SYLLABUS

BACHELOR OF SCIENCE (B.Sc)

MATHEMATICS

FIRST YEAR

BMath : 101 [SEMESTER-I]

ALGEBRA -I

Full Marks 100

Unit-I

Inequalities **(10 Marks)**

Geometric Mean and Arithmetic mean, Cauchy-Schwarz, Holder's and Minkowski's inequalities. **[6 lectures]**

Theory of Equations **(15 Marks)**

Polynomial, Descartes rule of signs, Fundamental theorem of Algebra (Statement only), Relation between roots and coefficient, Symmetric functions of roots, Transformation of equations, Solution of cubic equations by Cardan's method and biquadratic equations by Ferrari's method. **[12 lectures]**

Unit-II

Convergence of Series **(15 Marks)**

Infinite series-definitions, Cauchy's general principle for convergence, Geometric series, some useful theorems on series of positive terms, Comparison test of convergence, convergence and divergence of p-series. Cauchy's root test, D'Alembert's ratio test, Raabe's test, Logarithmic test, D'Morgan & Bertrand test, Leibnitz's test for alternating series. Conditional and Absolute convergence. (Ref. Ch.XIV [6], Ch.4[2])) **[12 lectures]**

Unit-III

Abstract Algebra **(25 Marks)**

Mappings, Equivalence relations and partitions, Congruence modulo n

Group and its elementary properties, Examples of Abelian and Non-abelian groups, Subgroups, Condition for being a subgroup, Order of a group and order of an element of a group, Cyclic groups and generators, Permutation group, Symmetric groups S_1, S_2, S_3, S_n is abelian for $n \leq 2$ and non-abelian for n=3 Cycle notation, Even and odd permutation, Alternating groups, Coset decomposition, Lagrange's theorem, Fermat's and Wilson's Theorem(Group Theoretic approach), Isomorphism of groups and their elementary properties (i) $\varphi(e)=e'$, (ii) $\varphi(a^n)=\varphi(a)^n$ (iii) $\varphi(G)$ is abelian iff G is abelian, (iv) $\varphi(G)$ is cyclic iff G is cyclic, (v) φ^{-1} is isomorphic if φ is isomorphic and (vi) $\varphi(K)$ is a subgroup if K is a subgroup. Cayley's Theorem (Ref.Ch.2-7[7]) **[20 lectures]**

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Unit –IV

Matrices **(15 Marks)**

Some types of Matrices, Elementary operations on matrices, Inverse of a matrix, Linear independence of row and column matrices, Row rank, Column rank and rank of a matrix, Equivalence of column and row ranks, Eigenvalues, eigenvectors and the characteristic equation of a matrix, Cayley Hamilton theorem and its use in finding inverse of a matrix.

[10 lectures]

Unit-V

Trigonemetry **(20 Marks)**

De Moivre's theorem and its applications, Expansion of trigonometric functions, Exponential values for circular functions, complex argument, Gregory's series, Hyperbolic functions, summation of series including C + iS method, Infinite product.(Sin x and Cos x).

[15 lectures]

RECOMMENDED BOOKS

1. **Das** and **Mukherjee**- *Higher Trigonometry,* U.N.Dhur & Sons Pvt. Ltd., Kolkata
2. **Chandrika Prasad** - *Algebra and Theory of Equations* ,Pothisala Pvt. Ltd.
3. **Burnside** and **Panton**- *The Theory of Equations,* S.Chand & Co., New Delhi
4. **I.N.Herstein** - *Topics in Algebra*, John Wiley & Sons, New Delhi
5. **Shanti Narayan** & **P.K.Mittal** : A Text Book of Matrices, S.Chand & Co., New Delhi
6. **J,G,Chakravorty** & **P.R.Ghosh** : Advanced Higher Algebra, U.N.Dhur &Sons Pvt.Ltd, Kolkata
7. **Joseph A. Gallan** : Contemporary Abstract Algebra, Narosa, 4e

REFERENCES

1. **John B.Fraleigh** – *A First course in Abstract Algebra*, Narosa Publishing House, New Delhi
2. **Surjeet Singh** and **Quazi Zameerudin**- *Modern Algebra*, VIKAS
3. **K.B.Dutta** - *Matrix and Linear Algebra*, Prentice Hall of India Pvt. Ltd, New Delhi
4. **P.B.Bhattacharya, S.K.Jain** and **S.R.Nagpaul**- *Basic Abstract Algebra*, CUP, Indian Edition
5. **P.B.Bhattacharya**, **S.K.Jain** and **S.R.Nagpaul** - *First Course in Linear Algebra*, Wiley Eastern, New Delhi
6. **H.S.Hall and S.R.Knight** - *Higher Algebra,* A.I.T.B.S. Publishers & Distributors, New Delhi
7. **S.L.Loney** - *Plane Trigonometry Part I and II*, Macmillan
8. **R.S.Varma** and **K.S.Shukla** - *Text Book on Trigonometry*, Pothisala Pvt. Ltd.
9. **S.K.Jain, A.Gunawardena** and **P.B.Bhattacharya**-*Basic Linear Algebra with MATLAB*, Kewy College Publishing)Springer-Verlag), 2001
10. **Frank Ayres**(JR.) – *Matrices*, Schaum Outline Series
11. **Madhumangal Pal** – *U.G. Mathematics*, Asian Books Pvt. Ltd, 2004
12. **S.Bernard & J.M.Child** : *Higher Algebra*, A.I.T.B.S. Publishers & Distributors, New Delhi
13. **Pranjal Rajkhowa** : Topics in Degree Mathematics, Book I and II, Asian Books Pvt Ltd., New Delhi
14. **Vijay K, Khanna**; **S.K.Bhambri** : A course in Abstract Algebra, VIKAS

BMath : 202 [SEMESTER-II]

CALCULUS AND ORDINARY DIFFERENTIAL EQUATIONS

Full Marks – 100

Unit-I

Differentiation: **(6 Marks)**

Limit and Continuity (using $\varepsilon - \delta$ definition) of the functions, Successive differentiation, Leibnitz's Theorem and its application. **[5 Lectures]**

Rules of differentiation: **(14 Marks)**

Rolle's Theorem, Lagrange's and Cauchy's Mean Value theorems, Taylor's and Maclarin's theorem with Lagrange's and Cauchy's form of remainders, Indeterminate forms, L – Hospital's rule, Expansion of standard functions: $e^x, \sin x, \cos x$, $\log(1+x), (1+x)^m$, $\sin^{-1} x, \cos^{-1} x, \tan^{-1} x$. **[10 Lectures]**

Unit - II

Partial Differentiation: **(10 Marks)**

Function of Two and three variables, Limit and Continuity for functions of two and three variables, Partial differentiation, successive partial differentiations, Euler's theorem on Homogeneous functions of two and three variables, Maxima and Minima of functions of two variables. **[8 Lectures]**

Applications: **(10 Marks)**

Curvature, radius of curvature for the Cartesian, parametric, implicit and polar equations, Asymptotes. **[10 Lectures]**

Unit - III

Integration: **(15 Marks)**

Integration as the limit of a sum, Fundamental theorem of integral calculus, Definite integrals, Reduction formulae for indefinite and definite integrals.

Applications: Quadrature and Rectification. **[6 Lectures]**

Unit - IV

Double Integrals: **(15 Marks)**

Working knowledge of double integrals, Jacobian, change of variable in double integrals, Application of double integral.

Applications: Volume and surface areas of solid of revolution **[15 Lectures]**

Unit – V

Equations of First order and First degree **(15 Marks)**

Exact equations and integrating factors (Rules), Linear equations and equations reducible to linear form, Solutions of simultaneous equations of the form $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$, total differential equations of the form: $Pdx + Qdy + Rdz = 0$, method of solutions and their geometrical interpretations, orthogonal trajectory.

Equations of the First order but not of First Degree

Equations solvable for x, y, p and Clairaut's equation, Singular solutions

[15 lectures]

Linear Second Order Differential Equations **(15 marks)**

Second order linear differential equations with constant coefficients, Homogeneous linear equations, Complementary functions and particular integrals, Power Series solutions at ordinary and regular singular points.

[10 Lectures]

RECOMMENDED BOOKS

1. **Piaggio** – *An Elementary Treatise on Differential Equation and Their Applications,* C.B.S.Publishers & Distributors, New Delhi
2. **Das** and **Mukherjee** – *Differential Calculus*, U.N.Dhur & Sons, Kolkata
3. **Das** and **Mukherjee** – *Integral Calculus*, U.N..Dhur & Sons Pvt. Ltd., Kolkata.

REFERENCES

1. **Maity** and **Bagchi** – *Integral Calculus*, An Introduction to Analysis, New Central Book Agency, Calcutta.
2. **T.M. Apostol** – *Calculus, Volume I and II*, Willey Eastern Ltd., New Delhi.
3. **Shanti Narayan** – *Integral Calculus*, S. Chand & Co. Pvt. Ltd., New Delhi
4. **Gorakh Prasad** – *Integral Calculus,* Pothisala Pvt.Ltd., Allahabad.
5. **Gorakh Prasad** – *Differential Calculus,* Pothisala Pvt.Ltd., Allahabad.
6. **Erwin Kreyszig** - *Advanced Engineering Mathematics*, John Wiley & Sons.
7. **Boyce and Diprima** - *Elementary Differential Equations and Boundary Value Problems*, John Wiley & Sons
8. **Coddington** - *An Introduction to Ordinary Differential Equations and their Applications*, Prentice Hall of India., New Delhi
9. **G.F.Simmons** - *Differential Equations*, Tata McGraw Hill
10. **D.A.Murray** - *Introductory Course in Differential Equations*, Orient Longman(India).
11. **Jain** and **Kaushik** - *An Introduction to Real Analysis,* S,Chand & Co. Pvt. Ltd., New Delhi
12. **N.Piskunov** - *Differential and Integral Calculus*, Peace Publishers, Moscow.
13. **Murray R. Spiegel** - *Theory and Problems of Advanced Calculus,* Schaum's Outline series, Schaum Publishing Co., New York
14. **Gabriel Klambaucer** - *Mathematical Analysis*, Marcel Dekkar, Inc New York
15. **Maity and Ghosh** - *Integral Calculus, New Central Book Agency*, Kolkata
16. **Pranjal Rajhkowa** : Topics in Degree Mathematics, Book II, Asian Books Pvt. Ltd., New Delhi
17. **Bhamra KS** & **Ratna Bala** - Ordinary Differential Equations, Allied Publishers, Delhi

SECOND YEAR

BMath : 303 [SEMESTER - III]

VECTOR, GEOMETRY AND PROBABILITY

Full Marks 100

Unit-I

Vector Analysis **(20 Marks)**

Scalar and vector product of three and four vectors, reciprocal vectors, Differentiation of vectors, Gradient, Divergence and Curl of a vector, vector integration, ordinary integrals of vectors, Line, Surface and Volume integrals, theorems of Gauss, Green, Stokes and related problems. **[12 Lectures]**

Unit-II

Two dimensional Geometry **(30 Marks)**

Change of axes: Change of origin without changing the direction of axes, Change of direction of axes of co-ordinates without changing the origin.

Pair of straight lines: Pair of straight lines, homogeneous equation of second degree, Angle between the pair of lines given by the homogeneous equation, Bisectors of the angles between the pair of lines, Condition for the general equation of second degree represents a pair of straight lines, Point of intersection, Equation of the pair of lines joining the origin to the points of intersection of the line and a curve.

System of Conics: Every general equation of second degree in two variables always represents a conic section, The centre of a conic, Reduction of the general second degree equation into a central and non-central conics, Condition that a line is a tangent to a conic, Chord of contact, pole and polar, Diameter, conjugate diameters, feet of normals, Intersection of two conics, Pair of tangents.

Confocal Conics and their Properties

Polar equation of conics: Polar equation of a conic with respect to focus as pole, equation of a chord, tangent and normal. **[21 Lectures]**

Unit-III

Three Dimensional Geometry **(20 Marks)**

Sphere: Equations of sphere, condition for the general equation of second degree to represent a sphere, plane section of sphere, intersection of a plane and a sphere, intersection of two spheres, power of a point, equation of a tangent plane, condition for a plane to be a tangent plane to a sphere, plane of contact, polar plane, pole of a plane.

Cone: Equation of a cone with a conic as guiding curve, enveloping cone of a sphere, quadratic cones with vertex at origin, condition for the general equation of second degree to represent a cone, reciprocal cone right circular cone.

Cylinder: Equation of cylinder, enveloping cylinder, right circular cylinder.

Central conicoids: Equations and properties of conicoids, intersection of a line with a conicoid, Tangent line and plane, normal, number of normals from a given point, plane of contact. Polar plane of a point, enveloping cone and cylinder, chord, conjugate diameters.

Parabloids: Equations and simple properties.

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Confocal conicoids: Equations and simple properties. **[18 Lectures]**

Unit-IV

Theory of Probability **(30 Marks)**

Random variables, probability distribution: Poisson, Geometric, rectangular, exponential, normal. Expectation and moments, marginal and conditional distributions, characteristic functions, probability inequalities (Tchebychev), Weak and strong convergence of random variables, convergence in probability.

Chebychev's inequality, weak law of large number, Idea of central limit theorem, De moivre's, Laplace theorem, Liapunov's theorem (without proof) and application of CLT.

[24 Lectures]

RECOMMENDED BOOKS

1. **B. Das**-Analytical Geometry with Vector Analysis, Orient Book Company, Kolkata.
2. **Shanti Narayan and P.K. Mittal**-Analytical Solid Geometry, S. Chand.
3. **M.R. Spiegel**-Vector analysis and an introduction to tensor analysis-Schaum series.
4.

REFERENCES

1. **S.L. Loney**: Co-ordinate geometry of twodimension, Macmillan and Sons Pvt. Ltd.
2. **R.J.T. Bell**: Co-ordinate geometry of three dimensions, Macmillan and Sons Pvt. Ltd.
3. **Ross S.M.**(2007): Introduction to Probability Models, 9th edition, Indian Reprint, Academic Press.
4. **Goon A.M., Gupta M.K.** and **Dasgupta B.**(2003): An outline of statistical theory, vol.1. 4th edition, World Press. Kolkuta.
5. **Rohatgi V.K. and Saheh A.M.** (2009): An introduction to probability and statistics, 2nd ed, John Wiley and Sons.
6. **Hogg K.V., Craig A.T. and Mekean J.N.**(2009): Introduction to mathematical statistics, 6th ed, Pearson Education.
7. **Johnson N.L., Kotz S. and Balakrishnan N**(1994): Discrete univariates Distributions, John Wiley.

BMath : 404 [SEMESTER – IV]

MECHANICS [DYNAMICS, STATICS, RIGID DYNAMICS]

Full Marks 100

UNIT-I

DYNAMICS **(35 Marks)**

Components of velocities and accelerations along, radial and transverse, along tangential and normal (Art' 48. 49. 87, 88) Simple Harmonic motions (Art[1] 22-25, Art[2]17.1 - 17.4. 17.6. 17.7) **[7 Lectures]**

Dynamics of a particle, Motion on smooth and rough plane curves (Art1 14.1, 14.2, 15.1, 15.2, 16.1, 16.2) Motion in resisting medium including projectile, Motion of varying mass (Art' 104-i12) central orbit, Kepler's Law (Art' 53-55, 57, 60, 64-67, 69-70)

[15 Lectures]

Acceleration in different Coordinate system (Art[1] 125-127)

[4 Lectures]

UNIT-II

STATICS **(35 marks)**

Equilibrium condition of coplanner forces (Art2 81., 8.3), Equilibrium of strings, common catenary, catenary of uniform strength (Art[3] 141-145. Art[5] 12.2, 12.21, 12.22, 12.5)

[14 Lectures]

Force in 3-dimension, Poinsots Central axis (Art[1] 154-157, 162-165, Art[4] 184-186, 188-190), Wrenches Null lines and planes (Art[4] 206-208) stable and unstable equilibrium (Art[4] 158) Art[1] 11:5, 11.6, 11.62, 11.7)

[12 Lectures]

UNIT-III

DYNAMICS OF RIGID BODIES **(Marks 30)**

Moments and products of inertia (Art[1] 144-149), Momental Ellipsoid (Art' 151) Equimomental systems, Principal Axis (Art[1] 154, 155)

[7 Lectures]

D'Alembcrt's Principle, Equations of motion of rigid bodies, Motion of centre of inertia, Motion relative to centre of inertia (Art[1] 162)

[7 Lectures]

Motion about a fixed axis (Art[1] 168 -171), Compound Pendulum (Art[1] 173-175), Motion in 2 dimension under finite and impulsive forces (Art[1] 187-190), Conservation of momentum and Energy. (Art[1] 235, 236, 238, 239, 242)

[9 Lectures]

RECOMMENDED BOOKS

1 **S.L. LONEY** : An elementary treatise on, dynamics of particle and of rigid bodies. Cambridge university press 1956, reprinted by S.Chand & Company (P) Ltd. 1988.

2 **DAS & MUKHERJEE**: Dynamics published by S. Chand & company (p) Ltd, 2010 ISBN-81-85624-96-8.

3 **DAS & MUKHERJEE**: Statics published by S.Chand & company (p) Ltd.2010, ISBN-81-85624-18-6.

4 **S.L. LONEY** : An Elementary treatise on Statics published by A.I.T.B.S., New Delhi, 2004 ISBN-81-7473-123-7.

5 **A.S. RAMSEY**: Statics, CBS Publishers and Distributors, Shahdara, New Delhi-110032, India

REFERENCES

6 **M. RAY and G.C. SHARMA**: A Textbook of dynamics published by S. Chand & company (p) Ltd., 2008(Chapter 1,2,6,8,9,11,12), ISBN-81-219-0342-4.

7 **R.S. VERNA**: A Text Book on Statics Pothishala Pvt Ltd., Allahabad.

8 **A.S. RAMSEY**: Dynamics Part-I, Cambridge University Press, 1973.

THIRD YEAR

BMath : 505 [SEMESTER – V]

ABSTRACT ALGEBRA AND LINEAR ALGEBRA

Full Marks - 100

UNIT- I

GROUPS: **(25 Marks)**

Normal subgroups, Quotient Groups, Homomorphism and Isomorphism of groups, Kernel of a homomorphism, Isomorphism Theorems, Auto-morphisms, Inner Auto-morphism, Auto-morphism groups, Cayley's Theorem, Conjugacy Relation, Conjugate class, Counting Principle and Class Equation of a finite group, Centre of a group, Normalizer, Centralizer and related Theorems, Cauchy's Theorem, Sylow Theorems, p-Sylow subgroups.

(Ref. Chapter 2[1]) **[20 Lectures]**

UNIT - II

RINGS: **(25 Marks)**

Rings, Elementary Properties of Rings, Integral Domains, Division Rings, Fields and related Theorems, Ideals and Quotient Rings, Ideals generated by a subset, Sum of two ideals, Homomorphism and Isomorphism of Rings, Kernel of a homomorphism, Isomorphism Theorems, Maximal Ideal, Prime Ideal, Principal Ideal, Euclidean Rings, Polynomial Rings, Polynomials over the Rational Field, Eisenstein's Irreducibility criterion, Polynomial Rings over Commutative Rings, Unique Factorization Domain.

(Ref.Chapter3[1]) **[20 Lectures]**

UNIT - III

VECTOR SPACES: **(35Marks)**

Concept of Vector Space over a Field K, n-tuple space, Subspaces, Necessary and sufficient condition for being a Subspace, Subspace generated by a Subset, Sum as Direct sum of Subspaces, Linear Span, Linear Dependence, Linear Independence and their basic properties, Basis, Dimensions, Finite Dimensional Vector Spaces, Existence Theorem for Basis, Complement of a Subspace and Existence of a Complement of a Subspace of a Finite Dimensional Vector Space, Dimension of sum of Subspaces, Quotient Space and its Dimension, Linear Transformation, Kernel of a Linear Transformation, Isomorphism, Isomorphism Theorem, Representation of Linear Transformation as matrices, Algebra of Linear Transformations, Rank and Nullity of a Linear Transformation, Rank-Nullity Theorem, Change of Basis, Dual Space, Annihilator of a Subspace, Quadratic and Hermitian Forms. (Ref Chapter 4[1], Chapter 9 and 10[3], Chapter 8 and 9[2])

[30 Lectures]

UNIT-IV

INNER PRODUCT SPACES: **(15Marks)**

Inner Product Spaces, Cauchy-Schwarz Inequality, Orthogonal Vectors, Orthogonal Complements, Orthonormal sets and Orthonormal Basis, Bessel's inequality for Finite Dimensional Vector Spaces, Gram-Schmidth Orthogonalization process.

(Ref.Chapter 9[3]) **[10 Lectures]**

RECOMMENDED BOOKS

1. **I.N.Herstein**: Topics in Algebra, John Wiley & Sons, New Delhi.
2. **Kenneth Hoffman** and **Ray Kunze**: Linear Algebra, Pearson.
3. **V.K. Khanna** & **S.K. Bhambri**: A Course in Abstract Algebra, Vikas Publishing House Pvt. Ltd., New Delhi.

REFERENCES

1. **S. Kumaresan**: Linear Algebra, Prentice Hall of India.
2. **Vivek Sahai** and **Vikas Bist**: Linear Algebra, Narosa Publishing House, New Delhi.
3. **Shanti Narayan** & **P.K. Mittal:** A Text Book of Matrices, S Chand & Co., New Delhi.
4. **Joseph A. Gallan**: Contemporary Algebra, Narosa Publishing House, New Delhi.
5. **Surjeet Singh** and **Qazi Zameerudin**: Modern Algebra, Vikas.
6. **P.B.Bhattacharya, S.K.Jain** and **S.R.Nagpaul**: Basic Abstract Algebra, CUP.
7. **John F. Fraleigh**: A First Course in Abstract Algebra, Addison Wesley.
8. **J.G. Chakravorty** and **P.R. Ghosh**: Advanced Higher Algebra, U.N.Dhur & Sons Pvt. Ltd., Kolkata.
9. **Michael Artin:** Algebra, Prentice Hall of India Ltd.
10. **N.Jacobson**: Basic Algebra Vol. I & II, Hindustan Publishing Corporation, New Delhi.
11. **K.B.Dutta:** Matrix And Linear Algebra, Prentice Hall of India Pvt. Ltd.
12. **I.S.Luthar, I.B. Passi:** Algebra Vol-I(Groups), Vol-II(Rings) and Vol-III(Modules), Narosa Publishing House, New Delhi.
13. **D.S. Malik, J.N.Moderson** & **M.K.Sen**: Fundamentals of Abstract Algebra, Mc-Graw Hill International Edition.
14. **David S. Dummit, Richard M. Foote**: Abstract Algebra, John Wiley and Sons(Asia) Pte Ltd, Singapore.
15. **S.Lipschutz**: Theory And Problems Of Linear Algebra, SI(metric) edn., Schaum's Out Series, Mc Graw Hill.
16. **Frank Ayres**: Modern Algebra, Schaum Outline Series, Mc Graw Hill.

BMath : 506 [SEMESTER – V]

ANALYSIS – I [REAL ANALYSIS]

Full Marks – 100

Unit-I

Real Number System (sets) **(10 Marks)**

Order completeness in R (statement only); Archimedean property [Ref:- Ch - 4- 4.1, 4.2 [1]] ; Bounded sets and their bounds; Limit points; Bolzano-Weierstrass theorem; open and closed sets and related properties/theorems; Concept of compactness; Heine-Borel theorem [Ref :- Ch. 2 - 1, 1.1 to 3.5, Th. 12[1]]; [Ch 4[2]]; [Ch. 2[3]]. **[8 Lectures]**

Real Sequence **(10 Marks)**

Bounded sequences, Limit points, Bolzano-Weierstrass theorem, Cauchy sequence; Cauchy's general principle of convergence, convergent sequences and their properties, monotonic sequence and their properties.

Subsequences, lim sup., lim inf., Nested interval theorem; [Ref :- Ch. 3[1]]; [Ch.5[2]]; [Ch. 3 - 3.1 to 3.7[3]] **[7 Lectures]**

Continuity **(10 Marks)**

Types of discontinuities; Properties of continuous functions on a closed interval.

Uniform continuity; [Ref :- Ch. 5[1]]; [Ch. 8[2]]; [Ch. 4 - 4.1 to 4.4[3]]. **[7 Lectures]**

Unit - II

Riemann Integration **(20 Marks)**

Upper and lower Riemann Integrals (R.I.); Darboux's theorems; Integrability conditions, R.I. as a limit of a sum; Properites; Inequalities for Integrals; Integral function; Mean value theorems. [Ref :- Ch. 9 - 1 to 13, th. 23[1]]; [Ch. 8[2]]; [Ch. 6 - 6.1 to 6.9.2[3]]

[14 Lectures]

Unit - III

Improper Integrals **(15 Marks)**

Different types of improper integrals; Evaluation, convergence of improper integrals; Beta function, Gamma function; Abel's test and Dirichlet's test, Frullani's Integral.

[Ref :- Ch. 11[1]]; [Ch. 11[2]]; [Ch. 9[3]] **[13 Lectures]**

Unit - IV

Functions of Several Variables **(15 Marks)**

Differentiability and differential, Partial derivatives of higher order, Young's and Schwarz's theorems , Differentials of higher order, Functions of Functions, Differentials of higher order of a function of functions; Derivation of composite functions (the chain rules); Change of variables, [Ref :- Ch. 15 [1] ; (Ch. 13 - 13.9, 13.10, 13.13[2]] **[13 Lectures]**

Unit - V

Multiple Integrals **(20 Marks)**

Concept of line integrals; Double and repeated integrals; Green's theorem in the plane, evaluation of area, Change of order of integration.

Surface areas; surface integrals; Stoke's Theorem; Volume integrals, Triple integrals; Gauss divergence Theorem and its application. [Ref :- Ch. 17 and 18[1]]; [Ch. 20[2]]; [Ch. 16, 17, 18[3]] **[13 Lectures]**

RECOMMENDED BOOKS

1. **S.C. Malik** and **Savita Arora** - Mathematical Analysis, New Age International (P) Limited; Publishers, New Delhi.
2. **K.C. Maity** & **R.K. Ghosh** - An Introduction to Analysis, Differential Calculus Part I & II, Integral Calculus, Books and Allied (P) Ltd., Kokuta 700009.
3. **Shanti Narayan** and **P.K. Mittal** - A Course of Mathematical Analysis, S Chand & Company Ltd. Ram Nagar, New Delhi - 110055.

REFERENCES

1. **Shanti Narayan** and **Md. Raisinghania** - Elements of Real Analysis, S. Chand & Company Ltd., Ram Nagar, New Delhi - 110055.
2. **S.L. Gupta** & **N.R. Gupta** - Principles of Real Analysis, Pearson Education (Singapore) Pte. Ltd., Indian Branch, 482 F.I.E. Patparaganj N.D. - 110092.
3. **S.K. Jain & S.K. Kaushik** - Introduction to Real Analysis, S. Chand & Company Ltd., Ram Nagar, N.D. - 110055.
4. **S.K. Sinha** - Real Analysis, P.C. Dwadash Shreni & Co (P) Ltd. Publihser & Book Seller's, Bara Bazar, Aligarh - 202001.

5. **V.K. Krishnan** - Fundamentals of Real Analysis, Pearson Education (Singapore) Pte. Ltd, Indian Branch.
6. **K.K. Jha** - Honours Course in Real Analysis and Convergence, Navbharat Prakashan Patna - 4, Delhi - 6.
7. **D. Somasundarum & B. Choudhury** - A First Course in Mathematical Analysis, Narosa Publishing House, New Delhi.
8. **R.G. Bartle & D.R. Sharbert** - Introduction to Real Analysis, John Wiley and Sons (Asia) Pte. Ltd, Singapore.
9. **R.R. Goldberg** - Method of Real Analysis, Oxford and INH Publishing Co.
10. **Murray R Spiegel** - Theory and Problems of Advanced Calculus, Schaum Out Line Series Mc Graw Hill Book Company.
11. **Frak Aryer Jr.** - Theory & Problem of Calculus, Schaum Out Line Series Mc Graw Hill Book Company.

BMath : 507 [SEMESTER – V]

NUMERICAL ANALYSIS AND COMPUTER PROGRAMMING IN C

[THEORY – 80 (DURATION – THREE HOURS)]

[PRACTICAL – 20 (DURATION – ONE HOUR)]

Full Marks – 100

Unit I (Marks 20)

Finite difference, relation between the operators, ordinary and divided differences, Newton's forward and Backward interpolation formulae, Newton's divided difference formulae and their properties.

Lagrange's and Hermite's interpolation formulae, Least square polynomial approximation.

[15 - Lectures]

Unit II (Marks 20)

Numerical differentiation, numerical integration, quadrature formulae, Trapezoidal rule, Simpson's rule.

Numerical solution of ODEs using Picard, Euler, Eurler's modified, Runge-Kutta methods. Solution of algebric and transcendential equation using method of iteration and Newton-Raphson method. System of linear algebraic equation using Gauss elimination method.

[15 - Lectures]

Unit – III (Marks – 20)

Introduction to C-programming: Basic model of a computer, Algorithm, Flow Chart, programming language, Compilers and operating system, character set, identifiers and keyword, Constant, variables and data type, operations and expressions, operator precedence and associativity, Basic input/output statements, simple C-programs.

Conditional statements and loops: Decision making with a program, logical and conditional operators, if statement, nested if else statement, loops, while loop, do-while loop, for loop, nested loops, break statement, switch statement, continue statement, goto statement, the comma operator.

[15 - Lectures]

Unit – IV (Marks – 20)

Arrays: One dimensional arrays, declaration and initialization of one dimensional arrays, searching, insertion and delation of an element from an array, sorting an array. Two dimensional arrays.

Function: Defining a function, accessing a function, function declaration/prototype, function parameters, return values, passing arguments to a function, call by a reference, call by value, function calls, recursion, passing arrays to function.

[15 - Lectures]

Unit – V (Marks - 20)

Programs for practical (any one)

1. To calculate the compound interest accepting the necessary data from the keyboard.
2. To find the value $\frac{x}{1!} - \frac{x^3}{3!} + \frac{x^5}{5!} - \ldots\ldots\ldots$
3. That will read a positive number from the keyboard and check the number is prime or not.
4. To convert octal to decimal number.
5. To generate prime numbers up to n terms.
6. To find GCD of two given numbers.
7. To find GCD of two given numbers using recursion.
8. To arrange numbers in ascending order and decreasing order.
9. To generate Fibonacci series of numbers up to n terms.
10. To implement selection sort.
11. To implement insertion sort.
12. To find the solution of non-linear equation by (i) Bisection (ii) Secant and (iii) Newton-Raphson method.
13. To find the solution of linear equation by Gauss Elimination method.
14. Numerical Integration (i) Trapezoidal rule and (ii) Simpson's 1/3 rule.
15. Ordinary differential equation (i) Euler's method and (ii) Runge-Kutta method.

[15 – Practicals]

INSTRUCTIONS FOR PRACTICAL

Duration – One Hour. [a) 5 marks Program writing, b) 10 Marks Output c) 5 Marks Viva Voce]

RECOMMENDED BOOKS

1. **M.K. Jain, S.R.K Iyenger, R.K. Jain** – Numerical methods for scientific and engineering computation, New Age international (p) Ltd.
2. **James B. Scarborough** – Numerical mathematical analysis, Oxford and IBH publishing Co. pvt. Ltd.
3. **H.C. Saxena** – Finite differences and numerical analysis, S Chand & Co. Ltd., New Delhi.
4. **Byron Gottfried**, Programming with C, Tata McGraw Hill
5. **E. Balaguruswami**, Programming with ANSI-C Tata McGraw Hill
6. **RG Dromey,** How to solve it by computer, Prentice Hall of India.
7. **Venugopal & Prasad**, Programming with C, Tata McGraw Hill.

REFERENCES

1. **K.E. Atkinson** – An introduction to numerical analysis, John Wiley and Sons.

2. **M.K. Jain, S.R.K. Iyenger, R.K. Jain** – Numerical method for problems and Solutions, New Age international (p) Ltd.
3. **R.Y. Robistein** – Simulation and Montecarlo method, John Wiley.
4. **C.E. Froberg** – Introduction to numerical analysis, Addison Wesley, 1979.
5. **A. Kamtham,** Programming with ANSI & Turbo C, Pearson Education
6. **B.W. Kernighan and D.M. Ritchie**, The Programming Language, Prentice Hall of India.
7. **V. Rajaraman**, Programming in C, Prentice Hall of India.
8. **Robert C Hutchison** and **Steven B. Just**, Programming using C language, Tata McGraw Hill.

BMath : 605 [SEMESTER – VI]

PARTIAL DIFFERENTIAL EQUATIONS, LAPLACE TRANSFORM, CALCULUS OF VARIATION

Full Marks – 100

Unit – I

First order PDE: **(20 Marks)**

Origin of Ist order PDE, Formation of PDE by eliminating arbitrary constants and arbitrary functions. Cauchy's problem of First order equation [Ref. Ch-2 (1)]. Definitions of (i) Complete Integral (ii) Particular Integral (iii) Singular Integral (iv) General Integral. Equations of Ist order but not of Ist degree (i) Solvable for p (ii) Solvable for y (iii) Solvable for x [Ref. Ch - V (2)].

Lagrange's method of solving the linear PDE of order one namely $Pp + Qq = R$, where P, Q, R are functions of x, y, z. Its Geometrical Interpretation. Linear equation with n independent variables [Ref. Ch - XII (2)]

[15 Lectures]

Unit – II

Non-linear PDE of order one **(20 Marks)**

Different Standard Forms (i) Only p and q present (ii) Only p , q and z present (iii) $f(x,p) = F(y , q)$ (iv) Analogous to Clairaut's form . [Ref. Ch – XII (2)] .

Partial differential equations of Ist order but of any degree (i) Two independent variables. Charpit's Method (ii) Three or more independent variables . Jacobi's method [Ref. Ch – XIII (2)].

[15 Lectures]

Unit – III

PDE of second order **(20 Marks)**

Introduction to Higher order PDEs (constant coefficients only): Origin of second order equations [Ref. Ch – 3 (1)]. Solution of Linear Homogenous PDE with constant coefficients. To find the complete solution of the equations namely (i) $f(D , D^l)z = 0$ and (ii) $f(D , D^l)z = F(x , y)$. Equations reducible to linear form with constant coefficients [Ref. Ch – 2.9 (4)].

Monge's method of integrating (i) $Rr + Ss + Tt = V$ (ii) $Rr + Ss + Tt + U(rt - s^2) = V$ [Ref. Ch – XIV (2)].

[15 Lectures]

Unit – IV

Laplace Transformation **(20 Marks)**

Definition of Laplace Transformations. Kernel of the Integral transformation [Ref. Ch – 6 (3)] . Existence of Laplace Transformation [Ref. Ch – 8.1 (4)] . Transformations of some elementary functions such as $f(t) = e^{-at}$, Cos at , Sin at , Cosh at , Sinh at , t^n etc. [Ref. Ch – 6 (3)].

Properties of Laplace Transformation [Ref. Ch – 6 (3)] . First Translation or Shifting Theorem . Second Translation or Heaviside's shifting Theorem [Ref. Ch – 8.5 (4)] . Differentiation property [Ref. Ch – 6 (3)]. Change of scale property with examples [Ref. Ch – 8.5 (4)] . Laplace Transformation of Derivatives of order n with Theorems [Ref. Ch – 13.6 (5)] .

Inverse Laplace transformations. Theorems on multiplication by s and 1/s . First and Second Shifting properties with examples [Ref. Ch – 13.20 (5)]. Convolution Theorem. Properties of Convolution, examples of Convolution [Ref. Ch – 8.16 (4)] .

Application of Laplace Transformation in solving PDE [Ref. Ch – 8.19 (4)] .

[15 Lectures]

Unit – V

Calculus of Variation **(20 Marks)**

Fundamental Theorem on Calculus of Variation. Definition, Euler's equations, particular cases of Euler's equation [Ref. Ch – 17 (5)]. Necessary condition for extremums . Sufficient condition for extremums of higher order variations [Ref. Ch – 10 (4)] . Legendre condition for extremum (Sufficient condition for extremum with problems) [Ref. Ch – 10.7 (4)] . Brachistochron problems. Extension of the variational case (several dependent variables) with examples.

[15 Lectures]

RECOMMENDED BOOKS

1. *Elements of partial differential equations* by **IAN SNEDDON** : Mc-Graw Hill International editions.
2. *An elementary treatise on differential equations and their applications* by **H.T.H.PIAGGIO.**
3. *Introduction to partial differential equations* by **K. Krishna Rao.**
4. *Advanced partial differential equations (with Boundary value problems)* by Pundir & Pundir.
5. *Advanced engineering Mathematics* by **H.K. Dass** .
6. *Partial Differential Equations* by **KS Bhamra**, PHI Learning Pvt. Ltd, New Delhi, 2010

REFERENCES

1. **W.E. Williams**: *Partial differential equations*, Oxford.
2. **Phoolan Prasad**: *Partial differential equations*, Wiley Eastern, NewDelhi (and Renuka Ravindran) .
3. **Spiegel**: *Laplace Transform*, Schaum Outlines Series.
4. **I.N. Sneddon** *: The use of Integral Transform* , Mc-Graw Hill , New York 1972 .
5. *An Introduction to Transform Theory*, Academic Press, New York by D.V. Widder .
6. **I.N. Sneddon** *: Partial differential equations* , Mc-Graw Hill , New York .
7. **KS Bhamra** & **Ratna Bala** *Ordinary Differential Equations*, Allied Publishers, Delhi, 2003

BMath : 606 [SEMESTER – VI]

ANALYSIS – II [METRIC SPACE & COMPLEX ANALYSIS]

FULL MARKS – 100

UNIT-I

Metric Spaces **(25 Marks)**

Definition and example of a metric space, Diameter and boundedness of sets, Distance between two subsets of a Metric space, Fundamental inequalities (Holder and Minkowski), some function spaces, Subspace of a metric space. Open spheres/balls, Open sets and properties, closed sets, neighbourhood of a point, limit points, adherent Point, Interior, Exterior and Frontier points, closure of a set, Dense subsets. **[Ref: CH.2 [1]]**

[18 Lectures]

UNIT- II

Complete Metric Spaces **(20 Marks)**

Convergent sequences, Cauchy sequences, Convergence of a Cauchy Sequence, Complete spaces, Examples of complete and in-complete metric spaces, Cantor's intersection theorem.

Continuous functions: Characterization of continuous functions, Uniform Continuity, Homeomorphism. **[Ref: CH 3, 4 [1]]**

[13 Lectures]

UNIT- III

Compactness **(20 Marks)**

Compact metric spaces, Sequential Compactness, Bolzano Weirstrass property, Totally boundedness, Finite intersection property, equivalence among the kinds of compactness, Continuous functions and compact sets. **[CH: 5 [1]]**

[14 Lectures]

UNIT- IV

Complex Analysis **(20 Marks)**

Limits and Continuity, Differentiability, The necessary and sufficient condition for a function f(z) to be analytic, Method of constructing a regular function, Polar form of Cauchy-Riemann equations, Complex equations of a straight line and circle. **[CH : 2, 5 [2]]**

[18 Lectures]

UNIT –V

Conformal Mappings **(15 Marks)**

Definition, Jacobian of transformation, Necessary and sufficient condition for w = f(z) to represent conformal mapping, Bilinear transformation and fixed points, Types of bilinear transformation, Preservance of cross ratio, Family of circles and straight lines under bilinear transformation. **[CH : 7, 8 [2]]**

[12 Lectures]

RECOMMENDED BOOKS

1. **P. K. Jain** and **K. Ahmad**: metric spaces, Narosa Publishing House, New Delhi

2. **R.V. Churchil & J.W. Brown**: Complex variables and Application (5th Edition) Mc Graw Hill International Editions.

REFERENCES

1. **G.F. Simmons**: Introduction to Topology and Modern analysis, Tata Mc Graw Hill Education Private Limited, New Delhi.
2. **S.Lipchutz**: General Topology, Schaum's Outline Series, Mc Graw Hill Book Company.
3. **S.C.Malik, Savita Arora**: Mathematical Analysis, New Age International (P) Ltd.;(Chapter 19)
4. **E.T. Copson**: Metric Spaces, Universal Book Stall, 5 Ansari Road, New Delhi-11
5. **H.S.Kasana**: Complex Variables(Theory and Applications), Prentice Hall of India, P. Ltd, New Delhi
6. **John B. Conway**: Functions of One Complex Variable, Narosa Publishing House.
7. **L.V.Ahlfors**: Complex Analysis, Mc Graw Hill Book Company.
8. **Murray R. Spiegel**: Complex Variables, Schaum's Outline Series, Mc Graw Hill Book company.
9. **Shanti Narayan** and **P. K. Mittal**: Theory of Complex Variables: S Chand And Company Ltd. Ram Nagar, New Delhi.
10. **R.K.Ghosh & K.C.Maity**: Differential Calculus(an introduction to analysis)Part-II(including Metric Spaces and Complex Analysis) New Central Book Agency(p) Ltd. Kolkata.

OPTIONAL PAPER – BMath - 607

BMATH : 60701 [SEMESTER – VI]
HIGHER MECHANICS [OPTIONAL PAPER]

Full Marks – 100

UNIT-I

System of Particles **(8 Marks)**

Centre of mass, centre of gravity, momentum, conservation of Linear momentum, Angular momentum, kinetic Energy, conservation of Energy for a system of particles.

[6 Lectures]

UNIT-II

Motion of rigid bodies **(30 Marks)**

Generalized coordinates for rigid body, translational and rotational motion Angular momentum, moments and products of inertia, Kinetic Energy due to rotation, kinetic energy in terms of inertia tensor, principal axes, Principal moments of inertia, Euler's angle, Euler's geometrical equations, rate of change of vector, coriolis forces, Euler's equation of motions,

[20 Lectures]

UNIT-III

Lagrangian Mechanics **(25 Marks)**

Generalized Coordinates, degrees of freedom, generalized force, generalized momenta. Holonomic, non-holonomic, Seleronomic and Rheonomic systems, virtual works, D' Alembert's principal, Kinetic Energy as quadratic functions of generalized velocities, Lagrangian of a force system, Lagrange's Equations of motion. Applications to S.H.M. Compound pendulum, projectile, central orbit, motion of a particle on the Earth's surface.

[20 Lectures]

UNIT-IV

Hamiltonian Mechanics **(25 Marks)**

Configuration space, system point, Hamiltonian of a force system, relation between Lagrangian and Hamiltonian of a system, Hamilton's Principle, Physical significances of Hamiltonian, Derivation of Hamilton's Principle from Lagrange's Equations and Vice-Versa, Derivation from D' Alembert's Principle, Hamilton's Canonical Equation of motion, advantages of Hamiltonian approach over Lagrangian approach, meaning of Action in Hamiltonian sense, Least action Principle.

[20 Lectures]

UNIT-V

Canonical Transformation **(12 Marks)**

Meaning and conditions for a transformation to be canonical, Examples, Lagrange's bracket, Poisson's bracket and their elementary properties, equations of motion in Poisson's bracket.

[10 Lectures]

RECOMMENDED BOOKS

1. **S.L Loney** : An Elementary treatise on Dynamics of a particles and rigid bodies.
2. **G.Aruldhas** : Classical Mechanics, Prentice Hall of India, Private Limited, New-Delhi-2008.
3. **H. Goldstein** : Classical Mechanics Narosa Publishing House, New Delhi-1985
4. C.R. Mondal: Classical Mechanics, Prentice hall of India New Delhi.

REFERENCES

1. **Murray R. Spiegel**: Theoretical Mechanics Mc Graw Hill Book Company, New Delhi.
2. **K. Shankara Rao**: Classical Mechanics Prentice Hall of India.
3. **R.G. Takwale** and **P.S. Puranik**: Introduction to Classical Mechanics, Tata Mc Graw Hill Publishing Company, New Delhi

BMath : 60702 [SEMESTER-VI]

FLUID MECHANICS [OPTIONAL PAPER]

Full Marks: 100

Unit I

Kinetics **(30 Marks)**

Eulerian and Lagrangian description of fluid motion. Concept of local and connective accelerations. Steady and Non-Steady flows. Stream lines and path lines. Equation of continuity in different forms. Irrotational and Rotational flows. Controlled volume analysis for mass, momentum and energy. Velocity potential.

[25Lectures]

Unit II

Equation of Motion **(30 Marks)**

Equations of motion-Eulerian and Lagrangian. Pressure equation, Bernoulli's equation and its applications, Cauchy's integrals. Motion under the action of impulsive forces. Sources, Sinks, Doublets and their Images.

[25 Lectures]

Unit III

Dimensional Analysis **(25 Marks)**

Concept of Geometric, Kinematic and Dynamic Similarities, Concept of Fluid rotation, Vorticity, Stream function and Potential function, Potential flows, Elementary flow fields and Principle of superposition.

[15 Lectures]

Unit IV

Vortex Motion **(15 Marks)**

General theorem (vortex motion and its properties), Rectilinear vortices, Motion under circular and rectilinear vortices.

[10 Lectures]

RECOMMENDED BOOKS

1. **G.K. Batchelor**, An introduction to Fluid Mechanics, Cambridge Univ. Press 1967.
2. **F.Chorlton**, Text Book of Fluid Dynamics, CBS Publication, Delhi 1985.

REFERENCES

1. **AJ Chorin & JF Mursden** , mathematical introduction to Fluid dynamics 1993
2. **L.D. Landu and F. M. Lifshitz,** Fluid Mechanics, Pregmon Press 1985.
3. **O'Neil and F. Chorlton,** Ideal and incompressible Fluid Dynamics, Ellis Horwood Ltd. 1986

BMath : 60703 [SEMESTER – VI]

PROBABILITY THEORY [OPTIONAL PAPER]

FULL MARKS - 100

Unit-1

Continuous probability distributions **(22 Marks)**

Continuous probability distributions - uniform, exponential, rectangular, beta gamma distributions, probability generating functions.

[17 Lectures]

Unit-2

Generating functions & Convegence **(22 Marks)**

Moment inequalities-Holder, Minkowsky, Schwarz: Weak and strong convergence of random variables, almost sure convergence, Convergence in r'th mean.

[16 Lectures]

Unit-3

Convergence of distribution functions **(18 Marks)**

weak and complete convergence of distribution functions: probability inequalities: Chebychev, Markov and Jensen.

[14 Lectures]

Unit-4

Normal distribution **(20 Marks)**

Normal distribution as limiting case of binomial distribution, properties of normal distribution, normal probability curve, area under normal curve, Characteristic functions and its properties.

[15 Lectures]

Unit-5

Central Limit Theorem **(18 Marks)**

Univariate distribution, Transformation, Bivariate normal distribution and its properties. De Moivre Laplace limit theorem, Liapunov theorem (without proof) and applications of central limit theorem.

[13 Lectures]

RECOMMENDED BOOKS

1. **B.R Bhatt**, Modern Probability Theory, Wiley Eastern Ltd, 1989
2. **P. Mukhopadhyay** Theory of Probability, New Central Book Agency, Kolkata, 2002
3. **Kai Lai Chung**, A Course in Probability Theory, 3/e. Academic Press, 2001

REFERENCES

4. **M. H. DeGroot, M. J. Schervish** : Probability and Statistics, Addison Wesley, 2001
5. **Sheldon Ross**, A First Course in Probability, Prentice Hall, New Jersey, 2002
6. **William Feller**, An Introduction to Probability Theory and Its Applications, Volume 1, John Wiley and Sons, Inc., New York, 1971
7. **A. N. Kolmogorov**, Foundations of the Theory of Probability, 2nd ed., AMS, 1997
8. **Richard Durrett**, Probability: Theory and Examples 2/e, Duxbury Press, 1995
9. **J N Kapur & H C Saxena**, Mathematical Statistics, S. Chand, 1961

BMath : 60704 [SEMESTER – VI]

CRYPTOGRAPHY [OPTIONAL PAPER]

FULL MARKS - 100

Unit -1

Prerequisites of Number theory **(22 Marks)**

Prime numbers, format's theorem (without proof), Euler's theorem; Primality test- Methods of Naïve, Fermat, Miller- Rabin, Leonard Adleman and Huang, probability, fast deterministic, number theoretic tests. Chinese Remainder Theorem, discrete logarithms.

[17 Lectures]

Unit-2

Cryptography & Information Security **(18 Marks)**

Information security, security attacks, services and mechanisms, conventional encryption techniques, substitution ciphers and transposition ciphers, cryptanalysis, stereography, stream and block ciphers.

[12 Lectures]

Unit-3

Block Ciphers and DES **(21 Marks)**

Block cipher principles, Data Encryption Standards (DES), strength of DES, differential and linear cryptanalysis of DES, block ciphers models of operation, triple DES, IDEA encryption and decryption, traffic confidentiality, key distribution, random number generation.

[16 Lectures]

Unit-4

Public Key Cryptography **(20 Marks)**

principles of public key cryptography, prime and related prime numbers, modular arithmetic, key management, authentication, key length and encryption strength, RSA algorithm, security of RSA key management.

[15 Lectures]

Unit-5

DSS & IP Security **(20 Marks)**

Athentication functions, and message authentication codes, digital signatures, authentication protocols, digital signature standards (DSS) digital signature algorithm. IP security and its overview, intruders, viruses and related threads, firewell design principles

[15 Lectures]

RECOMMENDED BOOKS

1. **William Stallings**, Cryptography and Network Security, Principles and Practice, Prentice Hall of India, New Delhi, 2007
2. **V. K Pachghare**, Cryptography and Information Security, PHI Learning (P) Ltd, New Delhi, 2009

REFERENCES

3. **Johannes A. Buchman**, Introduction to cryptography, Spiringer Verlag
4. **Bruce Schiener**, Applied Cryptography, Addison Wesley, 2001

BMATH :60705 [SEMESTER - VI]

SPHERICAL TRIGONOMETRY AND ASTRONOMY

[OPTIONAL PAPER]

Unit I

Spherical Trigonometry **(30 marks)**

Spherical triangle, Polar triangle, properties of Polar and Spherical triangles. Sine formula, Cosine formula, Four parts formula, Sine cosine formula, Cotangent formula, Napier's analogies, Delambre's analogies.

Right angled spherical triangle. Formulae relating to the right spherical triangles. Area of a spherical triangle. Area of a spherical polygon. **[20 Lectures]**

Unit II

Celestial sphere **(20 marks)**

Three systems of celestial coordinates. Rectangular coordinates. Sidereal time. Rising and setting of stars. Circumpolar stars. Rate of change of zenith distance and azimuth. Twilight. Motion of the Sun. Vernal and Autumnal Equinox. Summer and Winter Solstice. Different kinds of time. Seasons.

[17 Lectures]

Unit III

Refraction, Precession and Nutation **(20 marks)**

Laws of Refraction. Cassini's hypothesis. Simpson's hypothesis. Bradely's formula. Effect of refraction on (1) sunrise and sunset (2) the right ascension and declination of a star (3) in the distance between two neighbouring stars (4) on the shape of the disc of the sun.

Precession on the right ascension and declination of a star. Nutation in the right ascension and declination of a star. Precession and nutation both on the right ascension declination of a star.

[16 Lectures]

Unit IV

Aberration, Parallax **(20 marks)**

Annual and diurnal aberration. Annual aberration in (1) ecliptic longitude and latitude (2) right ascension and declination of a star. Diurnal aberration in (1) hour angle and declination (2) zenith distance and azimuth.

Geocentric parallax and Annual parallax. Geocentric parallax in (1) right ascension and declination (2) the distance between two planets (3) azimuth and zenith distance. Annual parallax in (1) latitude and longitude (2) right ascension and declination.

[16 Lectures]

Unit V

Planetary motion **(10 marks)**

Synodic and orbital Period. Kepler's laws. Deduction of Kepler's laws from Newton's laws of Gravitation. **[6 Lectures]**

RECOMMENDED BOOKS

1. **M. Ray** : *Spherical Trigonometry*
2. **M. Ray** : *Spherical Astronomy*
3. **K.K. De** : *Text Book of Astronomy*, Book Syndicate Pvt. Ltd., Kolkata

REFERENCES

1. **W.M. Smart** : *Text Book of Spherical Astronomy*, CUP-VIKAS Student's Edition
2. **W.M. Smart** : *Foundation of Astronomy*, CUP-VIKAS Student's Edition
3. **Gorakh Prasad** : *Text Book on Spherical Astronomy*, Pothisala Pvt. Ltd., Allahabad
4. **Standy P. Wyatt** : *Principles of Astronomy* : Allyn and Bacon, Inc

BMath : 60706 [SEMESTER – VI]

COMPUTATIONAL MATHEMATICS LABORATORY

[OPTIONAL PAPER]

FULL MARKS 100

[THEORY – 50 (DURATION – TWO HOURS)]
[PRACTICAL – 50 (DURATION – TWO HOURS)]

UNIT-I

(20 Marks)

Simple arithmetical operations, variables, round-off errors, formatting printing, common mathematical functions, script M-files, File Input-Output. Two-dimensional graphics, three-dimensional graphics **[15 Lectures]**

UNIT-II

(10 Marks)

Generating matrices, colon operator, manipulating matrices, simple arithmetical operations, operator procedure, common mathematical functions, data manipulation commands, sparse matrices **[10 Lectures]**

UNIT-III

(10 Marks)

Solving linear system of equations-square linear system, Catastrophic round-off error, over determined and undetermined linear system, Initial-valued ordinary differential equations.

[12 Lectures]

UNIT-IV

(10 Marks)

Programming in MATHLAB-Flow control and logic variables, matrix relational operators and logical operators, function M-files.

[8 Lectures]

UNIT - V

PRACTICAL - 50 MARKS (List of practical topics based on MATLAB)

[30 Lectures]

1. Plotting of functions
2. Matrix operations, vector and matrix manipulation, matrix function
3. Data analysis and curve fitting
4. Use of FFT algorithm
5. Numerical Integration
6. Differential equations
7. 2-D graphics and 3-D graphics-general purpose graphic functions, colour maps and colour functions
8. Sparse matrices-Iterative methods for sparse linear equations, eigenvalues of sparse matrices.

Instructions for Practical [**Two Programs Only** a) Program writing **10 marks**, b) Output – **30 marks** c) Viva Voce **5 marks d) Note book 5 marks**]

RECOMENDED BOOKS:

1. **MATHLAB**-High performance numeric computation and visualisation software: User's guide
2. **A MATHLAB** Tutorial-Ed Doverman, Dept. Of Math., Ohio State University.

BMath : 60707 [SEMESTER – VI]
SPECIAL THEORY OF RELATIVITY & TENSORS
[OPTIONAL PAPER]

FULL MARKS 100

Unit-I

Basic Aspects of STR **(10 Marks)**

Inertial frames, Galilean transformation, Michelson – Morley' experiment. The relativistic concept of space and time, Postulates of special theory of relativity,

[10 Lectures]

Unit-II

Relativistic Kinematics **(20 Marks)**

Lorentz transformation equations, the general Lorentz transformation equations, Consequences of Lorentz transformation equations like Relativity of simultaneity, Einstein's time distillation or apparent retardation of clocks, Relativity of space - Lorentz – Fitzgerald contraction and related problems.

[18 Lectures]

Unit-III

Relativistic Dynamics **(25 Marks)**

Redefined momentum, The relativistic force Law and the Dynamics of a single particle, Equivalence of Mass and Energy, $E = mc^2$ and its consequences.

[15 Lectures]

Unit-IV

Relativistic Mechanics **(15 Marks)**

Transformation properties of Momentum, Energy, Mass and Force.

[10 Lectures]

Unit-V

Tensors **(30 Marks)**

Space of N-dimension, Transformation of co-ordinates, contravariant and covariant vectors (Tensor of first order), Tensor of second order (or of rank two), Tensors of higher rank (or higher orders), Mixed tensors, Kronecker delta symbol, Invariant or scalar, Algebraic operations with tensors, Addition & subtraction of tensors, contraction, product of tensors, Inner Product, symmetric and Skew symmetric tensor.

[22 Lectures]

RECOMMENDED BOOKS

1. **M. Ray** : Special Theory of Relativity.
2. **A. Das** : The Special Theory of relativity.
3. **Banerjee** and **Banerjee** : The Special Theory of relativity, Prentice Hall of India, New Delhi.
4. **Resnick:** Special Theory of relativity, John Wiley.

REFERENCES

1. **Dirac** : General Theory of Relativity, Prentice Hall of India, New Delhi.
2. **S.K. Bose**: General Theory of Relativity, Wiley Eastern Ltd.

BMath - 60708 [SEMESTER-VI]

ALGEBRAIC CODING THEORY [OPTIONAL PAPER]

FULL MARKS - 100

UNIT 1

(Mark-20)

Elements of Coding Theory, Introduction, Encoding and Decoding messages, Binary Symmetric Channel, Block Codes, Parity Check Code, Hamming Code, Hamming Distance, Linear Codes, Hamming and Lee Matrices, Parity Check and Generator Matrices.

[15 Lecture]

UNIT 2

(Mark-20)

Description of Linear Codes by Matrices, Coset decomposition of Linear Codes, Step by Step Decoding, Modular Representation, Linear Code Equivalence, Dual code.

[15 Lecture]

UNIT 3

(Mark-25)

Weight Distribution and Mac-Williams Identities, Maximum-Distance separable(MDS) Codes, Generator and Parity check matrices of MDS Codes, Weight distribution of MDS Code, Necessary and sufficient condition for a linear code to be an MDS code. (Lecture-20)

UNIT 4

(Mark-20)

Bounds for Burst error detecting and correcting Linear Codes, Perfect and Quasi-perfect Codes, Binary Hamming Codes, Golay Codes, Cyclic Codes, Matrix Description of a systematic cyclic code ,Error Detection, Shorten Cyclic code, Code Symmetry,

[15 Lecture]

UNIT 5

(Mark-15)

Reed-Mullar Codes, Hadamard Matrices and Hadamard Codes, Product Codes, Low-Density Codes, Concatenated Codes.

[10 Lecture]

RECOMMENDED BOOKS

1. Error-correcting codes by **F.J.Mac Williams** and **N.J.A Sloane**, North Holland Publishing Company,1977
2. Error-Correcting Codes by **W.W.Peterson** and **E.J Weldon,Jr.** MIT press,Cambridge,Messachusetts,1972

REFERENCES

1. Algebraic Coding Theory by **E.R.Berlekamp**, McGraw Hill Book Co, New York, 1968

2. **Juergen Bierbraver**, Introduction to Coding Theory, Chapman and Hall/CRC,London,Newyork,2008
3. **Roberto Togneri** and **Christopher J.de Silva**, Fundamentals of Information Theory and Coding Design, Chapman And Hall/CRC,London,Newyork,2008