conditions of Integrebility, Integrability of sum and difference of integrable functions. Integral as a limit of sum, some integrable functions, integration and differention. Fundamental theorem of integral calculus and mean value theorem of integral calculus.

Unit-II

Improper integrals; Convergence of Beta and Gamma functions, Integration of unbounded functions with finite limits of integration, comparison test for convergence at a of $\int_a^b f(x)dx$. Infinite range of integration.

Unit-III

Point-wise convergence and Uniform convergence of sequence of functions on an interval, Couchy's criterion for uniform convergence and Weierstrass M-Test test for uniform convergence, Properties of uniformly convergence sequences and series.

Unit-IV

Power series, Definitions, some theorems, properties of functions expressible as power series, Abels theorem, Taylors theorems, Weierstrass Approximation Theorem.

Book Recommended:

Mathematical Analysis by S.C.Malik and Savita Arora, New-Age Pvt. Ltd.
Ch. 9(Art. 1-10), Ch. 11(Art.1-4), Ch. 12, Ch. 13(Art.1-4)

Books for References:

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

C-10: Ring Theory and Linear Algebra-(ALGEBRA-III)

Total Marks:100

Theory:80 Marks+Mid-Sem:20 Marks

5 Lectures, 1 Tutorial (per week per student)

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, operations on ideals, prime and maximal ideals.

Unit-II

Ring homeomorphisms, properties of ring homeomorphisms, Isomorphism theorems I, II and III, field of quotients.

Unit-III

Matrix associated with a Linear Map, Linear map associated with a matrix, Matrix multiplication, Rank and Nullity of a Matrix, Transpose of a Matrix, Special types of matrices, Elementary Row operation, System of Linear Equations, Matrix Inversion.

Unit-IV

Determinant: Definition, fundamental properties, Minors, Product of determinants, Application to Linear equations, Eigen Values, Eigen Vectors and Characteristic equation of a matrix

Book Recommended:

1. Joseph A. Gallian, Contemporary Abstract Algebra(4th Edn.), Narosa Publishing House, New Delhi. Chapters:12, 13, 14, 15.
2. An Introduction to Linear Algebra by V Krishna Murthy, V P Mainra, J L Arora, Affiliated East-West Press Pvt. Ltd. Chapter 5, 6(6.1, 6.2, 6.5-6.8).

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 Ho_man, Ray Alden Kunze, Linear Algebra, 2nd Ed., Prentice-Hall of India Pvt. Ltd., 1971.
7. I.N. Herstein-Topics in Algebra, Wiley Eastern Pvt. Ltd.
8. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, 4th Ed., Prentice- Hall of India Pvt. Ltd., New Delhi, 2004.
9. Linear Algebra, Surjeet Singh, VIKAS Publishing House Ltd.

Semester-V

C-11: Multivariate Calculus (Calculus-II)

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

Unit-I
Functions of several variables, Explicitly and Implicitly functions, limit and continuity of functions of two variables Partial differentiation, differentiability, Partial derivative of Higher Order, Differentiability of Higher Order, Functions of a Functions, Change of Variable.

Unit-II
Extreme Values: Maxima and Minima, Implicitly Functions, Definition, Jacobians, Stationary Values under Subsidiary Conditions.

Unit-III
Integration on $\boldsymbol{R^2}$, Line Integrals, Double Integrals, Double integration over a Region, Greens Theorem, Change of variables.

Unit-IV
Integration on $\boldsymbol{R^3}$, Rectifiable curve, Line integrals, Surface integrals, Stokes theorem, The volume of a cylindrical solid by Double Integrals, Volume integrals, The Divergence theorem.

Books Recommended:

Mathematical Analysis by S.C.Malik and Savita Arora, New-Age Pvt. Ltd.

Chapter 15 (1- 8, 10), Ch. 16 (1 - 3), Ch. 17 (1 -5), Ch. 18 (1- 8)

Books for Reference:

1. M.J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) Pvt. Ltd.
2. . G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.
3. . E. Marsden, A.J. Tromba and A. Weinstein, Basic Multivariable Calculus, Springer (SIE), Indian reprint, 2005.
4. . Santosh K. Sengar-Advanced Calculus, Cengage Learning India Pvt. Ltd.

C-12: Probability and Statistics

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

Unit-I
Sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function, Certain Probability Model.

Unit-II
Conditional Probability, Marginal and conditional distributions, correlation coefficient and Sticstochastic Independece,

Unit-III
The binomial, Trinomial and Multinomial distribution, Poisson distribution, Gamma and Chi-Square distribution, Normal Distribution, bivariate normal distribution .

Unit-IV
Chebyshevs inequality, statement and interpretation of (weak) law of large numbers and strong law of large numbers, Central Limit theorem for independent and identically distributed random variables with finite variance, Markov Chains, Chapman-Kolmogorov equations, classification of states.

Books Recommended:
1. Robert V. Hogg, Joseph W. McKean and Allen T. Craig, Introduction to Mathematical Statistics, Pearson Education, Asia, 2007. Chapters: 1(1.1, 1.3 -1.9), 2(2.1-2.4), 3 (3.1-3.5).
2. Sheldon Ross, Introduction to Probability Models, 9th Ed., Academic Press, Indian Reprint, 2007. Chapters:2(2.7), 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. Irwin Miller and Marylees Miller, John E. Freund, Mathematical Statistics with Applications, 7th Ed., Pearson Education, Asia, 2006. Chapters: 4, 5(5.1-5.5, 5.7), 6(6.2,6.3, 6.5-6.7), 14(14.1, 14.2)

4. S. Ross-A First Course in Probability, Pearson Education.

Semester-VI

C-13: Metric Spaces and Complex Analysis (Analysis-IV)

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

Unit-I

Metric spaces: definition and examples. Sequences in metric spaces, Cauchy sequences. Complete Metric Spaces. Open and closed balls, neighbourhood, open set, interior of a set. Limit point of a set, closed set, diameter of a set, Cantors theorem. Subspaces, dense sets, separable spaces. Continuous mappings, sequential criterion and other characterizations of continuity. Uniform continuity. Homeomorphism, Contraction mappings, Banach Fixed point Theorem.

Unit-II

Compactness and Connectedness, connected subsets of R:

Unit-III

Properties of complex numbers, regions in the complex plane, functions of complex variable, mappings. Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability.

Unit-IV

Analytic functions, examples of analytic functions, exponential function, Logarithmic function, Branches and derivative of Logarithmic function, trigonometric function, derivatives of functions, definite integrals of functions. Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals. Cauchy- Goursat theorem, Cauchy integral formula.

Books Recommended:

1. Mathematical Analysis by S.C.Malik and Savita Arora, New-Age Pvt. Ltd. Chapter 19
2. James Ward Brown and Ruel V. Churchill, Complex Variables and Applications, 7th Ed., McGraw Hill International Edition,. Chapters: 1(2,3,10,), 2(11, 12,18-21,23,24), 3(28, 29, 30,33) 4(36-41, 44, 45,47)

.

2. **Books for References:**

1. Satish Shirali and Harikishan L. Vasudeva, Metric Spaces, Springer Verlag, London, 2006.
2. S. Kumaresan, Topology of Metric Spaces, 2nd Ed., Narosa Publishing House, 2011.
3. S. Ponnusamy-Foundations of Complex Analysis, Alpha Science International Ltd.
4. J.B. Conway-Functions of one complex variable, Springer.
5. N. Das- Complex Function Theory, Allied Publishers Pvt. Ltd., Mumbai.
6. P.K. Jain and K. Ahmad, Metric Spaces, Narosa Publishing House, New Delhi

C-14: Linear Programming

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

Unit-I

Introduction to linear programming problem, Fundamental Properties of solutions, The computational Procedure, Use of Artificial Variables, Solution of Simultaneous Linear equations, Inverting a matrix using Simplex method, .

Unit-II

Introduction, General Primal- Dual pair, formulating a dual problem, Primal- Dual pair in Matrix form, Duality Theorem, Complementary Slackness theorem, Duality and Simplex Method, Dual simplex method, economic interpretation of the dual.

Unit-III

Introduction ,General Transportation Problem, Transportation table, Duality in Transportation problem, Loops in Transportation Tables, LP- formulation of Transportation Problem, Triangular Basis in a Transportation problem, Solution of a Transportation problem, Finding an initial basic feasible solution, Test for optimality, Degeneracy in Transportation problem, Modi Method of Transportation algorithm, Stepping stone solution method, Time minimization transportation problem, Transhipment problems.

Unit-IV

Introduction to Assignment problem, Mathematical Formulation of the Problem, Assignment Method, Special cases in assignment problems, A typical assignment problem, The travelling sales man problem.

Recommended Books:

1. Kanti Swarup, P.K. Gupta and Man Mohan-Operations Research, S. Chand and Co. Pvt. Ltd. Ch. 4(1-6), Ch. 5(1-5), Ch.10 (1-13,15,16), Ch. 11 (1-6)

Books for Reference:

1. G. Hadley, Linear Programming, Narosa Publishing House, New Delhi, 2002.
2. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, Linear Programming and Network Flows, 2nd Ed., John Wiley and Sons, India, 2004.
3. N.V.R. Naidu, G. Rajendra and T. Krishna Rao-Operations Research, I.K. International Publishing House Pvt. Ltd., New Delhi, Bangalore.
4. R. Veerachamy and V. Ravi Kumar-Operations Research- I.K. International Publishing House Pvt. Ltd., New Delhi, Bangalore.
5. P.K. Gupta and D.S. Hira-Operations Research, S. Chand and Company Pvt. Ltd., New Delhi.
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:
8. Operation Research(4^{th} Edn.) S Kalavathy, Vikas Publishing House.

Discipline Specific Ecectives(DSE)

DSE-1

Programming in C++ (Compulsory)

Part-I(Marks:75)

(Theory:60 Marks+Mid-Sem:15 Marks)

Introduction to structured programming: data types- simple data types, floating data types, character data types, string data types, arithmetic operators and operators precedence, variables and constant declarations, expressions, input using the extraction operator and cin, output using the insertion operator and cout, pre-processor directives, increment(++) and decrement({) operations, 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, 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, 6^{TH} Edition, Course Technology, Cengage Learning, India Edition. Chapters: 2(Pages:37-95), 4(Pages:183-206), 5(Pages:259-303), 6(Pages 335-361), 8(Pages 505-527), 12 (Pages 781-792)

Books for References:

1. E. Balaguruswami: Object oriented programming with C++, _fth 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

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Part-II(Practical, Marks:25)

List of Practicals (Using any software)

Practical/Lab work to be performed on a Computer.

1. Calculate the Sum of the series

$$\frac{1}{1}+\frac{1}{2}+\frac{1}{3}\dots\dots\dots.+\frac{1}{N}$$

for any positive integer N:

2. Write a user de_ned function to _nd the absolute value of an integer and use it to evaluate the function $\frac{(-1)n}{|n|}$, $for\ n=-2,-1,0,1,2$

3. Calculate the factorial of any natural number.

4. Read oating 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 _rst 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 (_rst 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 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 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 _le 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 Digit 12345 is 54321 and the value of reverse Digit -532 is -235:

DSE-II

Total Marks:100
Theory:80 Marks+Mid-Sem:20 Marks
5 Lectures, 1 Tutorial (per week per student.
(Any one of the following)

1-Discrete Mathematics

Unit-I

Logic, proportional equivalence, predicates and quantifiers, nested quantifiers, 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 relations 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 as ordered sets, Lattices as algebraic structures, sub-lattices, Boolean algebra and its properties, Boolean functions and their representation..

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.

Book Recommended:

1. Kenneth H. Rosen, Discrete Mathematics and Applications, Tata McGraw Hill Publications, Chapters: 1(1.1 to 1.4), 4(4.1, 4.2, 4.5), 6(6.1, 6.2, 6.4), 7(7.1, 7.2,7.6), 8,10(10.1,10.2).

Books for References:

1. B A. Davey and H. A. Priestley, Introduction to Lattices and Order, Cambridge University Press, Cambridge, 1990.
2. Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory (2nd Edition), Pearson Education (Singapore) Pte. Ltd., Indian Reprint 2003.
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.

N C h S N Iyengar, V M Chandrasekharan, K A Venkatesh, P S Arunachalam, Discrete Mathematics, Vikas Publishing House.

2-Mathematical Modelling

Unit-I

Simple situations requiring Mathematical modeling. The technique of Mathematical modeling, Mathematical modeling through differential equations, linear growth and decay models, non-linear growth and decay models, compartment models, Mathematical modeling of geometrical problems through ordinary differential equations of first order.

Unit-II

Mathematical modeling in population dynamics, Mathematical modeling of epidemics through systems of ordinary differential equations of first order, compartment models through systems of ordinary differential equations, Mathematical modeling in economics through systems of ordinary differential equations of first order.

Unit-III

Mathematical models in medicine, arms race, battles and international trade in terms of systems of ordinary differential equations, Mathematical modeling of planetary motions, Mathematical modelling of circular motion and motion of satellites, mathematical modeling through linear differential equations of second order.

Unit-IV

Situation giving rise to partial differential equations models, mass balance equations: First method of getting PDE models, momentum balance equations. The second method of obtaining partial differential models, variation principles , third function, fourth method of obtaining partial differential equation models, models for traffic flow of a highway. Situation that can be modelled through graphs, mathematical models in terms of directed graphs, optimization principles and techniques, Mathematical modeling through calculus of variations.

Books Recommended:

1. J.N. Kapur-Mathematical Modeling, Chapters: 1(1.1 and 1.2), 2(2.1 to 2.4, 2.6), 3(3.1 to 3.5), 4(4.1 to 4.3), 6(6.1 to 6.6), 7(7.1 to 7.2), 9(9.1 and 9.2).

3-Number Theory

Unit-I

Divisibity theorem in integers, Primes and their distributions, Fundamental theorem of arithmetic, Greatest common divisor, Euclidean algorithms, Modular arithmetic, Linear Diophantine equation, prime counting function, statement of prime number theorem, Goldbach conjecture.

Unit-II

Introduction to congruence, Linear Congruencies, Chinese Remainder theorem, Polynomial congruence, System of linear congruence, complete set of residues, Chinese remainder theorem, Fermats little theorem, Wilsons theorem.

Unit-III

Number theoretic functions, sum and number of divisors, totally multiplicative functions, definition and properties of the Dirichlet product, the Mobius inversion formula, the greatest integer function, Eulers phi function, Eulers theorem, reduced set of residues, some properties of Eulers phi-function.

Unit-IV

Order of an integer modulo n, primitive roots for primes, composite numbers having primitive roots, Eulers criterion, the Legendre symbol and its properties, quadratic reciprocity, quadratic congruence with composite moduli.

Book Recommended:

1. D.M. Burton-Elementary Number Theory, McGraw Hill, Chapters: 2(2.1 to 2.4), 3(3.1 to 3.3), 4(4.1 to 4.4), 5(5.1 to 5.4), 6(6.1 to 6.3), 7(7.1 to 7.3), 8(8.1 to 8.2), 9(9.1 to 9.3).

Books for References:

1. K.H. Rosen-Elementary Number Theory & its Applications, Pearson Addition Wesley.

2. I. Niven and H.S. Zuckerman-An Introduction to Theory of Numbers, Wiley Eastern Pvt. Ltd.
3. Tom M. Apostol-Introduction to Analytic Number Theory, Springer International Student Edn.
4. Neville Robinns, Beginning Number Theory (2nd Edition), Narosa Publishing House Pvt. Limited, Delhi, 2007.
5. Basic Number Theory, S B Mallik, 2nd Revised Edn. Vikas Publishing House.

DSE-III

Total Marks:100
Theory:80 Marks+Mid-Sem:20 Marks
5 Lectures, 1 Tutorial (per week per student.
(Any one of the following)

1-Differential Geometry

Unit-I

Theory of Space Curves: Space curves, Planer curves, Curvature, torsion and Serret-Frenet formulae. Osculating circles, Osculating circles and spheres. Existence of space curves. Evolutes and involutes of curves.

Unit-II

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

Unit-III

Developable: Developable associated with space curves and curve son surfaces, Minimal surfaces.

Unit-IV

Theory of Surfaces: Parametric curves on surfaces. Direction coefficients. First and second Fundamental forms. Principal and Gaussian curvatures. Lines of curvature, Euler's 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 Di_erential Geometry, Dover Publications, 2012.
2. S. Lang, Fundamentals of Di_erential Geometry, Springer, 1999.
3. B. O'Neill, Elementary Di_erential Geometry, 2nd Ed., Academic Press, 2006.
4. A.N. Pressley-Elementary Di_erential Geometry, Springer.
5. B.P. Acharya and R.N. Das-Fundamentals of Differential Geometry, Kalyani Publishers, Ludhiana, New Delhi.

2-Mechanics

Unit-I

Moment of a force about a point and an axis, couple and couple moment, Moment of a couple about a line, resultant of a force system, distributed force system, free body diagram, free body involving interior sections, general equations of equilibrium, two point equivalent loading, problems arising from structures, static indeterminacy.

Unit-II

Laws of Coulomb friction, application to simple and complex surface contact friction problems, transmission of power through belts, screw jack, wedge, first moment of an area and the centroid, other centres, Theorem of Pappus-Guldinus, second moments and the product of area of a plane area, transfer theorems, relation between second moments and products of area, polar moment of area, principal axes.

Unit-III

Conservative force field, conservation for mechanical energy, work energy equation, kinetic energy and work kinetic energy expression based on center of mass, moment of momentum equation for a single particle and a system of particles.

Unit-IV

Translation and rotation of rigid bodies, Chasles theorem, general relationship between time derivatives of a vector for different references, relationship between velocities of a particle for different references, acceleration of particle for different references.

Book Recommended:

1. I.H. Shames and G. Krishna Mohan Rao, Engineering Mechanics: Statics and Dynamics, (4^{th} Ed.), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2009. Chapters:3, 4, 5, 6(6.1-6.7), 7, 11, 12(12.5, 12.6), 13.

Books for References:

1. R.C. Hibbeler and Ashok Gupta, Engineering Mechanics: Statics and Dynamics, 11th Ed., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi.
2. Grant R Fowles, Analytical Mechanics, Cengage Learning India Pvt. Ltd. a line, resultant of a force system, distributed force system, free body diagram, free body involving interior sections, general equations of equilibrium, two point equivalent loading, problems arising from structures, static indeterminacy.

3.Mecanics, P Duraipandian, Laxmi Duraipandian, M Jayapragasam, S Chand Publication.

3-Ring Theory and Linear Algebra-II

Unit-I

Polynomial rings over commutative rings, division algorithm and consequences, principal ideal domains, factorization of polynomials, reducibility tests, irreducibility tests, Eisenstein criterion, unique factorization in Z[x]:

Unit-II

Divisibility in integral domains, irreducible, primes, unique factorization domains, Euclidean domains.

Unit-III

Dual spaces, dual basis, double dual, transpose of a linear transformation and its matrix in the dual basis, annihilators, Eigen spaces of a linear operator, diagonalizability, invariant subspaces and Cayley-Hamilton theorem, the minimal polynomial for a linear operator.

Unit-IV

Inner product spaces and norms, Gram-Schmidt orthogonalisation process, orthogonal complements, Bessels inequality, the adjoint of a linear operator, Least Squares Approximation, minimal solutions to systems of linear equations, Normal and self-adjoint operators, Orthogonal projections and Spectral theorem.

Books Recommended:

1. Joseph A. Gallian, Contemporary Abstract Algebra (4th Ed.), Narosa Publishing House, 1999. Chapters: 16, 17, 18.
2. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra (4th Edition), Prentice-Hall of India Pvt. Ltd., New Delhi, 2004. Chapters: 2(2.6 only), 5(5.1, 5.2, 5.4), 6(6.1, 6.4, 6.6), 7(7.3 only).

Books for References:

(For Linear Algebra)

1. S Lang, Introduction to Linear Algebra (2nd edition), Springer, 2005
2. Gilbert Strang, Linear Algebra and its Applications, Thomson, 2007
3. S. Kumaresan, Linear Algebra- A Geometric Approach, Prentice Hall of India, 1999.
4. Kenneth Ho_man, Ray Alden Kunze, Linear Algebra 2nd Ed., Prentice-Hall Of India Pvt. Limited, 1971.

(For Ring Theory)

1. John B.Fraleigh, A first course in Abstract Algebra, 7th Edition, Pearson Education India, 2003.
2. Herstein, Topics in Algebra (2nd edition), John Wiley & Sons, 2006

3. M ichael Artin, Algebra (2nd edition), Pearson Prentice Hall, 2011
4. Robinson, Derek John Scott., An introduction to abstract algebra, Hindustan book agency, 2010.

DSE-IV

Project Work(Compulsory)
Total Marks:100 (Project:75 Marks+Viva-Voce:25 Marks)

Skill Enhancement Courses(SEC)
(Credit: 2 each, Total Marks:50)
SEC-I to SEC-IV

SEC-I

Communicative English and Writing Skill(Compulsory)

SEC-II

(Any one of the following)

1-Logic and Sets

Introduction, propositions, Compound Proposition, truth table, negation, conjunction and disjunction. Implications, bi-conditional propositions, converse, contra-positive and inverse propositions and precedence of logical operators. Algebra of proposition, Negation of Compound Statement Propositional equivalence: Logical equivalences. Tautologies and Contrapositive, Mathematical Introduction, Method of Proof, Normal form, Predicate Calculus, 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. Power set of a set. Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections, Fuzzy sets. Product set, Relation: Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation, Partial ordering relations.

Books Recommended:

A Text Book of Discrete Mathematics**, S K Sarkar, S Chand, Publication.,** Chapter 2 (2.1-2.14,2.16,2.17) Ch. 4, Ch.7(7.1-7.7).

Books Reference:

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.

2-Information Security

Overview of Security: Protection versus security; aspects of security data integrity, data availability, privacy; security problems, user authentication, Orange Book. Security Threats: Program threats, worms, viruses, Trojan horse, trap door, stack and buffer over flow; system threats- intruders; communication threats- tapping and piracy. Security Mechanisms: Intrusion detection, auditing and logging, tripwire, system-call monitoring.

Books Recommended:

1. C. Peeger and S.L. Peeger-Security in Computing , 3rd Ed., Prentice-Hall of India, 2007.
2. D. Gollmann-Computer Security, John Wiley and Sons, NY, 2002.
3. J. Piwprzyk, T. Hardjono and J. Seberry-Fundamentals of Computer Security, Springer- Verlag Berlin, 2003.

4. J.M. Kizza-Computer Network Security, Springer, 2007.
5. M. Merkow and J. Breithaupt-Information Security: Principles and Practices, Pearson Education, 2006.

3-Combinartorial Mathematics

Basic counting principles, Permutations and Combinations (with and without repetitions), Binomial theorem, Multinomial theorem, Counting subsets, Set-partitions, Stirling numbers Principle of Inclusion and Exclusion, Derangements, Inversion formulae Generating functions: Algebra of formal power series, Generating function models, Calculating generating functions, Exponential generating functions. Recurrence relations: Recurrence relation models, Divide and conquer relations, Solution of recurrence relations, Solutions by generating functions. Integer partitions, Systems of distinct representatives.

Books Recommended:

1. J.H. van Lint and R.M. Wilson-A Course in Combinatorics, 2nd Ed., Cambridge University Press, 2001.
2. V. Krishnamurthy-Combinatorics, Theory and Application, A_liated East-West Press 1985.
3. P.J. Cameron-Combinatorics, Topics, Techniques, Algorithms, Cambridge University Press, 1995.
4. M. Jr. Hall-Combinatorial Theory, 2nd Ed., John Wiley & Sons, 1986.
5. S.S. Sane-Combinatorial Techniques, Hindustan Book Agency, 2013.
6. R.A. Brualdi-Introductory Combinatorics, 5th Ed., Pearson Education Inc., 2009.

GE (Paper-1)

Calculus and Ordinary Differential Equations
(GE-I for 1st SEM. Or GE-II for 2nd SEM.)

Total Marks:100

Theory:80 Marks+Mid-Sem:20 Marks

5 Lectures, 1 Tutorial (per week per student)

Unit-I

Curvature, Asymptotes, Tracing of Curves (Cartenary, Cycloid, Folium of Descartes, Astroid, Limacon, Cissoid & loops), Rectication, Quardrature, Volume and Surface area of solids of revolution.

Unit-II

Sphere, Cones and Cylinders, Conicoid.

Unit-III

Explicit and Implicit functions, Limit and Continuity of functions of several variables, Partial derivatives, Partial derivatives of higher orders, Homogeneous functions, Change of variables, Taylors theorem and Maclaurins theorem for functions of two variables. Extreme values of functions of two and three variables, Implicit functions, Lagranges multipliers.

Unit-IV

Ordinary Differential Equations of 1st order and 1st degree (Variables separable, homogenous, exact and linear). Equations of 1st order but higher degree. Second order linear equations with constant coefficients, homogeneous forms, Second order equations with variable coefficients, Variation of parameters.

Books Recommended:

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

2. Shantinarayan-Text Book of Calculus, Part-III, S. Chand and Co., Chapter-1 (Art 1,2), 3, 4(Art.10 to 12 omitting Simpsons Rule), 5(Art-13) and 6(Art-15).
3. B.P. Acharya and D.C. Sahu-Analytical Geometry of Quadratic Surfaces, Kalyani Publishers, New Delhi, Ludhiana.
4. Mathematical Analysis by S C Malik & S Arora, New Age International Publisher, Chapters: (Statements and applications only) 15,16.
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. L N Sahoo, Calculus and Ordinary Differential Equations(Generic Elective), Kalyani Publishers.
5. M.D. Raisinghania-Advanced Differential Equations, S. Chand & Company Ltd., New Delhi.
6. Santosh K. Sengar-Advanced Calculus.

GE (Paper-2)

(GE-I for 3rd SEM. Or GE-II for 4th SEM.)

Total Marks:100

Theory:80 Marks+Mid-Sem:20 Marks

5 Lectures, 1 Tutorial (per week per student)

GE-: Linear Algebra and Advanced Algebra

Unit-I

Group Theory: Definition and examples, Subgroups, Normal subgroups, Cyclic groups, Cosets, Quotient groups, Permutation groups, Homomorphism.

Unit-II

Ring Theory: Definition and examples, Some special classes of Rings, Ideals, Quotient rings, Ring homomorphism, More Ideals and Quotient Rings, The field of integral Domain .

Unit-III

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.

Unit-IV

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, Determinant and Rank of matrices, Eigen values, Eigen vectors, Quadratic forms.

Books Recommended:

1. V. Krishnamurty, V. P. Mainra, J. L. Arora-An introduction to Linear Algebra, Affialiated East-West Press Pvt. Ltd., New Delhi, Chapters: 3, 4(4.1 to 4.7), 5(except 5.3), 6(6.1, 6.2, 6.5, 6.6, 6.8),7(7.4 only).
2. Topics in Algebra by I N Herstein, Wiley Eastern ltd, New Age international Publication. Chapters:2(2.1-2.72.10), 3(3.1-3.6).

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. I.N. Herstein-Topics in Algebra, Wiley Eastern Pvt. Ltd.
6. Gallian-Contemporary Abstract Algebra, Narosa publishing House.
7. Artin-Algebra, Prentice Hall of India.
8. V.K. Khanna and S.K. Bhambri-A Course in Abstract Algebra, Vikas Publishing House Pvt. Ltd. New Delhi.
9. Algebra, M Artin,, Pearson(2^{nd} Edition).

COURSES OF STUDIES

Courses of Studies (Choice Based Credit System)

B.A/B.Sc. (Hons.) Mathematics

SESSION 2016-17

CORE COURSES

B.Sc.(Honours)-Mathematics

CREDIT : 06 each

KHALLIKOTE UNIVESITY

&

KHALLIKOTE AUTONOMOUS COLEGE

BERHAMPUR,GANJAM, ODISHA-760001

COURSE STRUCTURE

B.A/B.Sc (Honours) – Mathematics

- **Core Courses:6 credit each, Max. Marks:100**
- **Ability Enhancement Compulsory Courses (AECC):2 credit each, Max. Marks:50**
- **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: 75(Mid-Sem:15+End Sem: 60)Marks, Practical(End Sem):25 Marks.
- **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.

Semester-I

Core Courses (C)	**Ability Enhancement Compulsory Courses (AECC)**	**Skill Enhancement Courses (SEC)**	**Discipline Specific Elective (DSE)**	**Generic Electives (GE)**
C-1.1: Calculus & 3 D-I(P) C-1.2: Algebra-I	MIL/Alt. English	X	X	GE-I PAPER-I

Semester-II

Core Courses (C)	**Ability Enhancement Compulsory Courses (AECC)**	**Skill Enhancement Courses (SEC)**	**Discipline Specific Elective (DSE)**	**Generic Electives (GE)**
C-2.1: Real Analysis (Analysis-I) C-2.2: Differential Equations(P)	Environmental Science		**X**	GE-II PAPER-I

Semester-III

Core Courses (C)	Ability Enhancement Compulsory Courses (AECC)	Skill Enhancement Courses (SEC)	Discipline Specific Elective (DSE)	Generic Electives (GE)
C-3.1: Theory of Real Functions (Analysis-II) C-3.2: Group Theory (Algebra-II) C-3.3: Partial Differential Equations and Systems of Ordinary Differential Equations (P)	**X**	**SEC-I**	**X**	**GE-I PAPER-II**

Semester-IV

Core Courses (C)	Ability Enhancement Compulsory Courses (AECC)	Skill Enhancement Courses (SEC)	Discipline Specific Elective (DSE)	Generic Electives (GE)
C-4.1: Numerical Methods(P) C-4.2: Riemann Integration and Series of Functions (Analysis-III) C-4.3: Ring Theory and Linear Algebra-I (Algebra-III)	**X**	**SEC-II**	**X**	**GE-II PAPER-II**

Semester-V

Core Courses (C)	Ability Enhancement Compulsory Courses (AECC)	Skill Enhancement Courses (SEC)	Discipline Specific Elective (DSE)	Generic Electives (GE)
C-5.1: Multivariate Calculus (Calculus-II) C-5.2: Probability and Statistics	X	X	DSE-I DSE-II	X

Semester-VI

Core Courses (C)	Ability Enhancement Compulsory Courses (AECC)	Skill Enhancement Courses (SEC)	Discipline Specific Elective (DSE)	Generic Electives (GE)
C-6.1: Metric Spaces andComplex Analysis (Analysis-IV) C-6.2: Linear Programming	X	X	DSE-III DSE-IV	X

Semester – I

C-1.1: Calculus–I & 3-D

Part -I (Theory)

(Total Marks; 60+15)
5 Lectures, 1 Tutorial per week

Unit-I

Hyperbolic functions, higher order derivatives, Leibnitz Theorem and its applications , asymptotes, curvature, concavity, inflection points and multiple points, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves and parametric curves.

Unit-II

Reduction formulae, derivations and illustrations of reduction formulae of the, area of curves, area of polar curves, length of plane curves, volumes and surfaces of solid of revolution.

Unit-III

Sphere, Cone, Cylinder, Central Conicoids

Unit-IV

Multiple product, introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation of vectors, Differential operator, integration of vector functions.

Part -II (Practical) Total Mark-25

(Using any software)
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, the derivative graph, the second derivative graph and comparing them.
3. Sketching parametric curves (Eg. cycloid, asroid, cissoids, cardiod).
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, elliptic cone, elliptic, paraboloid, hyperbolic paraboloid using cartesian coordinates.
7. Matrix operation (addition, multiplication, inverse, transpose)

Books Prescribed

1. Mathematics for Degree students by Dr. P K Mittal, S. Chand & Co.(2014th Edn.)

   Differential Calculus, Chapters: 3(3.3), 5,6(excluding 6.5),7(7.1-7.5),8.
   Integral Calculus, Chapters: 3(3.1-3.14),5(5.1-5.6), 6(6.1-6.4),7
   Geometry (3-D) Chapter 4,5, 6
   Vector analysis- Chapter 1,2,3,4.

Books for reference

1. Text book of Calculus, Part-II by Shantinarayan, S Chand & Co.
2. Text book of Calculus, Part-III by Shantinarayan, S Chand & Co.
3. Elementary Calculus by Panda and Satapathy.
4. Calculus by G.B.Thomas, Pearson Education, Delhi

5. Analytical Solid Geometry by S.Narayan and Mittal, S.Chand Co.
6. Analytical Geometry of Quadratic Surfaces by B.P.Acharya and D.P.Sahu, Kalyani Publishers

C-1.2: Algebra-I
Total Marks:100

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

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, Divisibility & Euclidean algorithm, Primes, Principles of Mathematical Induction, statement of Fundamental Theorem of Arithmetic.

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: Definition, Range and Kernel of a linear map, Rank and nullity, Inverse of a Linear Transformation, Rank nullity theorem, The Space L(U, V), Composition of Linear Map

Books Prescribed

1. Mathematics for Degree students by Dr. P K Mittal, S. Chand & Co.(2014th Edn.)

   Trigonometry, Chapters:1 (1.1-1.4)
2. An introduction to the Theory of Number by Ivan Niven & H S Zuckerman, Wilea Eastern ltd. Chapter 1(1.1-1.3)
3. An Introduction to Linear Algebra by V Krishna Murthy, V P Mainra, J L Arora, Affiliated East-West Press Pvt. Ltd. Chapter 3, 4(4.1-4.7)

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.
7. I.N. Herstein-Topics in Algebra, Wiley Eastern Pvt. Ltd.
8. D. K Dalai, B.Sc Mathematics, Algebra-1, Kalyani Publishers.

Semester – II

C-2.1: Analysis –I
(Total Marks; 80+20)
5 Lectures, 1 Tutorial per week

Unit-I

Field structure and order structure, Bounded and unbounded sets, (excluding Dedikinds form of completeness property), completeness in the set of real numbers, Absolute value of a real number.

Unit-II

Neighborhood of a point, Interior point, Limit point, Open set, Closed set, Dense set, Perfect set, Bolzano-Weierstrass's theorem, Countable and Uncountable sets.

Unit-III

Sequences, Limit points function a sequence, Limit inferior and superior, Convergent sequence, Non-convergent sequence, Cauchy's general principle of convergence. Algebra of sequences, Some important theorems, Monotonic sequence.

Unit-IV

Infinite series, Positive term series, Comparison test for positive term series, Cauchy's root test, D'Alemberts root test, Raabe's test, Logarithemic test, Integral test, Series with arbitrary terms, Rearrangement of the terms.

Books Prescribed

Mathematical Analysis by S.C.Malik and Savita Arora, New-Age Pvt. Ltd.

Chapters: 1(2, 3,4.1,4.2,5),2,3,4(1-8,10.1,10.2.

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. Santi Narayan And P K Mittal, A Course of Mathematical Analysis, S Chand Publication.
3. Gerald G. Bilodeau , Paul R. Thie, G.E. Keough, An Introduction to Analysis, 2nd Ed., Jones & Bartlett, 2010.
4. Brian S. Thomson, Andrew. M. Bruckner and Judith B. Bruckner, Elementary Real Analysis, Prentice Hall, 2001.
5. S.K. Berberian, A First Course in Real Analysis, Springer Verlag, New York, 1994. 5. S.C. Mallik and S. Arora-Mathematical Analysis, New Age International Publications.
6. D. Smasundaram and B. Choudhury-A First Course in Mathematical Analysis, Narosa Publishing House.
7. S.L. Gupta and Nisha Rani-Real Analysis, Vikas Publishing House Pvt. Ltd., New Delhi.
8. G. Das and S. Pattanayak, Fundamentals of Mathematics Analysis, TMH Pub-lishing Co.

C-2.2: Differential Equations

(Total Marks:100) Part-I(Marks:75)
Theory:60 Marks+Mid-Sem:15 Marks
04 Lectures(per week per student)

Unit-I

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

Unit-II

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

Unit-III

Power series solutions of second order differential equations.

Unit-IV

Laplace transforms and its applications to solutions of differential equations.

Part-II (Practical: Marks:25)

List of Practicals (Using any Software) 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 problems.

Book Recommended:

1. J. Sinha Roy and S. Padhy, A Course of Ordinary and Partial Differential Equations, Kalyani Publishers, New Delhi. Chapters: 1, 2(2.1 to 2.7), 3, 4(4.1 to 4.7), 5, 7(7.1-7.4), 9(9.1, 9.2, 9.3, 9.4, 9.5, 9.10, 9.11, 9.13).

Books for References:

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

Semester-III

C-3.1: Theory of Real Functions (Analysis-II)

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

Unit-I
Limits of function ($\epsilon - \delta$ approach), Limit theorems, sequential approach of limits, Couchy's criterion for finite limit, Infinite limits and limits at infinity. Continuous functions, sequential criterion for continuity and discontinuity.
Ch.5(Art.1,2)

Unit-II
Algebra of continuous functions. Continuous functions on an interval, intermediate value theorem, Fixed point theorem, location of roots. Uniform continuity, uniform continuity theorem. Differentiability of a function at a point and in an interval, algebra of differentiable functions.
Ch.5(Art.3,4), Ch.6(Art.1,2)

Unit-III
Increasing functions,
Relative extrema, interior extremum theorem. Rolle's theorem, Mean value theorem, intermediate value Theorems of derivatives, Darbouxs theorem. Applications of mean value theorem to inequalities and approximation of polynomials, Taylors theorem and Maclaurin's theorem to inequalities.
Ch.6(Art.3-8(8.1-8.3))

Unit-IV
Taylors and Maclaurin's infinite series, Power series expansion, Taylors series and Maclaurins series expansions of exponential and trigonometric functions, ln(1 + x); 1/(ax + b) and $(1+x)^n$,extreme values, Indeterminate forms.
Ch.6(Art. 8(8.4-8.6)), Ch.7

Book Recommended:
Mathematical Analysis by S.C.Malik and Savita Arora, New-Age Pvt. Ltd.

Books for References:

1. G. Das and S. Pattanayak, Fundamentals of Mathematics Analysis, TMH Pub-lishing Co., Chapters:6(6.1-6.8), 7(7.1-7.7).
2. Shanti Narayan and M.D. Raisinghania-Elements of Real Analysis, S. Chand & Co. Pvt. Ltd.
3. R. Bartle and D.R. Sherbert, Introduction to Real Analysis, John Wiley and Sons, 2003.
4. K.A. Ross, Elementary Analysis: The Theory of Calculus, Springer, 2004.
5. A. Mattuck, Introduction to Analysis, Prentice Hall, 1999.
6. S.R. Ghorpade and B.V. Limaye, A Course in Calculus and Real Analysis, Springer, 2006.

C-3.2: Group Theory(Algebra-II)

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

Unit-I
Symmetries of a square, Dihedral groups, 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 a group.

Unit-II
Properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, 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.

Book Recommended:

1. Joseph A. Gallian, Contemporary Abstract Algebra(8th Edn.), Narosa Publishing House, New Delhi.

Books for References:

1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
2. Vijay K Khanna and S K Bhambri, A course in Abstract Algebra (Vikash Publication).
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.
5. I.N. Herstein, Topics in Algebra, Wiley Eastern Limited, India, 1975.

C-3.3: Partial Differential Equations and Systems of Ordinary Differential Equations

(Total Marks:100)
Part-I(Marks:75)
Theory:60 Marks+Mid-Sem:15 Marks
04 Lectures(per week per student)

Unit-I
Systems of linear differential equations, types of linear systems, differential operators, an operator
method for linear systems with constant coefficients, Basic Theory of linear systems in normal form,
homogeneous linear systems with constant coefficients(Two Equations in two unknown functions). Simultaneous linear first order equations in three variables, methods of solution, Pfaffan differential
equations, methods of solutions of Pfaffan 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,
Separation of variables, Non-linear equation of the second order.

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:25)

List of Practical's (Using any Software)

Practical/Lab work to be performed on a Computer.

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

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

   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) $u(x,0) = \phi(x), u_t(x,0) = \psi(x), x\epsilon R,\ t > 0$
b) $u(x,0) = \phi(x), u_t(x,0) = \psi(x),\ u_x(0,t) = 0,\ x\epsilon(0,\infty),\ t > 0$
c) $u(x,0) = \phi(x), u_t(x,0) = \psi(x),\ u(0,t) = 0,\ x\epsilon(0,\infty),\ t > 0$
d) $u(x,0) = \phi(x),\ u_t(x,0) = \psi(x),\ u(0,t) = 0, u(1,t) = 0,\ 0 < x < l,\ t > 0$

4. Solution of wave equation

$$\frac{\partial u}{\partial t} - k^2\frac{\partial^2 u}{\partial x^2} = 0$$

for the following associated conditions:

2. $u(x;\ 0) = \phi(x);\ u(0;\ t) = a;\ u(l;\ t) = b;\ 0 < x < l;\ t > 0$:
3. $u(x;\ 0) = \phi(x);\ x\,\epsilon\, R;\ 0 < t < T$:
4. $u(x;\ 0) = \phi(x);\ u(0;\ t) = a;\ x\epsilon\ (0;\infty);\ t \geq 0$:

Book Recommended:

1. J.Sinha Roy and S. Padhy, A Course on Ordinary and Partial Differential Equations, Kalyani, Publishers, New Delhi, Ludhiana, 2012.
   Chapters: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:

Tyn Myint-U and Lokenath Debnath, Linear Partial Differential Equations for Scientists and Engineers, 4th edition, Springer, Indian reprint, 2006.

S.L. Ross, Differential equations, 3rd Ed., John Wiley and Sons, India, 2004.

Dr. M D Raisinghania, Ordinary and Partial Differential Equation, **S. Chand Publication.**

Semester-IV

C-4.1: Numerical Methods

(Total Marks:100)
Part-I(Marks:75)

Theory:60 Marks+Mid-Sem:15 Marks
04 Lectures(per week per student)

Unit-I

Algorithms, Convergence, Errors: Relative, Absolute, Round o_, Truncation. Transcendental and Polynomial equations: Bisection method, Newtons method, Secant 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

Interpolation: Lagrange and Newtons methods. Error bounds. Finite di_erence operators. Gregory forward and backward di_erence interpolation.

Unit-IV

Numerical Integration: Trapezoidal rule, Simpsons rule, Simpsons 3/8th rule, Booles Rule. Midpoint rule, Composite Trapezoidal rule, Composite Simpsons rule. Ordinary Di_erential Equations: Eulers method. Runge-Kutta methods of orders two and four.

Part-II(Practical: Marks:25)

List of Practicals (Using any Software)

Practical/Lab work to be performed on a Computer.

1. Calculate the sum $\frac{1}{1}+\frac{1}{2}+\cdots\cdots\cdots\cdots+\frac{1}{N}$
2. To find the absolute value of an integer.
3. Enter 100 integers into an array and sort them in an ascending order.
4. Bisection Method.
5. Newton Raphson Method.
6. Secant Method.
7. Regulai Falsi Method.
8. LU decomposition Method.
9. Gauss-Jacobi Method.
10. SOR Method or Gauss-Siedel Method.
11. Lagrange Interpolation or Newton Interpolation.
12. Simpsons rule.

Note: For any of the CAS (Computer aided software) Data types-simple data types, floating data types, character data types, arithmetic operators and operator precedence, variables and constant declarations, expressions, input/output, relational operators, logical operators and logical expressions, control statements and loop statements, Arrays should be troduced to the students.

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).

2. **Brian Bradie,** A Friendly Introduction to Numerical Analysis, Pearson Education, India, 2007.
3. S. Ranganatham, Dr. M. V. S. S. N. Prasad, Numaerical Analysis, S. Chand Publication.

Books for References:

1. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scienti_c 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. Numerical Methods, P. Kandasamy, K. Thilagavathy, K. Gunavathi, S. Chand Publication.

C-4.2: Riemann Integration and Series of Functions (Analysis-III)

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

Unit-I

Riemann integration; Refinement of partitions, Darboux Theorem, Conditions of Integrebility, Integrability of sum and difference of integrable functions. Integral as a limit of sum, some integrable functions, integration and differention. Fundamental theorem of integral calculus and mean value theorem of integral calculus.

Unit-II

Improper integrals; Convergence of Beta and Gamma functions, Integration of unbounded functions with finite limits of integration, comparison test for convergence at a of $\int_a^b f(x)dx$. Infinite range of integration.

Unit-III

Point-wise convergence and Uniform convergence of sequence of functions on an interval, Couchy's criterion for uniform convergence and Weierstrass M-Test test for uniform convergence, Properties of uniformly convergence sequences and series.

Unit-IV

Power series, Definitions, some theorems, properties of functions expressible as power series, Abels theorem, Taylors theorems, Weierstrass Approximation Theorem.

Book Recommended:

Mathematical Analysis by S.C.Malik and Savita Arora, New-Age Pvt. Ltd.
Ch. 9(Art. 1-10), Ch. 11(Art.1-4), Ch. 12, Ch. 13(Art.1-4)

Books for References:

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

C-4.3: Ring Theory and Linear Algebra-(ALGEBRA-III)

Total Marks:100

Theory:80 Marks+Mid-Sem:20 Marks

5 Lectures, 1 Tutorial (per week per student)

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, operations on ideals, prime and maximal ideals.

Unit-II

Ring homeomorphisms, properties of ring homeomorphisms, Isomorphism theorems I, II and III, field of quotients.

Unit-III

Matrix associated with a Linear Map, Linear map associated with a matrix, Matrix multiplication, Rank and Nullity of a Matrix, Transpose of a Matrix, Special types of matrices, Elementary Row operation, System of Linear Equations, Matrix Inversion.

Unit-IV

Determinant: Definition, fundamental properties, Minors, Product of determinants, Application to Linear equations, Eigen Values, Eigen Vectors and Characteristic equation of a matrix

Book Recommended:

1. Joseph A. Gallian, Contemporary Abstract Algebra(4th Edn.), Narosa Publishing House, New Delhi. Chapters:12, 13, 14, 15.
2. An Introduction to Linear Algebra by V Krishna Murthy, V P Mainra, J L Arora, Affiliated East-West Press Pvt. Ltd. Chapter 5, 6(6.1, 6.2, 6.5-6.8).

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 Ho_man, Ray Alden Kunze, Linear Algebra, 2nd Ed., Prentice-Hall of India Pvt. Ltd., 1971.
7. I.N. Herstein-Topics in Algebra, Wiley Eastern Pvt. Ltd.
8. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, 4th Ed., Prentice- Hall of India Pvt. Ltd., New Delhi, 2004.
9. Linear Algebra, Surjeet Singh, VIKAS Publishing House Ltd.

Semester-V

C-5.1: Multivariate Calculus (Calculus-II)

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

Unit-I
Functions of several variables, Explicitly and Implicitly functions, limit and continuity of functions of two variables Partial differentiation, differentiability, Partial derivative of Higher Order, Differentiability of Higher Order, Functions of a Functions, Change of Variable.
Unit-II
Extreme Values: Maxima and Minima, Implicitly Functions, Definition, Jacobians, Stationary Values under Subsidiary Conditions.

Unit-III
Integration on $\boldsymbol{R^2}$, Line Integrals, Double Integrals, Double integration over a Region, Greens Theorem, Change of variables.
Unit-IV
Integration on $\boldsymbol{R^3}$, Rectifiable curve, Line integrals, Surface integrals, Stokes theorem, The volume of a cylindrical solid by Double Integrals, Volume integrals, The Divergence theorem.

Books Recommended:
Mathematical Analysis by S.C.Malik and Savita Arora, New-Age Pvt. Ltd.

Chapter 15 (1- 8, 10), Ch. 16 (1 - 3), Ch. 17 (1 -5), Ch. 18 (1- 8)
Books for Reference:

1. M.J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) Pvt. Ltd.
2. . G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.
3. . E. Marsden, A.J. Tromba and A. Weinstein, Basic Multivariable Calculus, Springer (SIE), Indian reprint, 2005.
4. . Santosh K. Sengar-Advanced Calculus, Cengage Learning India Pvt. Ltd.

C-5.2: Probability and Statistics

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

Unit-I
Sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function, Certain Probability Model.

Unit-II
Conditional Probability, Marginal and conditional distributions, correlation coefficient and Sticstochastic Independece,
Unit-III
The binomial, Trinomial and Multinomial distribution, Poisson distribution, Gamma and Chi-Square distribution, Normal Distribution, bivariate normal distribution .

Unit-IV

Chebyshevs inequality, statement and interpretation of (weak) law of large numbers and strong law of large numbers, Central Limit theorem for independent and identically distributed random variables with finite variance, Markov Chains, Chapman-Kolmogorov equations, classification of states.

Books Recommended:

1. Robert V. Hogg, Joseph W. McKean and Allen T. Craig, Introduction to Mathematical Statistics, Pearson Education, Asia, 2007. Chapters: 1(1.1, 1.3 -1.9), 2(2.1-2.4), 3 (3.1-3.5).
2. Sheldon Ross, Introduction to Probability Models, 9th Ed., Academic Press, Indian Reprint, 2007. Chapters:2(2.7), 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. Irwin Miller and Marylees Miller, John E. Freund, Mathematical Statistics with Applications, 7th Ed., Pearson Education, Asia, 2006. Chapters: 4, 5(5.1-5.5, 5.7), 6(6.2,6.3, 6.5-6.7), 14(14.1, 14.2)

4. S. Ross-A First Course in Probability, Pearson Education.

Semester-VI

C-6.1: Metric Spaces and Complex Analysis (Analysis-IV)

Total Marks:100

Theory:80 Marks+Mid-Sem:20 Marks

5 Lectures, 1 Tutorial (per week per student)

Unit-I

Metric spaces: definition and examples. Sequences in metric spaces, Cauchy sequences. Complete Metric Spaces. Open and closed balls, neighbourhood, open set, interior of a set. Limit point of a set, closed set, diameter of a set, Cantors theorem. Subspaces, dense sets, separable spaces. Continuous mappings, sequential criterion and other characterizations of continuity. Uniform continuity. Homeomorphism, Contraction mappings, Banach Fixed point Theorem.

Unit-II

Compactness and Connectedness, connected subsets of R:

Unit-III

Properties of complex numbers, regions in the complex plane, functions of complex variable, mappings. Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability.

Unit-IV

Analytic functions, examples of analytic functions, exponential function, Logarithmic function, Branches and derivative of Logarithmic function, trigonometric function, derivatives of functions, definite integrals of functions. Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals. Cauchy- Goursat theorem, Cauchy integral formula.

Books Recommended:

1. Mathematical Analysis by S.C.Malik and Savita Arora, New-Age Pvt. Ltd. Chapter 19
2. James Ward Brown and Ruel V. Churchill, Complex Variables and Applications, 7th Ed., McGraw Hill International Edition,. Chapters: 1(2,3,10,), 2(11, 12,18-21,23,24), 3(28, 29, 30,33) 4(36-41, 44, 45,47)

.

2. Books for References:

1. Satish Shirali and Harikishan L. Vasudeva, Metric Spaces, Springer Verlag, London, 2006.
2. S. Kumaresan, Topology of Metric Spaces, 2nd Ed., Narosa Publishing House, 2011.
3. S. Ponnusamy-Foundations of Complex Analysis, Alpha Science International Ltd.
4. J.B. Conway-Functions of one complex variable, Springer.

5. N. Das- Complex Function Theory, Allied Publishers Pvt. Ltd., Mumbai.
6. P.K. Jain and K. Ahmad, Metric Spaces, Narosa Publishing House, New Delhi

C-6.2: Linear Programming

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

Unit-I

Introduction to linear programming problem, Fundamental Properties of solutions, The computational Procedure, Use of Artificial Variables, Solution of Simultaneous Linear equations, Inverting a matrix using Simplex method, .

Unit-II

Introduction, General Primal- Dual pair, formulating a dual problem, Primal- Dual pair in Matrix form, Duality Theorem, Complementary Slackness theorem, Duality and Simplex Method, Dual simplex method, economic interpretation of the dual.

Unit-III

Introduction ,General Transportation Problem, Transportation table, Duality in Transportation problem, Loops in Transportation Tables, LP- formulation of Transportation Problem, Triangular Basis in a Transportation problem, Solution of a Transportation problem, Finding an initial basic feasible solution, Test for optimality, Degeneracy in Transportation problem, Modi Method of Transportation algorithm, Stepping stone solution method, Time minimization transportation problem, Transhipment problems.

Unit-IV

Introduction to Assignment problem, Mathematical Formulation of the Problem, Assignment Method, Special cases in assignment problems, A typical assignment problem, The travelling sales man problem.

Recommended Books:

1. Kanti Swarup, P.K. Gupta and Man Mohan-Operations Research, S. Chand and Co. Pvt. Ltd. Ch. 4(1-6), Ch. 5(1-5), Ch.10 (1-13,15,16), Ch. 11 (1-6)

Books for Reference:

1. G. Hadley, Linear Programming, Narosa Publishing House, New Delhi, 2002.
2. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, Linear Programming and Network Flows, 2nd Ed., John Wiley and Sons, India, 2004.
3. N.V.R. Naidu, G. Rajendra and T. Krishna Rao-Operations Research, I.K. International Publishing House Pvt. Ltd., New Delhi, Bangalore.
4. R. Veerachamy and V. Ravi Kumar-Operations Research- I.K. International Publishing House Pvt. Ltd., New Delhi, Bangalore.
5. P.K. Gupta and D.S. Hira-Operations Research, S. Chand and Company Pvt. Ltd., New Delhi.
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:
8. Operation Research(4^{th} Edn.) S Kalavathy, Vikas Publishing House.

Discipline Specific Ecectives(DSE)

DSE-1

Programming in C++ (Compulsory)

Part-I(Marks:75)

(Theory:60 Marks+Mid-Sem:15 Marks)

Introduction to structured programming: data types- simple data types, floating data types, character data types, string data types, arithmetic operators and operators precedence, variables and constant declarations, expressions, input using the extraction operator and cin, output using the insertion operator and cout, pre-processor directives, increment(++) and decrement({) operations, 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, 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, 6TH Edition, Course Technology, Cengage Learning, India Edition. Chapters: 2(Pages:37-95), 4(Pages:183-206), 5(Pages:259-303), 6(Pages 335-361), 8(Pages 505-527), 12 (Pages 781-792)

Books for References:

1. E. Balaguruswami: Object oriented programming with C++, _fth 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

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Part-II(Practical, Marks:25)

List of Practicals (Using any software)

Practical/Lab work to be performed on a Computer.

1. Calculate the Sum of the series

$$\frac{1}{1}+\frac{1}{2}+\frac{1}{3}\ldots\ldots\ldots+\frac{1}{N}$$

for any positive integer N:

2. Write a user de_ned function to _nd the absolute value of an integer and use it to evaluate the function $\frac{(-1)n}{|n|},\ for\ n=-2,-1,0,1,2$

3. Calculate the factorial of any natural number.

4. Read oating 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 _rst 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 (_rst 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 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 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 _le 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 Digit 12345 is 54321 and the value of reverse Digit -532 is -235:

DSE-II

Total Marks:100
Theory:80 Marks+Mid-Sem:20 Marks
5 Lectures, 1 Tutorial (per week per student.
(Any one of the following)

1-Discrete Mathematics

Unit-I

Logic, proportional equivalence, predicates and quantifiers, nested quantifiers, 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 relations 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 as ordered sets, Lattices as algebraic structures, sub-lattices, Boolean algebra and its properties, Boolean functions and their representation..

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.

Book Recommended:

1. Kenneth H. Rosen, Discrete Mathematics and Applications, Tata McGraw Hill Publications, Chapters: 1(1.1 to 1.4), 4(4.1, 4.2, 4.5), 6(6.1, 6.2, 6.4), 7(7.1, 7.2,7.6), 8,10(10.1,10.2).

Books for References:

1. B A. Davey and H. A. Priestley, Introduction to Lattices and Order, Cambridge University Press, Cambridge, 1990.
2. Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory (2nd Edition), Pearson Education (Singapore) Pte. Ltd., Indian Reprint 2003.
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.

N C h S N Iyengar, V M Chandrasekharan, K A Venkatesh, P S Arunachalam, Discrete Mathematics, Vikas Publishing House.

2-Mathematical Modelling

Unit-I

Simple situations requiring Mathematical modeling. The technique of Mathematical modeling, Mathematical modeling through differential equations, linear growth and decay models, non-linear growth and decay models, compartment models, Mathematical modeling of geometrical problems through ordinary differential equations of first order.

Unit-II

Mathematical modeling in population dynamics, Mathematical modeling of epidemics through systems of ordinary differential equations of first order, compartment models through systems of ordinary differential equations, Mathematical modeling in economics through systems of ordinary differential equations of first order.

Unit-III

Mathematical models in medicine, arms race, battles and international trade in terms of systems of ordinary differential equations, Mathematical modeling of planetary motions, Mathematical modelling of circular motion and motion of satellites, mathematical modeling through linear differential equations of second order.

Unit-IV

Situation giving rise to partial differential equations models, mass balance equations: First method of getting PDE models, momentum balance equations. The second method of obtaining partial differential models, variation principles , third function, fourth method of obtaining partial differential equation models, models for traffic flow of a highway. Situation that can be modelled through graphs, mathematical models in terms of directed graphs, optimization principles and techniques, Mathematical modeling through calculus of variations.

Books Recommended:

1. J.N. Kapur-Mathematical Modeling, Chapters: 1(1.1 and 1.2), 2(2.1 to 2.4, 2.6), 3(3.1 to 3.5), 4(4.1 to 4.3), 6(6.1 to 6.6), 7(7.1 to 7.2), 9(9.1 and 9.2).

3-Number Theory

Unit-I

Divisibity theorem in integers, Primes and their distributions, Fundamental theorem of arithmetic, Greatest common divisor, Euclidean algorithms, Modular arithmetic, Linear Diophantine equation, prime counting function, statement of prime number theorem, Goldbach conjecture.

Unit-II

Introduction to congruence, Linear Congruencies, Chinese Remainder theorem, Polynomial congruence, System of linear congruence, complete set of residues, Chinese remainder theorem, Fermats little theorem, Wilsons theorem.

Unit-III

Number theoretic functions, sum and number of divisors, totally multiplicative functions, definition and properties of the Dirichlet product, the Mobius inversion formula, the greatest integer function, Eulers phi function, Eulers theorem, reduced set of residues, some properties of Eulers phi-function.

Unit-IV
Order of an integer modulo n, primitive roots for primes, composite numbers having primitive roots, Eulers criterion, the Legendre symbol and its properties, quadratic reciprocity, quadratic congruence with composite moduli.

Book Recommended:
1. D.M. Burton-Elementary Number Theory, McGraw Hill, Chapters: 2(2.1 to 2.4), 3(3.1 to 3.3), 4(4.1 to 4.4), 5(5.1 to 5.4), 6(6.1 to 6.3), 7(7.1 to 7.3), 8(8.1 to 8.2), 9(9.1 to 9.3).

Books for References:

1. K.H. Rosen-Elementary Number Theory & its Applications, Pearson Addition Wesley.
2. I. Niven and H.S. Zuckerman-An Introduction to Theory of Numbers, Wiley Eastern Pvt. Ltd.
3. Tom M. Apostol-Introduction to Analytic Number Theory, Springer International Student Edn.
4. Neville Robinns, Beginning Number Theory (2nd Edition), Narosa Publishing House Pvt. Limited, Delhi, 2007.
5. Basic Number Theory, S B Mallik, 2nd Revised Edn. Vikas Publishing House.

DSE-III

Total Marks:100
Theory:80 Marks+Mid-Sem:20 Marks
5 Lectures, 1 Tutorial (per week per student.
(Any one of the following)

1-Differential Geometry

Unit-I
Theory of Space Curves: Space curves, Planer curves, Curvature, torsion and Serret-Frenet formulae. Osculating circles, Osculating circles and spheres. Existence of space curves. Evolutes and involutes of curves.

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

Unit-III
Developable: Developable associated with space curves and curve son surfaces, Minimal surfaces.

Unit-IV
Theory of Surfaces: Parametric curves on surfaces. Direction coefficients. First and second Fundamental forms. Principal and Gaussian curvatures. Lines of curvature, Euler's 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 Di_erential Geometry, Dover Publications, 2012.
2. S. Lang, Fundamentals of Di_erential Geometry, Springer, 1999.
3. B. O'Neill, Elementary Di_erential Geometry, 2nd Ed., Academic Press, 2006.
4. A.N. Pressley-Elementary Di_erential Geometry, Springer.
5. B.P. Acharya and R.N. Das-Fundamentals of Differential Geometry, Kalyani Publishers, Ludhiana, New Delhi.

2-Mechanics

Unit-I
Moment of a force about a point and an axis, couple and couple moment, Moment of a couple about a line, resultant of a force system, distributed force system, free body diagram, free body involving

interior sections, general equations of equilibrium, two point equivalent loading, problems arising from structures, static indeterminacy.

Unit-II

Laws of Coulomb friction, application to simple and complex surface contact friction problems, transmission of power through belts, screw jack, wedge, first moment of an area and the centroid, other centres, Theorem of Pappus-Guldinus, second moments and the product of area of a plane area, transfer theorems, relation between second moments and products of area, polar moment of area, principal axes.

Unit-III

Conservative force field, conservation for mechanical energy, work energy equation, kinetic energy and work kinetic energy expression based on center of mass, moment of momentum equation for a single particle and a system of particles.

Unit-IV

Translation and rotation of rigid bodies, Chasles theorem, general relationship between time derivatives of a vector for different references, relationship between velocities of a particle for different references, acceleration of particle for different references.

Book Recommended:

1. I.H. Shames and G. Krishna Mohan Rao, Engineering Mechanics: Statics and Dynamics, (4^{th} Ed.), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2009. Chapters:3, 4, 5, 6(6.1-6.7), 7, 11, 12(12.5, 12.6), 13.

Books for References:

1. R.C. Hibbeler and Ashok Gupta, Engineering Mechanics: Statics and Dynamics, 11th Ed., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi.
2. Grant R Fowles, Analytical Mechanics, Cengage Learning India Pvt. Ltd. a line, resultant of a force system, distributed force system, free body diagram, free body involving
   interior sections, general equations of equilibrium, two point equivalent loading, problems arising from structures, static indeterminacy.
3. Mecanics, P Duraipandian, Laxmi Duraipandian, M Jayapragasam, S Chand Publication.

3-Ring Theory and Linear Algebra-II

Unit-I

Polynomial rings over commutative rings, division algorithm and consequences, principal ideal domains, factorization of polynomials, reducibility tests, irreducibility tests, Eisenstein criterion, unique factorization in $Z[x]$:

Unit-II

Divisibility in integral domains, irreducible, primes, unique factorization domains, Euclidean domains.

Unit-III

Dual spaces, dual basis, double dual, transpose of a linear transformation and its matrix in the dual basis, annihilators, Eigen spaces of a linear operator, diagonalizability, invariant subspaces and Cayley-Hamilton theorem, the minimal polynomial for a linear operator.

Unit-IV

Inner product spaces and norms, Gram-Schmidt orthogonalisation process, orthogonal complements, Bessels inequality, the adjoint of a linear operator, Least Squares Approximation, minimal solutions to systems of linear equations, Normal and self-adjoint operators, Orthogonal projections and Spectral theorem.

Books Recommended:

1. Joseph A. Gallian, Contemporary Abstract Algebra (4th Ed.), Narosa Publishing House, 1999. Chapters: 16, 17, 18.

2. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra (4th Edition), Prentice-Hall of India Pvt. Ltd., New Delhi, 2004. Chapters: 2(2.6 only), 5(5.1, 5.2, 5.4), 6(6.1, 6.4, 6.6), 7(7.3 only).

Books for References:

(For Linear Algebra)

1. S Lang, Introduction to Linear Algebra (2nd edition), Springer, 2005
2. Gilbert Strang, Linear Algebra and its Applications, Thomson, 2007
3. S. Kumaresan, Linear Algebra- A Geometric Approach, Prentice Hall of India, 1999.
4. Kenneth Ho_man, Ray Alden Kunze, Linear Algebra 2nd Ed., Prentice-Hall Of India Pvt. Limited, 1971.

(For Ring Theory)

1. John B.Fraleigh, A first course in Abstract Algebra, 7th Edition, Pearson Education India, 2003.
2. Herstein, Topics in Algebra (2nd edition), John Wiley & Sons, 2006
3. M ichael Artin, Algebra (2nd edition), Pearson Prentice Hall, 2011
4. Robinson, Derek John Scott., An introduction to abstract algebra, Hindustan book agency, 2010.

DSE-IV

Project Work(Compulsory)
Total Marks:100 (Project:75 Marks+Viva-Voce:25 Marks)

Skill Enhancement Courses(SEC)
(Credit: 2 each, Total Marks:50)
SEC-I to SEC-IV

SEC-I

Communicative English and Writing Skill(Compulsory)

SEC-II
(Any one of the following)

1-Logic and Sets

Introduction, propositions, Compound Proposition, truth table, negation, conjunction and disjunction. Implications, bi-conditional propositions, converse, contra-positive and inverse propositions and precedence of logical operators. Algebra of proposition, Negation of Compound Statement Propositional equivalence: Logical equivalences. Tautologies and Contrapositive, Mathematical Introduction, Method of Proof, Normal form, Predicate Calculus, 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. Power set of a set. Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections, Fuzzy sets. Product set, Relation: Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation, Partial ordering relations.

Books Recommended:

A Text Book of Discrete Mathematics**, S K Sarkar, S Chand, Publication.,** Chapter 2 (2.1-2.14,2.16,2.17) Ch. 4, Ch.7(7.1-7.7).

Books Reference:

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.

2-Information Security

Overview of Security: Protection versus security; aspects of security data integrity, data availability, privacy; security problems, user authentication, Orange Book. Security Threats: Program threats, worms, viruses, Trojan horse, trap door, stack and buffer over flow; system threats- intruders; communication threats- tapping and piracy. Security Mechanisms: Intrusion detection, auditing and logging, tripwire, system-call monitoring.

Books Recommended:

1. C. Peeger and S.L. Peeger-Security in Computing , 3rd Ed., Prentice-Hall of India, 2007.
2. D. Gollmann-Computer Security, John Wiley and Sons, NY, 2002.
3. J. Piwprzyk, T. Hardjono and J. Seberry-Fundamentals of Computer Security, Springer- Verlag Berlin, 2003.
4. J.M. Kizza-Computer Network Security, Springer, 2007.
5. M. Merkow and J. Breithaupt-Information Security: Principles and Practices, Pearson Education, 2006.

3-Combinartorial Mathematics

Basic counting principles, Permutations and Combinations (with and without repetitions), Binomial theorem, Multinomial theorem, Counting subsets, Set-partitions, Stirling numbers Principle of Inclusion and Exclusion, Derangements, Inversion formulae Generating functions: Algebra of formal power series, Generating function models, Calculating generating functions, Exponential generating functions. Recurrence relations: Recurrence relation models, Divide and conquer relations, Solution of recurrence relations, Solutions by generating functions. Integer partitions, Systems of distinct representatives.

Books Recommended:

1. J.H. van Lint and R.M. Wilson-A Course in Combinatorics, 2nd Ed., Cambridge University Press, 2001.
2. V. Krishnamurthy-Combinatorics, Theory and Application, A_liated East-West Press 1985.
3. P.J. Cameron-Combinatorics, Topics, Techniques, Algorithms, Cambridge University Press, 1995.
4. M. Jr. Hall-Combinatorial Theory, 2nd Ed., John Wiley & Sons, 1986.
5. S.S. Sane-Combinatorial Techniques, Hindustan Book Agency, 2013.
6. R.A. Brualdi-Introductory Combinatorics, 5th Ed., Pearson Education Inc., 2009.

GE (Paper-1)

Calculus and Ordinary Differential Equations
(GE-I for 1st SEM. Or GE-II for 2nd SEM.)

Total Marks:100

Theory:80 Marks+Mid-Sem:20 Marks

5 Lectures, 1 Tutorial (per week per student)

Unit-I

Curvature, Asymptotes, Tracing of Curves (Cartenary, Cycloid, Folium of Descartes, Astroid, Limacon, Cissoid & loops), Rectication, Quardrature, Volume and Surface area of solids of revolution.

Unit-II

Sphere, Cones and Cylinders, Conicoid.

Unit-III

Explicit and Implicit functions, Limit and Continuity of functions of several variables, Partial derivatives, Partial derivatives of higher orders, Homogeneous functions,

Change of variables, Taylors theorem and Maclaurins theorem for functions of two variables. Extreme values of functions of two and three variables, Implicit functions, Lagranges multipliers.

Unit-IV

Ordinary Differential Equations of 1st order and 1st degree (Variables separable, homogenous, exact and linear). Equations of 1st order but higher degree. Second order linear equations with constant coefficients, homogeneous forms, Second order equations with variable coefficients, Variation of parameters.

Books Recommended:

1. Shantinarayan-Text Book of Calculus, Part-II, S. Chand and Co., Chapter-8 (Art. 24, 25, 26)
2. Shantinarayan-Text Book of Calculus, Part-III, S. Chand and Co., Chapter-1 (Art 1,2), 3, 4(Art.10 to 12 omitting Simpsons Rule), 5(Art-13) and 6(Art-15).
3. B.P. Acharya and D.C. Sahu-Analytical Geometry of Quadratic Surfaces, Kalyani Publishers, New Delhi, Ludhiana.
4. Mathematical Analysis by S C Malik & S Arora, New Age International Publisher, Chapters: (Statements and applications only) 15,16.
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. L N Sahoo, Calculus and Ordinary Differential Equations(Generic Elective), Kalyani Publishers.
5. M.D. Raisinghania-Advanced Differential Equations, S. Chand & Company Ltd., New Delhi.
6. Santosh K. Sengar-Advanced Calculus.

GE (Paper-2)

(GE-I for 3rd SEM. Or GE-II for 4th SEM.)

Total Marks:100

Theory:80 Marks+Mid-Sem:20 Marks

5 Lectures, 1 Tutorial (per week per student)

GE-: Linear Algebra and Advanced Algebra

Unit-I

Group Theory: Definition and examples, Subgroups, Normal subgroups, Cyclic groups, Cosets, Quotient groups, Permutation groups, Homomorphism.

Unit-II

Ring Theory: Definition and examples, Some special classes of Rings, Ideals, Quotient rings, Ring homomorphism, More Ideals and Quotient Rings, The field of integral Domain .

Unit-III

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.

Unit-IV

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, Determinant and Rank of matrices, Eigen values, Eigen vectors, Quadratic forms.

Books Recommended:

1. V. Krishnamurty, V. P. Mainra, J. L. Arora-An introduction to Linear Algebra, Affialiated East-West Press Pvt. Ltd., New Delhi, Chapters: 3, 4(4.1 to 4.7), 5(except 5.3), 6(6.1, 6.2, 6.5, 6.6, 6.8),7(7.4 only).
2. Topics in Algebra by I N Herstein, Wiley Eastern ltd, New Age international Publication. Chapters:2(2.1-2.72.10), 3(3.1-3.6).

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. I.N. Herstein-Topics in Algebra, Wiley Eastern Pvt. Ltd.
6. Gallian-Contemporary Abstract Algebra, Narosa publishing House.
7. Artin-Algebra, Prentice Hall of India.
8. V.K. Khanna and S.K. Bhambri-A Course in Abstract Algebra, Vikas Publishing House Pvt. Ltd. New Delhi.
9. Algebra, M Artin,, Pearson(2^{nd} Edition).