Course Structure & Syllabus of B.Sc. (H) Mathematics
Applicable for Batch: 2020-23

DIT UNIVERSITY
Dehradun

Detailed Course Structure& Syllabus of B.Sc. (H) Mathematics

Approved by the Academic Council at its 14th Meeting held on 20.04.2020

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Course Structure

Year: 1st **Semester: I**

Course Category	Course Code	Course Title	L	T	P	Credit
CC	MAT106	Algebra	3	1	0	4
CC	MAT107	Linear Algebra	3	1	0	4
CC	MAT108	Calculus - I	3	1	0	4
GEC	PHY103	Wave, Optics & Introduction to Quantum Mechanics	3	1	2	5
SEC	HS101	Professional Communication (Minor)	2	1	1	3.5
AEC	MAT109	Lab based on MS Office	0	0	4	2
		Total	**14**	**5**	**9**	**22.5**

Year: 1st **Semester: II**

Course Category	Course Code	Course Title	L	T	P	Credit
CC	MAT116	Calculus -II	3	1	0	4
CC	MAT117	Ordinary Differential Equations	3	1	0	4
CC	MAT118	Solid Geometry	3	1	0	4
GEC	MAT119	Programming in C	3	1	4	6
SEC	HS102	Corporate Communication & Soft Skills	2	1	1	3.5
		Total	**14**	**5**	**5**	**21.5**

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Year: 2nd **Semester: III**

Course Category	Course Code	Course Title	L	T	P	Credit
AEC	MAT206	Computer Based Numerical Techniques (CBNT)	3	1	4	6
CC	MAT207	Real Analysis- I	3	1	0	4
CC	MAT208	Partial Differential Equations	3	1	0	4
CC	MAT209	Linear Programing	3	1	0	4
AEC	HS348	Principle of Management (Minor)	3	0	0	3
SEC	MAT226	Lab Based on Mathematical Software	0	0	4	2
Total			**15**	**4**	**8**	**23**

Year: 2nd **Semester: IV**

Course Category	Course Code	Course Title	L	T	P	Credit
CC	MAT216	Probability Theory & Mathematical Statistics	3	1	4	6
CC	MAT217	Real Analysis- II	3	1	0	4
CC	MAT218	Complex Analysis	3	1	0	4
CC	CS201	Data Structure	3	0	2	4
AEC	CH201	Environmental Science	2	0	0	2
SEC	MAT227	Lab based on Python	0	0	4	2
Total			**14**	**4**	**8**	**22**

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Year: 3rd **Semester: V**

Course Category	Course Code	Course Title	L	T	P	Credit
CC	MAT306	Group Theory	3	1	0	4
CC	MAT307	Integral Transform	3	1	0	4
CC	MAT308	Dynamics& Statics	3	1	0	4
CC	MAT309	Graph Theory	3	1	0	4
DSE	MAT*	DSE- I	3	1	0	4
PRJT	MAT336	Minor Project	0	0	0	4
AEC	MAT337	Technical Writing with LaTeX-I	0	0	4	2
Total			**12**	**5**	**4**	**26**

DSE- I

Course Category	Course Code	Course Title	L	T	P	Credit
DSE	MAT356	Mathematical Modelling	3	1	0	4
DSE	MAT357	Financial Mathematics	3	1	0	4
DSE	MAT358	Statistical Inference	3	1	0	4
DSE	MAT359	Biostatistics	3	1	0	4
DSE	CS347	Digital Image Processing	3	0	2	4

Year: 3rd **Semester: VI**

Course Category	Course Code	Course Title	L	T	P	Credit
CC	MAT316	Ring Theory	3	1	0	4
CC	MAT317	Special Functions	3	1	0	4
DSE	MAT*	DSE- I	3	1	0	4
DSE	MAT*	DSE- II	3	1	0	4
PRJT	MAT338	Major Project	0	0	8	4
SEM	MAT339	Final Submission, Viva & Presentation using LaTeX	0	0	4	2
VAT	MAT318	Workshop	0	0	2	1
Total			**12**	**4**	**14**	**23**

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DSE- II						
Course Category	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credit**
DSE	MAT366	Integral Equations	3	1	0	4
DSE	MAT367	Tensor & Differential Geometry	3	1	0	4
DSE	MAT368	Number Theory & Cryptography	3	1	0	4
DSE	MAT369	Fuzzy Sets & Fuzzy Logic	3	1	0	4
DSE	MAT376	Metric Spaces	3	1	0	4
DSE	CS213	Theory of Computation	3	1	0	4

Summary of the Credit

Year	**Semester**	**Credit**
1	**1**	**22.5**
	2	**21.5**
2	**3**	**23**
	4	**22**
3	**5**	**26**
	6	**23**

Category wise classification of the Credit

Category		**Credit**	**Number of Subjects**
CC	Departmental Core Course	78	19
AEC	Ability enhancement Course	15	5
SEC	Skill Enhancement Course	11	4
GEC	Generic Elective Course	11	2
DSE	Discipline Specific Course	12	3
PRJT/THESIS	Project	8	2
SEM	Seminar	2	1
VAT/EEP/APT	Workshop	1	1
TOTAL		**138**	**139**

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Subject Code	MAT106	Subject Title	ALGEBRA						
LTP	3 1 0	Credit	4	Subject Category	CC	Year	1st	Semester	I

Course Objective: To prepare students with basic concepts of sets, relations, trigonometry and their applications in real life problems. The theory of equation furnishes an illuminating sequel to geometry, algebra and analytic geometry. Moreover, it develops anew and in greater detail various fundamental ideas of calculus for the simple, but important, case of polynomials.

Course pre/co-requisite (if any): The basic knowledge of trigonometry and polynomial.

UNIT-I: Set theory: **[10]**

Sets, Binary relations, Equivalence relation, Congruence relation between integers, Finite product of sets, Functions, Composition of functions, Invertible functions, Introduction of finite and infinite sets through correspondence, Binary operations, Principle of mathematical induction, Well ordering property of positive integers, Division algorithm, Statement of fundamental theorem of arithmetic.

UNIT-II: Trigonometry: **[11]**

Complex numbers, De Movire's Theorem and its applications, Exponential, Logarithmic, Circular and hyperbolic functions together with their inverses, Expansion of trigonometric functions, Angles, Right triangle trigonometry, Trigonometric values at special and at general angles, Unit Circle, Graphs of trigonometric functions, Inverse trigonometric functions, Trigonometric identities and formulas.

UNIT-III Applications of Trigonometric Functions: **[8]**

Solving trigonometric equations, Solving right triangles, Laws of Sines and Cosines, Areas of triangles.

UNIT-IV: Theory of equations: **[11]**

Polynomials in one variable and the division algorithm, Fundamental Theorem of Algebra, Relations between Roots and Coefficients, Descarte's rule of signs, Symmetric functions, Applications symmetric function of the roots, Transformation of equations, Algebraic Solution of a Cubic equations (Carden method), Bi-quadratic Equation.

Learning Outcome: Students will be able to:

- define set, element, object, and roster notation.
- apply basic set concepts to understand the calculus.
- recognize and use the vocabulary of angles (including standard position, initial and terminal sides, quadrantal angles, coterminal angles, acute, right, and obtuse angle.
- use right triangles to evaluate the trigonometric functions.
- know and draw the graphs of the trigonometric functions and their variations.
- understand the definitions of the inverse trigonometric functions.
- find all solutions of a trigonometric equation.
- find roots of quadratic functions and polynomial functions of various degrees.

Text Books:

1. Herbert B. Enderton, Elements of Set Theory, Academic Press, 1977
2. C. C. Mac Duffee, Theory of Equations, John Wiley & Sons Inc., 1954.
3. Leonard E. Dickson: First Course in the Theory of Equations.
4. John Bird: Engineering Mathematics, Fifth edition.
5. Jay Abramson, Algebra and Trigonometry, Arizona State University, 2015.

Reference Books:

1. W.S. Burnside and A.W. Panton, The Theory of Equations, Dublin University Press, 1954.
2. Schaum's Outline of Trigonometry, 5th Edition, Robert Moyer, Frank Ayres.

Course Structure & Syllabus of B.Sc. (H) Mathematics
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Subject Code	MAT107	Subject Title	LINEAR ALGEBRA						
LTP	3 1 0	Credit	4	Subject Category	CC	Year	1st	Semester	I

OBJECTIVES: Students will learn aboutAlgebraic operations on matrices, determinant, invertible matrices, Solving a system of linear equations by Gauss-Jordan method. Necessary conditions for a system of linear equation to have (i) unique solution. (2) infinitely many solutions, (3) no solution
Elementary matrices, determining inverse of invertible matrices.Properties of vectors in $\Re^2$, $\Re^3$, and their generalization to $\Re^n$.Definition of a vector space and its properties.Properties of Linear Transformations, relation with matrices, rank and nullity of given linear transformations.

Pre-requisite: Basic knowledge of algebra, linear equations.

UNIT I: System of linear equations &Vector Spaces [11]

Elementary row and column operations, Elementary matrices, Echelon form of matrix, Rank of a matrix, Existence and uniqueness of the solution, Solution of system of linear equations.

Review of algebraic properties of $R, R^2 \text{ and } R^3$, Definition of vector space, Examples, Subspace, Linear independence and dependence, Basis, Dimension, Coordinates with respect a basis, Relation between coordinates with respect to different bases.

UNIT II: Linear Transformations [10]

Definition, Examples, Range and null space, Rank-Nullity theorem, Matrix of linear transformation, Relation between matrices with different bases, Equivalent and similar matrices.

UNIT III: Diagonalization [10]

Definition, Necessary and sufficient condition for diagonalization, Characteristic equation, Eigen-values and Eigen-vectors, Cayley-Hamilton theorem and applications, Symmetric, Skew-Symmetric, Orthogonal and Orthonormal Matrices,Complex matrices, Hermitian, Skew-Hermitian, Unitary matrices, Similar and diagonalizable matrices.

UNIT IV: Inner Product Spaces and Quadratic Forms [9]

Scalar product and its properties in R^n, Definition of inner product space, C^n as an inner product spaces, Properties of inner product, Orthogonal and orthonormal bases, Gram-Schmidt process, Definition of quadratic form, Matrix of quadratic form, Positive definite, Negative definite, Indefinite forms, Rank, Index and signature of quadratic form, Canonical quadratic form (Principal axes form), Hermitian and Skew-Hermitian form.

LEARNING OUTCOMES: Students will be able to:

- solve system of linear equations using Gauss elimination Method
- determine inverse of matrices, Compute rank & nullity of a given Linear transformation, coordinates of an element in a vector space with respect to a given basis.
- compute characteristic equation of a given matrix, eigen values and eigen vectors of matrices, determine inverse using Cayley-Hamilton Theorem.
- define inner product for vectors over Complex numbers, Orthogonal and orthonormal bases for given inner product spaces.

Text Books:

1. V. Krishnamurthy, V. P.Mainra, J.L. Arora, "An introduction to linear Algebra", East-West Press Pvt. Ltd., 1976.

2. W. Cheney, D. Kincaid, " Linear Algebra:Theory and applications", 2nd Edition, Jones and Bartlett learning, 2012.

Reference Books:

1. R. Vasishtha and J.N. Sharma, "Linear Algebra", 42nd Edition, Krishna Publication, 2010.
2. G.Strang, "Linear Algebra and its Applications", 4th Edition, Cengage Publication, 2014.
3. K. M. Hoffman and R. Kunze, "Linear Algebra", 2nd Edition, Pearson Publication, 2015.

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Subject Code	MAT108	Subject Title	CALCULUS-I						
LTP	3 10	Credit	4	Subject Category	CC	Year	1st	Semester	I

Objectives

To prepare the students with basic concepts of limit, continuity, differentiability, and integration of functions and their applications.

UNIT I: Limit and Continuity **[8]**

Review of functions of single variable: Exponential, Logarithmic, Trigonometric and Hyperbolic functions, Limit, Continuity, Algebra of limits and continuous functions.

UNIT II: Differentiability **[10]**

Differentiability, Indeterminate forms, L' Hospital rule, Rolle's Theorem, Mean value theorems & their applications, Successive differentiation, Leibnitz theorem, Maclaurin & Taylor series of functions of one variable.

UNIT III: Applications of Derivatives **[10]**

Review conic sections and their Graphs, Monotonicity, Maxima and Minima, Concavity, Convexity, Point of inflection & Asymptotes, Polar coordinates, Curvature, Envelope of a family of curves, Graphs of functions and curves.

UNIT IV: Integral Calculus **[12]**

Review of indefinite and definite integrals, Fundamental theorem of integral calculus, Integral as the limit of sum, Area, Volume and surface of revolution, Arc lengths, Double and triple integrals, Change of order of integration, Change of variables, Dirichlet's integral, Application of multiple integrals.

Learning Outcome: Students will be able to:

- find derivative and anti-derivative of various functions and use them for further study
- draw graph of various functions in Cartesian and Polar coordinates
- determine area, volume, surface od revolutions using definite integrals
- use the concepts of calculus in higher learning.

Text Books:

1. G. B. Thomas and R. L. Finney, "Calculus and Analytic Geometry", 9th Edition, Pearson Education India, 2010

Reference Books:

1. R. K. Jain, & S. R. K. Iyenger,"Advanced Engineering Mathematics", 4thEdition, Narosa Publishing House, New Delhi, India, 2014.
2. E. Kreyszig, "Advanced Engineering Mathematics", 10thEdition, John & Wiley Sons, U.K., 2016.
3. Gorakh Prasad, "Integral Calculus", Pothishala Private Limited, 2015

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Subject Code	MA119	Subject Title	LAB BASED ON MS OFFICE					
LTP	0 0 4	Credit	2	Subject Category	AEC	Year	1st	Semester	I

Course Outline:
This course includes basic topics of MS word, excel and powerpoint.

Objectives:
To introduce basic and intermediate knowledge about MS Office which includes word, excel and powerpoint.

Course Pre/Co- requisite (if any) :no restricted pre-requisite.

Contents to be covered

1. Installation of MS OFFICE, Brief Introduction and key features.
2. Introduction and use of **MS Word**.
3. Creating a New Document, Formatting Text, Bulleted Lists, Line and Paragraph Spacing, Modifying Page Layout.
4. Working with Headers and Footers, Tables, Hyperlinks and Printing.
5. Introduction and use of **MS Excel**.
6. Starting a Workbook, working with Columns, Rows & Cells.
7. Working with Functions, Formatting Tables, Aligning Text, Freezing Worksheet Panes.
8. Working with Graphs and Charts.
9. Working with Data analysis using Data analysis tool pak.
10. Introduction and use of **Powerpoint**.
11. Presentation Basics, Themes and Background Styles.
12. Animating Text and Objects, Using Transitions, Slide Show Options
13. Inserting Pictures and Clip Art and video.

Learning Outcome: Students will be able to

1. Use MS word for report writing.
2. Use MS excel for data analysis and representation of data in tabular form.
3. Use powerpoint for presenting in a nice way.

Text Books:

1. Donald Sanders: Computers Today, McGraw-Hill Publishers.
2. Davis: Introduction to Computers, McGraw-Hill Publishers.

Reference Books:

3. V. Rajaraman : Fundamental of Computers, Prentice-Hall India Ltd., New Delhi.

Course Structure & Syllabus of B.Sc. (H) Mathematics
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Subject Code	MAT116	Subject Title	CALCULUS-II					
LTP	310	Credit	4	Subject Category	CC	Year	1st	Semester	II

Objective: Exposure to concepts of Vector Calculus, Vector Geometry, Vector Integration, Line and Surface Integrals and their relations to double and triple integrals.

UNIT I: Functions of Several Variables **[10]**

Limit, Continuity and differentiability, Partial differentiation, Euler's theorem and applications, Total Differential, Taylor series of functions of two variables, Extrema of functions of several variables, Lagrange's multiplier method.

UNIT II: Vector Differential Calculus **[9]**

Review of Vector Algebra in R^2 & R^3, Inner (Dot) Product, Cross Product, Parametric representation of curves, Continuity, Differentiation and integration of vector functions, Tangent and arc-length, Curves in Mechanics (Velocity and Acceleration), Gradient of a scalar field, Directional Derivative, Normal to a curve, Divergence & Curl of vector function and their applications, Physical interpretation of Divergence and Curl.

UNIT III: Vector Integration **[10]**

Line integrals, Application of line integral, Determination of a scalar potential, Integration around closed curves, Conservative and Non-conservative physical systems, Line integrals independent of path, Green's Theorem, Application of Green's theorem,

UNIT IV: Surface and Volume integral **[11]**

Review of double and triple integration, Parametric representations of surfaces (cylinder, sphere and cone), Tangent plane and surface normal, Surface area and Surface integrals, Gauss divergence theorem and applications, Evaluation of surface integrals by Gauss divergence theorem, Stokes theorem, Green's theorem in the plane as a special case of Stokes theorem,

Learning Outcome: After completion of this course student will be able to:

- know the concepts of limit, continuity and differentiability in two dimensional plane.
- evaluate the partial derivatives, application of Euler's theorem and maxima and minima of two variables.
- analyze the vector calculus and its applications in two and three –dimensional geometry.
- calculate surface integral and volume integral.

Text Books:

1. E. Kreyszig, "Advanced Engineering Mathematics**"**, 10th Edition, John & Wiley Sons, U.K., 2016.
2. MD. Ali Ashraf, and MD. Abdul KhaleqHazra, "Vector Analysis with Application", 3rd Edition, New Age International (P) Ltd, 2006.

Reference Books:

1. R. K. Jain, & S. R. K. Iyenger, "Advanced Engineering Mathematics", 4th Edition, Narosa Publishing House, New Delhi, India, 2014.
2. Seymour Lipschutz, Dennis Spellman, and Murray, Spiegel, "Vector Analysis", 2nd Edition, McGraw Hill Education (India) Private Ltd., 2009.

Course Structure & Syllabus of B.Sc. (H) Mathematics
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Subject Code	MAT117	Subject Title	ORDINARY DIFFERENTIAL EQUATIONS						
LTP	3 10	Credit	4	Subject Category	CC	Year	1st	Semester	II

OBJECTIVE

This course provides an introduction to the fundamentals of ordinary differential equations and their solutions

UNIT I: Differential Equations of first Order & first Degree [10]

Formation of differential equations, order and degree of differential equations, complete primitive, methods to solve the differential equations of first order and first degree; separation of variables, homogeneous differential equations, exact differential equations, equations reducible to separation of variables, homogeneous and exact differential equations, linear differential equations, equations reducible to linear differential equation.

Unit- II: Equations of first order but not of first degree & Trajectories [8]

Equations of first order but not first degree, Various cases & various methods to determine solution, Singular solutions, Clairaut's form, Trajectory, Orthogonal trajectory Self-orthogonal family of curves.

UNIT III:Second and Higher Order ODE [12]

Solution of homogeneous and non-homogeneous linear ODE with constant coefficients using inverse operator method and method of undetermined coefficients, Euler-Cauchy homogeneous linear differential equations, Simultaneous differential equations, Method of variation of parameters, Solution of second order differential equations by changing dependent and independent variable.

Unit – IV: Simultaneous linear differential equations & second order linear differential equations with variable coefficients [10]

Simultaneous linear differential equations with constant coefficients, Linear differential equations of second order with variable coefficients, following cases: the complete solution in terms of a known integral, finding one integral in C.F. by inspection, reduction to normal form, Change of independent variable, method of variation of parameters, Simultaneous equations of the form $P_1dx + Q_1dy + R_1dz = 0$, $P_2\,dx + Q_2dy + R_2\,dz = 0$.

LEARNING OUTCOMES

After completing this course, students should demonstrate competency in the following skills:

- To understand the order and degree of differential equations and classify them to linear or nonlinear differential equations.
- To determine the solution of differential equation of first order and first degree.
- To understand and identify higher order linear differential equation and determine their solutions by various methods.
- To understand and recognize fundamentals of singular solutions, Clairaut's equations.

Text Books:

1. M. D. Raisinghania, "Ordinary and Partial Differential Equations", 19th Edition, S. Chand Publications, 2017.
2. 2. G. F. Simmons and G. Krantz Steven, "Differential Equations", 17th Reprint, McGraw HillEducation (India) Private Ltd., 2016.

Reference Books:

1. M. Tenenbaum, and H. Polard, "Ordinary Differential Equations", Dover Publications, 1985.
2. V.P. Mishra, and J. Sinha, "Elements of Engineering Mathematics", 3rd Edition, S.K. Kataria& Sons, 2013.
3. E. Kreyszig, "Advanced Engineering Mathematics", 10th Edition, published by John Wiley & Sons, U.K, 2011.
4. B. Rai, D.P. Choudhary and H.I. Freedman, "A Course in Ordinary Differential Equations", 2nd Edition, Narosa Publishing House, 2013.
5. B.S. Grewal, "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, 2012

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Subject Code	MAT118	Subject Title	SOLID GEOMETRY						
LTP	3 1 0	Credit	4	Subject Category	CC	Year	1st	Semester	II

OBJECTIVE: Prepare students to develop fundamental aspects of two and three dimensional geometries. Course covers the topics of conic section, plane and solid geometry which are essential to understand geometry of surfaces.

Unit I: Conic Section **[9]**

General equation of second degree, General conics, Polar equation of conic and its properties, Tangent to the conic, Chord of contact.

Unit II: Three dimensional Geometry **[10]**

Three dimensional system of co-ordinates, Distance between two points, Projection and direction cosines, Straight lines, Angle between two lines, Shortest distance between two straight lines, Equation of plane, Normal form of plane, Distance of a point from plane, Image of a point w.r.t. given plane.

Unit III: Sphere **[10]**

Vector and Cartesian form of Sphere, Plane section of a sphere, Intersection of straight line and sphere, Distance of point from sphere, Equation of tangent and normal to the sphere, Plane of contact, Pole and polar plane and their properties, Ange between two spheres, Orthogonal Spheres, Length of tangent.

Unit IV: Conicoids **[11]**

Sphere, cone and cylinder, Central conicoids, Reduction of general equation of second degree, Tangent plane and normal to a conicoid, Pole and polar, Conjugate diameters, Generating lines, Plane sections.

Learning Outcome: The successful completion of this course will enable the students to:

- apply the concept and consequences of distance between two points in space, direction ratios and projections to determine the equations of straight lines.
- determine the equation of planes in various forms: vector form as well as Cartesian form, intercept form and equation of shortest distance between two skew lines.
- compute the equation of sphere in vector form as well as Cartesian form, equation of its tangent and normal.
- know the equations of central conicoids and the equations of tangent and normal to conicoids.
- write the equations of pole and polar to conicoids and equations of conjugate diameters to a given conicoids.

Text Books:

1. Shanti Narayan, and P.K. Mittal, “Analytical Solid Geometry”, S. Chand & Company, New Delhi, 2008.
2. P.K., Jain, K., Ahmad, "Text Book of Analytical Geometry", New Age International Private Ltd., 2014.
3. A. R. Vasishtha, “Text book on geometry & vector calculus”, Krishna Publications, 21st edition, 2017.

Reference Books:

1. R. J. T. Bell, “An Elementary Treatise on Co-ordinate geometry of three dimensions”, Macmillan India Ltd., New Delhi, 1994.
2. M. M. Tripathi, “Coordinate Geometry: Polar Coordinates Approach”,NarosaPublishing House, New Delhi.

Course Structure & Syllabus of B.Sc. (H) Mathematics Applicable for Batch: 2020-23

Subject Code	MAT206	Subject Title	COMPUTER BASED NUMERICAL TECHNIQUES						
LTP	3 1 4	Credit	6	Subject Category	AEC	Year	2nd	Semester	III

Course Objective: To enable students to obtain an intuitive and working understanding of numerical methods for the basic problems of numerical analysis and gain experience in the implementation of numerical methods using a computer.

Unit I: Solution of system of linear equations: [7]
Direct methods: Matrix inverse method, Gauss elimination, Gauss-Jordan methodand LU decomposition method, Iterative methods: Jacobi's method, Gauss-Seidal method

Unit II: Solution of Algebraic andTranscendental equations: [9]
Initial approximation of the roots, Bisection method, Method of false position, secant method, iteration method, Newton-Raphson method and its convergence.

Unit III:Finite differences and interpolation: [12]
Finite difference operators, their properties and their interrelations, finite difference tables, Newton's forward and Newton's backward interpolation formula, various central difference formulae including Stirling's formula, Bessel's formula. Divided differences: Operators and difference table, Newton's divided difference formula, Lagrange's interpolation formula.

Unit IV: Numerical differentiation and integration: [12]
Differentiation using Newton's forward and backward interpolation formula, Newton-Cotes quadrature formula - derivations & comparison of Trapezoidal rule, Simpsons 1/3 and 3/8 rules. Numerical solution of first order differential equations: Euler's method, modified Euler's method, Runge-Kuttasecondorder andfourth order methods.

Text Books:

- B. S. Grewal, **Numerical Methods in Engineering and Science,** (9th Edition), Khanna Publishers, New Delhi, India, 2010.

Reference Books:

- S.S. Sastry, **Introductory Methods of Numerical Analysis,** 4th edition, PHI learning Pvt. Ltd, 2005.
- Curtis F. Gerald and Patrick O. Wheatley**, Applied Numerical Analysis,** 7th Edition, Pearson Education Lt, 2009.
- M.K Jain, S.R.K Iyengar and R.K Jain, **Numerical Methods for Scientific and Engineering computation, 4th**Edition, New age International Publishers, 2003.

List of Practical:

(1) Bisection Method.
(2) Regula Falsi method.
(3) Newton Raphson method.
(4) Gauss Elimination method.
(5) Gauss - Jacobi Method.
(6) Gauss - Seidal Method.

(7) Newton's Forward Interpolation Formula.

(8) Newton's Backward Interpolation Formula.

(9) Trapezoidal rule.

(10) Simpson's $\frac{1}{3}rd$ rule.

(11) Simpson's $\frac{3}{8}rd$ rule.

(12) Euler's method.

(13) Fourth order Runge - Kutta methods.

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Subject Code	MAT207	Subject Title	REAL ANALYSIS - I						
LTP	3 1 0	Credit	4	Subject Category	CC	Year	2nd	Semester	III

Objective: The course will develop a deeper and more rigorous understanding of Calculus including defining terms and proving theorems about functions, sequences, series, limits, continuity, derivatives, the Riemann integrals, and sequences of functions. The course will develop specialized techniques in problem solving.

UNIT I: Point Set Topology **[11]**

Real Numbers, Field of Real Numbers, Ordering properties, Finite, Infinite, Countable, Uncountable and Bounded sets, Intervals, Supremum, Infimum, Completeness of R, Neighborhood, Interior points, Open sets, Limit points, Derived set, closure of a set, Closed sets, Connected sets, Compact sets.

UNIT II: Sequences **[11]**

Sequence of real numbers, Convergent and Divergent sequences, Bounded and Monotonic sequence, Limit superior and limit inferior, Cauchy's sequences, Cauchy's principle on convergence of a real sequence.

Unit-III: Series **[9]**

Convergence of infinite series of positive terms, Comparison test, Cauchy's Root test, D'Alembert's Ratio, Raabe's test, Logarithm test, Condensation test, Cauchy's Integral tests, Alternating series, Leibnitz test and Conditional convergence.

Unit – IV: Power series **[9]**

Power series (of real variable), Radius and interval of convergence, Term-wise differentiation and integration of power series.

Outcome: After completion of the course the students will be able to:

- prove a basic set theoretic statement
- define the limit of a function at a value, a limit of a sequence, and the Cauchy criterion
- prove a theorem about limits of sequences and functions
- state the Bolzano-Weierstrass theorem, Rolle's theorem, extreme value theorem, and the Mean Value theorem
- define Riemann integrable and Riemann sums and prove a theorem about Riemann sums and Riemann integrals.

Text Books:

1. S.C. Malik and Savita Arora, "**Mathematical Analysis"**, 5th Edition, New Academic Science Ltd, 2017.

Reference Books:

1. R.G. Bartle and D.R. Sherbert, "Introduction to Real Analysis", 4th Edition, Wiley, 2014.
2. T.M. Apostol, "Mathematical Analysis**",** 2nd Edition, Narosa Publishing House, New Delhi, 2002.
3. Shanti Narayan and M. D. Raisinghania, "Elements of Real Analysis", S. Chand & Co., New Delhi, 2003.
4. H.L. Royden and P.M. Fitzpatrick, "Real Analysis", 4th Edition, Pearson, 2010.

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Subject Code	MAT208	Subject Title	PARTIAL DIFFERENTIAL EQUATIONS						
LTP	3 1 0	Credit	4	Subject Category	CC	Year	2nd	Semester	III

Objective: To introduce the students various kinds of Partial Differential Equations (PDE), methods of their solutions and applications of some the well know PDE.

UNIT – I **[12]**

Partial differential equations – Basic concepts and definitions, Formation of PDE, Mathematical problems, First order equations: classification, construction and geometrical interpretation, Lagrange's equation, Integral surface passing through given curve, Compatible system of first order equation, Charpit's method, Jacobi's method

UNIT – II **[9]**

Partial differential equation of second and higher order, Linear partial differential equation of second order with constant coefficients, Homogeneous and Non-homogeneous linear partial differential equations with constant coefficients, Partial differential equations reducible to equations with constant coefficients.

UNIT – III **[12]**

Derivation of heat equation, Wave equation and Laplace equation, Classification of second order linear equations as Hyperbolic, Parabolic or Elliptic, Reduction of second order linear equations to canonical forms, Method of separation of variables, Solving first order partial differential equations, Solving the vibrating string problem, Solving the heat conduction problem.

Unit-IV **[9]**

Periodic functions, Basic properties of definite integrals of periodic functions, Fourier series of functions with period 2π , Even and odd functions, Half-Range expansions, Fourier series of functions with arbitrary period. Definition and relation to Fourier series, Fourier Sine and Cosine integrals.

LEARNING OUTCOMES: On successful completion of this course, the student will be able to:

- understand the formation of partial differential equations
- classify partial differential equationsand transformation into canonical form
- solve linear partial differential equations of both first and second order.
- understand basic concepts of Fourier series and its application

Text Books

1. M. D. Raisinghania, Ordinary and Partial Differential Equations, S. Chand Publishing, 2013.

Recommended Books:

1. S.L. Ross, "Differential Equations", 3rdEdition, John Wiley and Sons, India, 2004.
2. Martha L Abell and James P Braselton, "Differential Equations with MATHEMATICA", 3rdEdition, Elsevier, Academic Press, 2004.
3. Sneddon, I. N., Elements of Partial Differential Equations, McGraw Hill, 2006.

Course Structure & Syllabus of B.Sc. (H) Mathematics
Applicable for Batch: 2020-23

Subject Code	MAT209	Subject Title	LINEAR PROGRAMING						
LTP	3 1 0	Credit	4	Subject Category	CC	Year	2nd	Semester	III

Objective: Optimization methods using calculus have several limitations and thus not suitable for many practical applications. Most widely used optimization method is linear programming. The characteristics of linear programming problem (LPP) and also different techniques to solve LPP are introduced.

Unit-I **[8]**

Introduction, Linear programming problem, Mathematical formulation of LPP, Case studies of LPP, Graphical methods to solve linear programming problems, Standard and matrix forms of linear programming problem, Basic feasible solution, Applications, Advantages, Limitations

Unit –II [12]

Convex sets, convex sets, Extreme points, Hyperplanes and Half spaces, Convex cones, polyhedral sets and cones, Fundamental theorem of linear programming, Simplex method. Artificial variables, Big-M method, two phase method.

Unit – III **[10]**

Resolution of degeneracy, Revised simplex method, Duality in linear programming problems, Dual simplex method, Primal-dual method.

Unit- IV **[10]**

Mathematical model of transportation problem, North-West corner method, least cost method, Vogel's approximation method.

LEARNING OUTCOMES: Students will be able to

- formulate the linear programming problem.
- conceptualize the feasible region.
- solve the LPP with two variables using graphical and simplex method.
- formulate the dual problem from primal and their solutions.

Text Book:

1. Hamdy A. Taha, "Operations Research: An Introduction", 9thEdition, Pearson Publications; 2010.
2. J K Sharma, "Operations Research Theory &Applications, Macmillan India Ltd, 2007.
3. KantiSwarup, P. K. Gupta, Man Mohan, Operations Research, Sultan Chand & Sons Publications, 2019.

Reference Books:

1. P. SankaraIyer, "Operations Research", Tata McGraw Hill, 2008.
2. P. K. Gupta and D. S. Hira, "Operations Research", S. Chand &Co., 2007.

Course Structure & Syllabus of B.Sc. (H) Mathematics
Applicable for Batch: 2020-23

Subject Code	MAT226	Subject Title	LAB BASED ON MATHEMATICAL SOFTWARE					
LTP	0 0 4	Credit	2	Subject Category	SEC	Year	2nd	Semester	III

Objectives: The objectives of this lab are

- To provide skills for designing flowcharts and writing MATLAB programs.
- To create simple programming scripts and functions.
- To solve basic and advanced numerical and symbolic mathematics problems.
- To visualize and present data.

Course Pre/Co- requisite (if any) :no restricted pre-requisite

Contents to be covered

1. Brief Introduction, Installation of MATLAB, History, Use of MATLAB, Key features.
2. Introduction to MATLAB Software and MATLAB window.
3. Data files and Data types: Character and string, Arrays and vectors, Column vectors, Row vectors.
4. Program for Arithmetic operations and equations, Matrix operations, and Trigonometric functions.
5. Working with script tools.
6. Writing program for Plotting and Graphics
7. Writing programs with logic and flow control and Writing functions.
8. Use of Control Flow and Conditional Control.
9. Writing user defined functions.
10. Programs for Symbolic Math.
11. Simulink Environment & Interface.

Course Outcomes

Upon successful completion of the course, the students will be able to:

1. represent mathematical objects as data structures.
2. translate mathematical methods to MATLAB code.
3. break a complex task up into smaller, simpler tasks.
4. tabulate results and represent data visually.

Text Books:

1. Rudra Pratap, Getting Started with MATLAB, Oxford University Press, 2010.

Course Structure & Syllabus of B.Sc. (H) Mathematics
Applicable for Batch: 2020-23

Subject Code	MAT216	Subject Title	PROBABILITY THEORY AND MATHEMATICAL STATISTICS						
LTP	3 1 4	Credit	6	Subject Category	CC	Year	2nd	Semester	IV

Course Objective:

The objectives of the course include the following points: To relate the common statistical behavior of real phenomenon with distribution theory. Recognition of the statistical distributions. Applications of the basic statistical laws in real life problems. Establishment and analysis of regression problems for descriptive data as well as for mathematical/statistical functions.

Course Pre/Co- requisite (if any) : Basic idea about the descriptive statistics and probability.

Detailed Syllabus

UNIT- I **[10]**

Descriptive statistics and probability: measures of central tendency, dispersion, skewness and kurtosis. Types of variables. Graphical representations in data analysis. Probability, Bayes theorem, random variables and probability functions.

UNIT-II **[9]**

Standard Discrete Probability Distributions: Binomial, Poisson, Geometric, Negative Binomial, Hyper-geometric distributions and their parameters. Applications of the discrete probability distributions.

UNIT –III **[10]**

Standard continuous probability distributions: Normal, Uniform, Exponential, Gamma distributions and their parameters, Applications of the continuous probability distributions.

UNIT- IV **[10]**

Regression Analysis: Scatter diagram, Covariance, Coefficient of correlation, Spearman's rank correlation coefficient and Regression coefficients, Two lines of regression X on Y and Y on X, Two variable linear model: Estimation, Testing and problems of predication, Predication of the estimated regression equation, applications of regression analysis in real life problems.

List of Practicals:

1. Draw histogram for equal/unequal width class interval, Stem and Leaf plot,Box plot frequency polygon, pie chart, bar graphs, line charts, Ogive.
2. Construct frequency table using recode (having equal and unequal interval) and visual binning.
3. Compute descriptive statistics for raw data and grouped data and interpret by computing coefficient of variation, skewness and kurtosis.
4. Use of count, compute, compute with if and rank feature.
5. Calculate correlation coefficient (Karl Pearson), Spearman's rank correlation coefficient, Multiple and Partial correlation coefficient.
6. Generation of random sample from Binomial, Poisson, Negative binomial, Uniform, Exponential, Normal, Gamma and distributions Stem and Leaf plots and Box Plots for these random Samples.
7. Compute $F(x) = P(X \leq x)$ for random sample of observations drawn from theoretical distributions.
8. Computation of marginal probability functions and conditional probability.
9. Fitting of two lines of regression and their plot.
10. Estimation using regression lines.

Learning Outcome

1. Students shall have good knowledge of statistical distributions and their real life applications.
2. The course results a better understanding of the bivariate data and its graphical as well as numerical interpretations.
3. The outcome of this course includes to differentiate between the mathematical models and the probabilistic models and, hence, the regression models.
4. Students shall able to perform the regression analysis and prediction of the data points based on regression model.

Text books:

1. S.C. Gupta, V.K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, 2016.
2. V. K. Rohatgi, "Introduction to Probability Theory and Mathematical Statistics", Wiley Eastern, Latest Edition.

Reference books:

1. A.M. Goon, M.K. Gupta, and B. Dasgupta, "An Outline of Statistical Theory", 4th Edition, World Press, Kolkata, 2003.
2. R.V. Hogg, and E.A. Tanis, "A Brief Course in Mathematical Statistics", Pearson Education, 2009.
3. Sheldon Ross, "Introduction to Probability Models", 9th Edition, Academic Press, Indian Reprint, 2007.

Course Structure & Syllabus of B.Sc. (H) Mathematics
Applicable for Batch: 2020-23

Subject Code	MAT217	Subject Title	REAL ANALYSIS-II						
LTP	3 1 0	Credit	4	Subject Category	CC	Year	2nd	Semester	IV

Objective: The course will develop a deeper and more rigorous understanding of Calculus including defining terms and proving theorems about functions, sequences, series, limits, continuity, derivatives, the Riemann integrals, and sequences of functions. The course will develop specialized techniques in problem solving.

Unit – I: Riemann Integration **[11]**

Definition and existence of Riemann integral, Inequalities for Riemann integrals, Refinement of partitions, Darboux's theorem (without proof), The Riemann integral as a limit of sums (Riemann Sums), Integrabililty of continuous and monotonic functions, The Fundamental theorem of integral calculus. Mean value theorems of integral calculus.

Unit – II: Improper Integral **[10]**

Beta functions, Properties of Beta functions, Gamma functions, Properties of Gamma functions, Relation between Beta and Gamma function, Transformations of Beta and Gamma function, Duplication formula, Applications of Beta and Gamma function.

Unit – III: Convergence of Improper Integral **[9]**

Improper integrals and their convergence, Comparison tests, Abel's and Dirichlet's tests, Frullani's integral, Differentiation and integration under the sign of integration.

Unit – IV: Sequences and Series of Functions **[10]**

Sequences and series of functions, Pointwise and uniform convergence, Cauchy criterion for uniform convergence, Uniform convergence and continuity, Uniform convergence and differentiation, Weierstrass approximation theorem.

Outcome: After completion of the course the students will be able to

- prove a basic set theoretic statement
- define the limit of a function at a value, a limit of a sequence, and the Cauchy criterion
- prove a theorem about limits of sequences and functions
- state the Bolzano-Weierstrass theorem, Rolle's theorem, extreme value theorem, and the Mean Value theorem
- define Riemann integrable and Riemann sums and prove a theorem about Riemann sums and Riemann integrals

Text Books:

1. S.C. Malik and Savita Arora, "**Mathematical Analysis"**, 5th Edition, New Academic Science Ltd, 2017.

Reference Books:

1. R.G. Bartle and D.R. Sherbert, "Introduction to Real Analysis", 4th Edition, Wiley, 2014.
2. T.M. Apostol, "Mathematical Analysis**",** 2nd Edition, Narosa Publishing House, New Delhi, 2002.
3. Shanti Narayan and M. D. Raisinghania, "Elements of Real Analysis", S. Chand & Co., New Delhi, 2003.
4. H.L. Royden and P.M. Fitzpatrick, "Real Analysis", 4th Edition, Pearson, 2010.

Course Structure & Syllabus of B.Sc. (H) Mathematics
Applicable for Batch: 2020-23

Subject Code	MAT218	Subject Title	COMPLEX ANALYSIS						
LTP	3 1 0	**Credit**	4	**Subject Category**	CC	**Year**	2nd	**Semester**	IV

Objective: To develop in a rigorous and self-contained manner the elements of complex variables and to furnish an introduction to applications and residues and conformal mappings.

Unit I: Complex Functions **[7]**

Complex numbers, Algebra of complex numbers, Polar and exponential forms, Complex plane, Extended complex plane, Stereographic projection, Elementary complex functions (polynomials, power series, transcendental functions such as exponential, Trigonometric and hyperbolic functions, Multi-valued function and its branches, Logarithmic function, Inverse trigonometric and hyperbolic functions), Powers and roots

Unit II: Analytic Functions **[9]**

Function of complex variable, Limit, Continuity, Differentiability, Analytic functions, Necessary and sufficient condition for analyticity, Cauchy-Riemann equations, Harmonic function, Harmonic conjugate, Construction of analytic function- Milne-Thomson method

Unit III: Complex Integrals **[12]**

Contour (line) integrals and their properties, Simply and multiply connected domains, Cauchy's integral theorem, Cauchy-Goursat theorem, Extensions of Cauchy-Goursat theorem, Cauchy's Integral Formula, Cauchy's Integral Formula for derivatives, Cauchy's inequality, Liouville's theorem, Fundamental theorem of algebra, Maximum and minimum Modulus Principle, Schwarz lemma.

Unit IV: Series and Residues **[12]**

Power series, Integration and differentiation of power series, Taylor series, Laurent series, Zeros, and Singularities - classification of singularities as isolated and no-isolated, Removable singularities, Pole, Essential singularities, Behavior of function at infinity, Residues, Calculus of residues, Jordan's lemma, Definite integrals involving sine and cosine functions, Evaluation of improper integrals involving rational functions, involving sines and cosines.

Learning Outcome: Students will be able to:

- operate with complex numbers and complex functions.
- demonstrate knowledge of integration in the complex plane usingCauchy integral theorem and formula.
- Determine and use power series of complex functions.
- understand residues and their use in integration.

Text Books:

1. S.Ponnusamy, "Foundations of Complex Analysis", 2nd Edition, Narosa Publication, 2011.
2. Spiegel Murray, Lipchitz Seymour, Schiller John,"Schaum's Outline of Complex Variables", 2nd Edition, McGraw Hill Publication, 2009.

Reference books:

1. J. Brown and R. Churchill**, "**Complex Variables and Applications**"**, 9th Edition, McGraw Hill, 2013
2. D. G. Zill and D. P. Shanahan, "Complex analysis", 3rd Edition**,** Jones& Bartlett, 2015.

Course Structure & Syllabus of B.Sc. (H) Mathematics
Applicable for Batch: 2020-23

Subject Code	MAT227	Subject Title	LAB BASED ON PYTHON						
LTP	0 0 4	Credit	2	Subject Category	SEC	Year	2nd	Semester	IV

Objectives: The objectives of this lab are:

- to provide skills for writing PYTHON programs.
- to create simple programming scripts and functions.
- to solve basic and advanced numerical and symbolic mathematics problems.
- to visualize and present data.

Course Pre/Co- requisite (if any) :no restricted pre-requisite

Contents to be covered

1. Brief Introduction, Installation of PYTHON, Use of PYTHON, Key features.
2. Introduction to PYTHON Software and different editors.
3. Data files and Data types: Character and string, Arrays and vectors, Column vectors, Row vectors.
4. Program for Arithmetic operations on functions and equations, Factorizing and Expanding Expressions, Substituting Values, Solving Equations.
5. Writing program for Matrix operations, and Trigonometric functions.
6. Writing program for Plotting and Graphics.
7. Writing programs to solve mathematical problems by user defined functions.
8. Programs for Symbolic Math.
9. Introduction to Scientific Python and Numpy.

Course Outcomes

Upon successful completion of the course, the students will be able to

1. Translate mathematical methods to PYTHON code.
2. Break a complex task up into smaller, simpler tasks.
3. Use python software to solve mathematical problems.

Text Books:

1. Amit Saha. Doing Math with Python. William Pollock (2015).

Course Structure & Syllabus of B.Sc. (H) Mathematics
Applicable for Batch: 2020-23

Subject Code	MAT306	Subject Title	GROUP THEORY						
LTP	3 1 0	Credit	4	Subject Category	CC	Year	3rd	Semester	V

Course objectives: The main objective of the course is to study concepts of groups. The course also introduces the concepts of cosets, Normal subgroups, homomorphism and isomorphism.
Prerequisite course: None

UNIT I **[8]**
Binary relation, Function, Binary Operation; Groups, its examples and basic properties, Order of an element in a group, Subgroups, its examples and some basic properties, Centre of a group, Normaliser, Product of two subgroups, Cyclic groups, Generators, examples and related results.

UNIT II **[10]**
Cosets, Lagrange's theorem and its related results, Index of subgroup of a group, Euler's theorem, Fermat's theorem, Isomorphism and homomorphism of groups with examples and related results, Inner automorphism; Normal subgroups and simple Groups, their examples and related results.

UNIT III **[11]**
Quotient groups with examples, First, second and third isomorphism theorems and their related results, Internal and External direct product of groups and their related results, Characterization of a group as a direct product of its two subgroups.

UNIT IV **[11]**
Permutations, even and odd permutations, Order of a permutation, Transposition, Cycle and its length, Disjoint cycles and their examples, Permutation groups, Alternating groups and their related results, Signature of a permutation, Cayley's theorem, Cauchy's theorem for finite abelian groups.

Outcomes:
After completion of the course students will be able to:

- prove the basic structural properties of groups and subgroups.
- verify basic properties of subgroups and cosets.
- check the validity of some group-theoretic statements, including isomorphicgroups, normal subgroups, and simple groups.
- explore the groups of permutations and the alternating groups.
- check whether a given subgroup of a group is normal.

Text Books
1. Sen, Ghosh, Mukhopadhyay&Maity, "Topics in Abstract algebra", Fourth edition, University Press.
2. I.N. Herstein, "Topics in Algebra", Second edition, Wiley.

Reference Books
1. Joseph Gallian, "Contemporary Abstract Algebra", Eighth edition, Cengage Leraning.

Course Structure & Syllabus of B.Sc. (H) Mathematics
Applicable for Batch: 2020-23

Subject Code	MAT307	Subject Title	INTEGRAL TRANSFORM						
LTP	3 1 0	Credit	4	Subject Category	CC	Year	3rd	Semester	V

Course Objective:

The objectives of the course is to provide different tools to deal with differential equations.

Course Pre/Co- requisite (if any) : Basic idea about the Integral calculus.

Unit – I:Laplace Transforms **[12]**

Existence theorem for Laplace transforms, Linearity of the Laplace transforms, Shifting theorems, Laplace transforms of derivatives and integrals, Differentiation and integration of Laplace transforms, Convolution theorem, Inverse Laplace transforms, Inverse Laplace transforms of derivatives and integrals.

Unit- II: Fourier transforms **[9]**

Linearity property, Shifting, Modulation, Convolution Theorem, Fourier Transform of Derivatives, Relations between Fourier transform and Laplace transform, Parseval's identity for Fourier transforms, solution of differential Equations using Fourier Transforms.

UNIT-III: Z-Transform **[9]**

Z–transform and inverse Z-transform of elementary functions, shifting theorems, Convolution theorem, Initial and final value theorem, Application of Z-transforms to solve difference equations.

UNIT- IV: Applications of Transforms **[10]**

Solution of initial value problems using Laplace transform, solution of heat and wave equations using Fourier transform, solution of difference equations using Z-transform.

Learning Outcome: Students will be able to:

- determine Laplace transform of functions.
- determine Fourier and Z-Transforms for various functions.
- use properties of Fourier and Z-Transforms to solve physical problems.
- applications of transforms to solve physical problems.

Text Books:

1. E. Kreyszig, "Advanced Engineering Mathematics**"**, 10thEdition, John & Wiley Sons, U.K., 2016.

Reference Books:

1. Ian N. Sneddon, "Fourier Transforms", Dover Publications,2010.
2. Ronald N. Bracewell,"The Fourier Transforms and its Applications", 3rd Edition, McGraw Hill Science,1999.
3. R. K. Jain, & S. R. K.Iyenger,"Advanced Engineering Mathematics", 4thEdition, NarosaPublishing House, New Delhi, India, 2014.

Course Structure & Syllabus of B.Sc. (H) Mathematics
Applicable for Batch: 2020-23

Subject Code	MAT308	Subject Title	DYNNAMICS & STATICS						
LTP	3 1 0	Credit	4	Subject Category	CC	Year	3rd	Semester	V

Course Objective: The objectives of this course is to learn the concepts of Newton's law of motion, Kepler's law of motion, Central orbits, resolution of forces and friction to understand the kinematic of body and their equilibrium points.

Course Pre/Co- requisite (if any) : Newton's law of motion, Basic knowledge of calculus.

Unit –I **[9]**

Motion in a straight line: Velocity and acceleration, Newton's law of motion, Deduction from Newton's laws of motion, Motion in a straight line with constant acceleration, Simple harmonic motion, Motion under inverse square law.

Unit – II **[10]**

Work, Energy, Principle of energy,Impulse, Conservation of linear momentum, Central Orbits(pr) equation, Apses, Time in an orbit, Kepler laws of planetary motion.

Unit –III **[11]**

Composition and resolution of forces, Parallel forces,Equation of the line of action of resultants, General conditions of equilibrium, Equilibrium of rigid body under the action of three forces, Definition of catenary and common catenary, Intrinsic and Cartesian equations of common catenary, Properties of common catenary, Sag of tightly stretched wire.

Unit - IV **[10]**

Elementary concepts on Center of mass and center of gravity and distinction between them, Centers of gravity of some common bodies, Center of gravity by integration, Center of gravity of: an arc, a plane area, solid of revolution, surface of revolution, Sum or difference of two bodies.

Course Outcome: students will be able to:

- understand the forces applied on a particle and work done by particle.
- learn projectile motion, angular velocity.
- familiar about Kepler's law of motion and central orbits.
- resolve the forces on a body, moments and couple of forces.
- calculate friction between the surfaces and central gravity.

Text Books:

1. B. Johnston, Mazurek, Cornwell, Sanghi, "Vector Mechanics for Engineers: Statics & Dynamics", McGraw Hill Education, 10th edition, 2017.
2. A.S. Ramsey,"Dynamics Part-1&2", CBS Publisher & Distributors, 2002.
3. M. Ray & G. C. Sharma, "A text book on Dynamics", S. Chand Publications, 13th edition, 2005.

Reference Books:

1. S.L. Loney,"An Elementary Treatise on the Dynamics of a Particle and a Rigid Bodies", Cambridge University Press, 1956.
2. R.S. Verma,"A Text Book on Statics", Pothishala Pvt. Ltd., 1962.
3. S.L. Loney, "An elementary treatise on Statics", Cambridge University Press, 1912.

Course Structure & Syllabus of B.Sc. (H) Mathematics
Applicable for Batch: 2020-23

Subject Code	MAT309	Subject Title	GRAPH THEORY						
LTP	3 1 0	Credit	4	Subject Category	CC	Year	3rd	Semester	V

Course Objective: The objectives of this course is to learn the concepts of Discrete Mathematics and by applying the algorithms and to solve the problems related to Recursion, combinatorial mathematics and problems on basic graph theory.

Course Pre/Co- requisite (if any) : no restricted pre-requisite

Detailed Syllabus:

Unit-I:Introduction [10]

Preliminaries: Graphs (Walks, paths, circuit, connected graphs), Isomorphism, Subgraphs, Degree, operation on graphs, Bipartite graph, Regular graph, Homeomorphic graph, Euler graph, Hamiltonian paths and circuits and their properties.

Unit-II: Trees&Cutsets [12]

Trees: Properties of trees, spanning tree, Fundamental circuit, Spanning tree in a weighted graph, Prim's algorithm, Kruskalalgorithm.for minimum spanning tree.

Cut set, Cut vertex, properties of cutset, All cutsets in a graph , connectivity and seperability, Network flow,1 isomorphism, 2 isomorphism.

Unit-III: PLANAR AND DUAL GRAPHS & MATRIX REPRENTATION [9]

Combinational and geometric graphs, Planar graph, Kuratowski's two graphs, Detection of planarity, Geometric and Combinatorial dual.

Incidence matrix, Circuit matrix, Cutset matrix , Relationship among A_f , B_f and C_f .

Unit-IV: COLORING, COVERING AND PARTITIONING [9]

Chromatic Number, Chromatic Partitioning, Chromatic Polynomial, Matchings, Coverings,

The four color problem.

Learning Outcome: After successful completion of the course the student is expected to:

- to know the basic definitions and concepts of Graph theory.
- able to formulate problems in graph theoretic terms.
- understand various versions of connectedness of a graph,
- be able to formulate applied problems as coloring problems,
- understand and be able to use different models of random graphs and (random networks).

Text Books:

1. J. A. Bondy and U.S.R. Murty, "Graph Theory with Applications", Springer, 2008.
2. D. B. West, "Introduction to Graph Theory", Prentice-Hall of India/Pearson, 2009.
3. Narsingh Deo, "GraphTheory with application to Engineering and Computer Science".Prentice Hall of India, 2003.

Reference Books:

1. R. Diestel, "Graph Theory", Springer, 2000.
2. Clark J. and Holton D. A "A First Look at Graph Theory". Allied Publication, 1995.

Course Structure & Syllabus of B.Sc. (H) Mathematics
Applicable for Batch: 2020-23

Subject Code	MAT337	Subject Title	TECHNICAL WRITING WITH LATEX - I						
LTP	0 0 4	Credit	2	Subject Category	DSE	Year	3rd	Semester	V

Objectives: The objectives of this lab are to

- instal and basic handling of the software.
- teach the basics of LaTeX.
- introduce advanced techniques for writing mathematics.
- introduce advanced techniques for editing and formatting documents, preparing large documents such as
- use of LaTeX in daily academic and official work.

Course Pre/Co- requisite (if any) :no restricted pre-requisite
Contents to be covered

1. Installation of LaTex and editors.
2. Introduction of LaTex and different editors.
3. Basic and advanced document typesetting.
4. Mathematical equation typing and editing.
5. Inclusion of figures and tables.
6. Preparation of bibliography.
7. Typesetting of Journal articles, Technical reports, Thesis, Books.
8. Slide preparation using Beamer.

Course Outcomes

After successful completion of the workshop, participants will be able to :

1. execute typesetting of journal articles, technical reports, thesis, books, and slide presentations.
2. control over large documents containing sectioning, cross-references, tables and figures.
3. typesetting of complex mathematical formulae.
4. advanced typesetting of mathematics with AMS-LaTeX.
5. automatic generation of table of contents, bibliographies and indexes.

Text Books:

1. LaslieLamport,LaTeX: A Document Preparation System (2nd Edition), 1994

Reference Books:

1. George Gratzer, Practical LaTeX, Springer, 2014.

Course Structure & Syllabus of B.Sc. (H) Mathematics
Applicable for Batch: 2020-23

Subject Code	MAT356	Subject Title	MATHEMATICAL MODELLING						
LTP	3 1 0	Credit	4	Subject Category	DSE	Year	3rd	Semester	V

OBJECTIVE: To understand the process of developing a mathematical model which explain a system and to study the effects of different components, and to make predictions about behavior.

Unit-I: Introduction **[11]**

Models, Reality, Properties of models, Model classification and characterization, Steps in building mathematical models, Sources of errors, Dimensional analysis.
Modeling using Proportionality, Modeling using geometric similarity, Graphs of a functions as models
Model Fitting – Fitting models to data graphically, Analytic methods of model fitting, Applying the least square criterion,
Experimental Modeling – High order polynomial models, Cubic Spline models.

Unit-II: Discrete Probabilistic and Optimization Modeling **[10]**

Discrete Probabilistic Modeling –Probabilistic modeling with discrete system, Modeling components & System Reliability, Linear regression
Discrete Optimization Modeling – Linear Programming – Geometric solutions, Algebraic solutions, Simplex method and sensitivity analysis.

Unit-III: Modeling with a Differential Equations **[9]**

Population growth, Graphical solutions of autonomous differential equations, Numerical approximation methods-- Euler's method and R.K. method.

Unit-IV: Modeling with systems of Differential Equations **[10]**

Predator Prey model, Epidemic models, Euler's method for systems of differential equations.

Learning Outcome: Students will able to

- understand the basic components ofMathematical modeling.
- use modeling in the natural sciences (such as physics, biology, earth science, meteorology) and engineering
- construct differential equation describing physical problems by constructing a model for it.
- analyze various discrete probabilistic models.

Text Books:

1. J. N.Kapur, "Mathematical Modeling", New Age International, New Delhi, 2015.
2. Frank R. Giordano, Mawrice D Weir, William P. Fox, A first course in Mathematical Modeling, latest edition.

Reference Books:

1. Thomson Brooks/Cole,Vikas Publishing House (P) Ltd, 3rd ed3 2003
2. J.D. Murray, Mathematical Biology – I, Springer International Edition, 3rd ed2 2004.
3. J.N. Kapur, Mathematical Models in Biology and Medicine, East West Press, New Delhi, 1985.

Course Structure & Syllabus of B.Sc. (H) Mathematics
Applicable for Batch: 2020-23

Subject Code	MAT357	Subject Title	FINANCIAL MATHEMATICS						
LTP	3 1 0	Credit	4	Subject Category	DSE	Year	3rd	Semester	V

Objectives:
The students will learn about functions, limit, continuity and differentiability of functions and their applications. Definite and indefinite integrals with applications.

Unit I: Functions, Limit, Continuity **[7]**
Review of number system, Definition of function, Examples, limits at a point, limit theorems, infinite, limits/limits at infinity, continuity of a function at point.

Unit II: Differentiation, Tangent, Normal, Velocity, Acceleration **[10]**
Differentiation: the derivative and tangent, line concepts, differentiation rules, interpretation of the derivative in economics/business, the marginal concept, Differentiation of logarithm, exponential and trigonometric functions, Chain rule, implicit differentiation, Leibnitz rule for derivative, Taylor's series for one variable, Application problems (elasticity of demand, logarithmic differentiation, Newton's method).

Unit III: Extrema of functions and applications **[10]**
Applications of derivatives and curve sketching: monotonicity, extrema, extrema on a closed interval, applications in economics, concavity, derivative tests, asymptotes, curve sketching.

Unit IV: Integration **[12]**
Integration: the indefinite integral, integration, with initial conditions, applications in economics, elementary techniques of integration, substitution, manipulations, integration by parts, applications in economics, Definite integral, fundamental theorem of calculus, area beneath and between curves, Applications in economics (Consumers and producers), Monte-Carlo integration and Simulation.

Learning Outcome: Student will be able to:

- Understand the concept of limit, continuity and differentiability.
- Learn the use of differential calculus in business mathematics.
- Sketch the graph and its applications in economics.
- Learn the use of integral calculus in business mathematics.

Text Books:

1. AK Gupta & T.Varga, "Introduction to Actuarial Mathematics", Kluwer Academic Publishers, London .
2. R. Sharma,"Mathematics", Dhanpat Rai Publications (P) Ltd.

Reference Book:
1. J.K. Sharma , "Business Mathematics", J.K. International Publishing House pvt. Ltd. New Delhi, 3rd edition 2016.

Course Structure & Syllabus of B.Sc. (H) Mathematics
Applicable for Batch: 2020-23

Subject Code	MAT358	Subject Title	STATISTICAL INFERENCE						
LTP	3 1 0	Credit	4	Subject Category	DSE	Year	3rd	Semester	VI

Objective: The course objective includes the concepts of estimation theory, statistical hypothesis testing and non-parametric test procedures. The objective is to provide a sufficient knowledge of statistical inference and their significance in real world.

Unit I: Theory of estimation **[9]**

Point estimation. Criterion of a good estimator: unbiasedness, consistency, sufficiency and efficiency. Interval estimation.

Unit II: Statistical Inference **[9]**

Simple, composite, null and alternative hypothesis, level of significance, Type I and Type II errors. Critical region and power of test, one tail and two tail test.

Unit III: Hypothesis Testing **[11]**

Test statistic, parameter and statistic, standard error, large sample test & small sample test. Tests of significance based on chi-square, t and F Statistics.

Unit IV: Non-Parametric Tests **[10]**

One sample and two sample sign test, Wald-Wolfowitz run test, run test for randomness, Median test and Wilcoxon-Mann-Whitney test. Applications of non-parametric tests.

Learning Outcome: The student will be able to

- proceed the tools of statistical inference in any statistical experiment.
- applyvarious inferential test procedures in case of small and large sample sizes.
- use the distribution-free tests and their identification with parametric test.

Text Books:

1. S.C. Gupta, "Fundamentals of Statistics, 7thEdition, Himalaya Publishing House, 2018.
2. V. K. Rohatgi, "Introduction to Probability Theory and Mathematical Statistics", Wiley Eastern, 1988.

Reference Books:

1. G. Casella and R.L. Berger, "Statistical Inference", 2nd Edition, Thomson Duxbury, 2002.
2. J.D. Gibbons and S. Chakraborty, "Non Parametric Statistical Inference", 4th Edition, Marcel Dekkar, CRC, 2003.
3. A.M. Goon, M.K. Gupta and B. Dasgupta, "An Outline of Statistical Theory" (Vol. I), 4th Edition, World Press, Kolkata, 2003.
4. S.C. Gupta, "Fundamentals of Statistics", 7th Edition, Himalaya Publishing House, 2018.

Course Structure & Syllabus of B.Sc. (H) Mathematics
Applicable for Batch: 2020-23

Subject Code	MAT359	Subject Title	Biostatistics						
LTP	3 1 0	Credit	4	Subject Category	DSE	Year	3rd	Semester	V

Course Objective:
The emphasis of course is on applications in solving problems of interest to biostatistics. The students are to be examined entirely on the basis of problems, seen and unseen.

Course Pre/Co- requisite (if any) : Basic idea about the statistical methods and bio-sciences.

Detailed Syllabus

UNIT- I **[10]**
Design of Experiments: Basic principles of design of experiments, one way and two way classifications, analysis of variance (ANOVA), selection of a design, Completely Randomized Design (CRD), Randomized Block Design (RBD) and Latin Square Design (LSD).

UNIT – II **[9]**
Stochastic Epidemic Models: Simple epidemic models, general epidemic model definition and concept (without derivation). Duration of an epidemic.

UNIT- III **[10]**
Statistical Genetics: Introduction, Concepts-Genotype, Phenotype, Dominance, Recessiveness, Linkage and Recombination, Coupling and Repulsion. Mendelian laws of Heredity, Random mating, Gametic Array relation between genotypic array and gametic array under random mating. Distribution of genotypes under random mating.

UNIT-IV **[10]**
Clinical Trials: Planning and design of clinical trials, Phase I, II and III trials. Blinding: Single, Double, Triple.

Learning Outcome

1. Descriptive Statistics and design of experiments.
2. Simple Stochastic epidemic model.
3. Basic concept of genetics.
4. Need of Clinical drug trials.

Text books:

1. Biswas, S. (2007). Applied Stochastic Processes: A Biostatistical and Population Oriented Approach, Reprinted 2nd Ed., New Central Book Agency.
2. Indrayan, A. (2008). Medical Biostatistics, 2nd Ed., Chapman and Hall/CRC.
3. S.C. Gupta, V.K. Kapoor, Fundamentals of Applied Statistics, Sultan Chand & Sons, 2014.

Reference books:

1. Elandt-Johnson R.C (1971). Probability model and Statistical Methods in Genetics, John Wiley & Sons.
2. Narayan P. (1999). Statistical Genetics, New Age International Pvt. Ltd.

Course Structure & Syllabus of B.Sc. (H) Mathematics
Applicable for Batch: 2020-23

Subject Code	MAT316	Subject Title	RING THEORY						
LTP	3 1 0	Credit	4	Subject Category	CC	Year	3rd	Semester	VI

Course objective: The main objectives of the present course are to introduce basics concepts of ring theory like rings, subrings, ideals, ring homomorphisms and their properties. The course also introduces the concepts of Polynomial rings, UFD, ED, PID.

Prerequisite course: None

UNIT –I **[11]**

Rings, Zero divisors, Integral domains, Division rings, Fields, Subrings and Ideals, Congruence modulo a subring relation in a ring, Simple ring, Algebra of ideals, Ideal generated by a subset, Nilpotent ideals, Nil ideals, Quotient rings, Prime and Maximal ideals.

UNIT-II **[10]**

Homomorphism in rings, Natural homomorphism, Kernel of a homomorphism, Fundamental theorem of homomorphism, First and second isomorphism theorems, Field of quotients, Embedding of rings, Ring of endomorphisms of an abelian group.

UNIT –III **[10]**

Prime and irreducible elements, H.C.F. and L.C.M. of two elements of a ring, Principal ideals domains, Euclidean domains, Unique factorization domains, Different relations between Principal ideal domains, Euclidean domains and Unique factorization domains.

UNIT –IV **[9]**

Polynomials rings, Algebraic and transcendental elements over a ring, Factorization in polynomial ring R[x], Division algorithm in R[x], where R is a commutative rings with identity, Properties of polynomial ring R[x] if R is a field or a U.F.D.

Outcomes: After the completion of the course, students will be able to

1. understand the standard computations of ring theory.
2. learn the elementary theorems and proof techniques of ring theory.
3. apply the theorems, proof techniques and standard computations of ring theory to solve problems.
4. apply factorization and ideal theory in the polynomial rings.
5. utilize the Polynomial rings, UFD, ED, PID to solve different related problems.

Text Books

1. Topics in Abstract algebra, Sen, Ghosh, Mukhopadhyay&Maity, Fourth edition, University Press.
2. Topics in Algebra, I.N. Herstein, Second edition, Wiley.

Reference Books

1. Contemporary Abstract Algebra, Joseph Gallian, Eighth edition, Cengage Leraning.

Course Structure & Syllabus of B.Sc. (H) Mathematics
Applicable for Batch: 2020-23

Subject Code	MAT317	Subject Title	SPECIAL FUNCCTIONS						
LTP	3 1 0	Credit	4	Subject Category	CC	Year	3rd	Semester	VI

Course Objective: The objectives of this course is to find the series solution of differential equations with variable coefficients.

Course Pre/Co- requisite (if any) :. no restricted pre-requisite

UNIT-I:Series Solution **[9]**

Power series solution of differential equations, Ordinary point, Solution about singular points, Frobenius method.

UNIT-II: Bessel Function **[11]**

Bessel's equation, Solution of Bessel's equation, Bessel's functions $J_n(x)$, Recurrence formulae, Equations reducible to Bessel's equation, Orthogonality of Bessel's Functions, Generating function for $J_n(x)$,

Unit – III: **Legendre function** **[11]**

Legendre's equation, Legendre's polynomial $P_n(x)$, General solution of Legendre's equation, Rodrigue's formula, Legendre polynomials, Generating function of Legendre's polynomial, Orthogonality of Legendre polynomials, Recurrence formulae for $P_n(x)$.

Unit – IV: ChebyshevPolyomials **[9]**

Chebyshev differential equation and its solution, Chebyshev polynomial of first kind $T_n(x)$ and second kind , Generating function, Recurrence relations, Orthogonality property of $T_n(x)$, Orthogonal series of Chebyshev polynomials.

Course Outcomes: Students will be able to:

- know the solution of second order differential equations with variable coefficients.
- find the solution of Legendre's differential equations and know about its properties.
- determine the solution of Bessel's differential equation.
- find the solution of Chebyshev differential equations and its properties.

Text Books:

1. W.W. Bell, "Special Functions for Scientist and Engineers", Dover Publication, New York, 1996.
2. M.D. Raisighania, Ordinary and partial differential Equations, S. Chand Publications,2016.

Reference Book:

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publications, 43rd edition.

Course Structure & Syllabus of B.Sc. (H) Mathematics
Applicable for Batch: 2020-23

Subject Code	MAT366	Subject Title	INTEGRAL EQUATIONS						
LTP	3 1 0	Credit	4	Subject Category	DSE	Year	3rd	Semester	VI

OBJECTIVE: To learn the techniques for solutions of certain integral equations and their applications. Conversion of boundary value problems into integral equations using Green's function.

Unit-I **[9]**

Definition of integral equation and their classification, Solution of an integral equation, Differentiation of a function under integral sign, Conversion of an ordinary differential equation into integral equation, Eigenvalues and Eigen functions.

Unit-II **[11]**

Iterated kernel, Resolvent kernel, Solution of Fredholm integral equation of second kind by successive approximation, Solution of Volterra integral equation of second kind by successive approximation, Iterative method, and Neumann series.

Unit-III **[10]**

Green's function and its application in Initial and Boundary Value Problems to integral equations, Conversion of IVP/BVP into integral equations.

Unit-IV **[10]**

Solution of integral equations using integral transform, Singular integral equation, Applications of integral equations to differential equations and Boundary Value Problem.

Learning Outcome: Students will be able to

- convert boundary value problems into integral equations using Green's function.
- solve different types of integral equations and their applications to various real life problems.
- solve Volterra integral equation of the second kind by successive approximations.
- convert a boundary Value Problem to Fredholm integral equation.

Text Books:

1. M. D. Raisinghania, "Integral equations and boundary value problems"6th revised Edition, S. Chand Publications. 2013

2. Shanti Swaroop, "Integral Equations"**,** 22ndEdition, Krishna Prakashan, 2014.

Reference Books:

1. R. P. Kanwal, "Linear Integral Equations: Theory and Techniques", 2ndEdition, Birkhäuser, 2013.

Course Structure & Syllabus of B.Sc. (H) Mathematics
Applicable for Batch: 2020-23

Subject Code	MAT367	Subject Title	TENSORS& DIFFERENTIAL GEOMETRY						
LTP	3 1 0	Credit	4	Subject Category	DSE	Year	3rd	Semester	VI

Course Objective : To introduce space curves and their intrinsic properties of a surface. Further the nonintrinsic properties of surface Tensor law of transformation and the differential geometry of surfaces are explored

Course Pre/Co requisite: Multivariable Calculus, Linear Algebra
Detail Syllabus:

Unit-I **[9]**

Curves in space, space curves, arc lengths, tangent plane lines, osculating plane, normal plane, unit vectors t, n, b, Serret- fernet formula, curvature and torsion of curves helix, osculating circle and osculation sphere.

Unit-II **[10]**

Parametric curves on surfaces. Direction coefficients. First and second Fundamental forms. Principal and Gaussian curvatures. Lines of curvature, Euler's theorem. Rodrigue's formula, Conjugate and Asymptotic lines, MainardiCodazzi Equations, Weingarten Equations.

Unit-III **[11]**

Envelopes and Developable surfaces, characteristics envelop, edge of regression, developable surface, envelops of a plane, Canonical geodesic equations. Nature of geodesics on a surface of revolution. Clairaut's theorem. Normal property of geodesics. Torsion of a geodesic. Geodesic curvature

Unit-IV **[10]**

Contra variant & Covariant Vectors & Tensors, Contraction, Tensor algebra, Associated Vectors and Tensors. Christoffel Symbols, Tensor law of transformation, Covariant derivative of Tensors. Riemann Christoffel Tensor.

Course outcomes: This course will enable the students to:

i) explain the basic concepts of tensors.
ii) understand role of tensors in differential geometry.
iii) learn various properties of curves including Frenet–Serret formulae and their applications.
iv) know the Interpretation of the curvature tensor, Geodesic curvature, Gauss and Weingarten formulae
v) apply problem-solving with differential geometry to diverse situations in physics, engineering and in other mathematical contexts.

Text Books:

1. Christian Bär, Elementary Differential Geometry, Cambridge University Press, 2010.
2. "Differential Geometry" by A. R. Vasistha and J. N. Sharma, KedarnathRamnath.
3. "Tensor Calculus" by G. C. Sharma and S.K. Singh Laxmi Narayan Publisher Agra.
4. "Differential Geometry" by P. P. Gupta and G. S. Malik, PragatiPrakashan.

Reference Books:

1. "Differential Geometry" by A.B. Chandra Moule and J. B. Chauhan, SikshaSahityaPrakashan.
2. "Differential Geometry" by S. C. Mittal and D. C. Agarwal, Krishna Pracashan.
4. "Differential Geometry" by T. J. Willmore Oxford University Press, New Delhi.
5. A. Thorpe, Elementary Topics in Differential Geometry, Springer, India, 2004.

Course Structure & Syllabus of B.Sc. (H) Mathematics
Applicable for Batch: 2020-23

Subject Code	MAT368	Subject Title	NUMBER THEORY & CRYPTOGRAPHY						
LTP	3 1 0	Credit	4	Subject Category	DSE	Year	3rd	Semester	VI

Objective: To introduce the students with some basic concepts of number theory and cryptography.
Outline: The course contains some basic theorems of number theory; e.g. Euclid's Euler- Fermat's theorem, Chinese remainder theorem. It also connects the concepts of number theory with cryptography.

Unit-I **[11]**

Divisibility in integers, Division Algorithm in integers, Well ordering property in the set of positive integers, Greatest common divisor and least common multiple and algorithms to find them. Primes, Fundamental Theorem of Arithmetic, Euclid's theorem, Congruences, Euler's phi function, Euler-Fermat theorem, Linear congruence equations, Chinese Remainder theorem.

Unit-II **[10]**

Quadratic Residues, Legendre symbols, Gauss' lemma, Quadratic Reciprocity Law and applications, Jacobi symbol, Tests of primality. Multiplicative functions, Functions τ, σ, and μ and their multiplicativity, Diophantine equations.

Unit-III **[9]**

Review of finite fields, Divisibility and Euclidean algorithm, congruences, Gauss Algorithm for computing primitive elements, Primitive root theorem and algorithm to find primitive elements in case it exists. Power residues, Algorithm to determine irreducible polynomials of degree n over Zp.

Unit-IV **[10]**

Cryptosystems (definition illustrations and classical examples), the idea of public key cryptography, RSA Public Cryptosystems, RSA key generation and algorithm, the RSA conjecture, Attack on RSA crypto systems, El Gamal Public Key Cryptosystems and algorithm, Digital signature algorithm (DSA).

Outcome:

After completion of the course students will be able to

- comprehend the properties of integers and prime numbers
- apply the concept of congruence relation to some real life problems
- apply the Chinese remainder theorem to solve the system of linear congruence
- apply Euclidean algorithm to prove some basic results
- apply the concept of number theory to the field of cryptography

Text Books

1. Elementary Number Theory, 2nd edition Gareth A. Jones and Josephine M. Jones, Springer.

2. Elementary Number Theory, 7th edition, David Burton, McGraw Hill Education.

Course Structure & Syllabus of B.Sc. (H) Mathematics
Applicable for Batch: 2020-23

Subject Code	MAT369	Subject Title	Fuzzy Sets and Fuzzy Logic						
LTP	3 10	Credit	4	Subject Category	DSE	Year	3rd	Semester	VI

Course Objective: To introduce the fundamentals of fuzzy sets, to discuss theoretical differences between fuzzy sets and classical sets. The course is designed to give a solid grounding of fundamental concepts of fuzzy logic and its applications. The level of the course is chosen to be such that all students aspiring to be a part of computational intelligence directly or indirectly in near future should get a foundation of these concepts through this course.

Course Pre/Co- requisite (if any): Basic knowledge about set theory and its operations.

Unit- I **[12]**

Background of Fuzzy set theory, Uncertainty and Imprecision, Statistics and Random Processes, Fuzzy sets – Basic definitions, level sets, convex fuzzy sets, Basic operations on fuzzy sets, Types of fuzzy sets, Cartesian products, Algebraic products bounded sum and difference, Extension principle and application, Zadeh extension principle, image and inverse image of fuzzy sets.

Unit- II **[10]**

Fuzzy numbers, Elements of fuzzy arithmetic, Fuzzy relations on fuzzy sets, The union and intersection of fuzzy relation, Composition of fuzzy relations, Min-max composition and its properties, Fuzzy equivalence relation.

Unit- III **[9]**

Fuzzy decision making, Fuzzy linear programming problem, Symmetric fuzzy linear programming problem, Fuzzy linear programming with crisp objective function, Fuzzy graph.

Unit- IV **[9]**

Fuzzy logic: An overview of classic logic, its connectives, Tautologies, Contradiction fuzzy logic, Fuzzy quantities, Logical connectives for fuzzy logic, Applications to control theory.

Learning Outcome: Students will be able to:

- interpret fuzzy set theory and uncertainty concepts.
- identify the similarities and differences between probability theory and fuzzy set theory and their application conditions.
- apply fuzzy set theory in modeling and analyzing uncertainty in a decision problem.
- apply fuzzy control by examining simple control problem examples.

Text Books:

1. Didier Dubois, Henri M. Prade, “Fuzzy Sets and Systems: Theory and Applications”, Academic Press, 1994.
2. H. J. Zimmermann, Fuzzy set theory and its applications, Allied publishers Ltd., New Delhi, 2001.

Reference Books:

1. G. J. Klir& B. Yuan, “Fuzzy sets and Fuzzy logic; Theory and Applications”, Prentice Hall of India 1995.
2. Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, Wiley India Pvt. Ltd., 2009.
3. Kwang H. Lee, “First Course on Fuzzy Theory and Applications”, Springer-Verlag Berlin Heidelberg 2005

Course Structure & Syllabus of B.Sc. (H) Mathematics
Applicable for Batch: 2020-23

Subject Code	MAT376	Subject Title	METRIC SPACES						
LTP	3 1 0	Credit	4	Subject Category	DSE	Year	3rd	Semester	VI

OBJECTIVE: The main objective of the course is to study the concept of distance on abstract spaces. This also provides the concept of convergence, compactness and connectedness.

UNIT I: Basic concepts **[11]**

Metric Spaces: Definition and examples, Neighborhood, Open set, Interior of a set, Limit point of a set, Closed sets, Diameter of a set, Dense sets, Nowhere dense sets, Separable spaces, Continuous functions, Uniform continuity.

UNIT II: Complete metric spaces **[10]**

Sequences in metric spaces, Convergence of a sequence, Cauchy sequences, Complete metric spaces, completion of a metric spaces, Baire category theorem, Banach contraction theorem.

Unit III: Compact metric spaces **[10]**

Compact spaces and their properties, Characterization of compact metric spaces, Sequentially compact metric spaces, Continuous functions on compact metric spaces.

UNIT IV: Connected metric spaces **[9]**

Separated sets, Connected metric spaces, Path connected spaces, Continuous functions on connected spaces, Components.

Learning Outcome: Students will be able to understand

- the concept of distance on a given abstract space.
- the idea of completeness, compactness and connectedness in a metric space.
- Banach contraction theorem and applications.

Text Books:

1. Q. H. Ansari "Metric Spaces", 1st Edition, Narosa Publishing House, 2010.
2. P. K. Jain and K. Ahmad, "Metric Spaces" 2nd Edition, Narosa Publishing House, 2004

Reference Books:

1. S. Kumaresan "Topology of Metric Space", 2nd Edition, Narosa Publishing House, 2011.