Course Structure& Syllabus of B.Sc. (Hons.) – Mathematics
Applicable for Batch: 2019-22

DIT UNIVERSITY
Dehradun

Detailed Course Structure& Syllabus
of
B.Sc. (Hons.) – MATHEMATICS

Amended by the BoS and approved by the Academic Council at its 11th Meeting held on 29.04.2019

Course Structure& Syllabus of B.Sc. (Hons.) – Mathematics

Applicable for Batch: 2019-22

Year: 1st **Semester: I**

Course Category	Course Code	Course Title	L	T	P	Credit
GEC	PY107	Mechanics	3	1	4	6
CC	MA106	Matrices &Linear Algebra	3	1	0	4
CC	MA107	Calculus I	3	1	0	4
SEC	CA102	Programming in C	3	0	2	4
AEC	HS101	Professional Communication	2	1	1	3.5
		Total				**21.5**

Year: 1st **Semester: II**

Course Category	Course Code	Course Title	L	T	P	Credit
CC	MA-108	Calculus II	3	1	0	4
CC	MA-109	Solid Geometry	3	1	0	4
SEC	CA-118	Computer Organization	3	1	0	4
CC	MA-116	Ordinary Differential Equations and Laplace Transforms	3	1	0	4
SEC	HS-102	Corporate Communication & Soft Skills	2	1	1	3.5
		Total				**19.5**

Course Structure& Syllabus of B.Sc. (Hons.) – Mathematics
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Year: 2nd **Semester: III**

Course Category	Course Code	Course Title	L	T	P	Credit
CC	MA -206	Computer Based Numerical and Statistical Techniques	3	0	2	4
CC	MA -207	Real Analysis	3	1	0	4
CC	MA-208	Partial Differential Equations	3	1	0	4
CC	MA-209	Introduction to Statistical Methods	3	1	0	4
CC	MA-219	Linear Programing	3	1	0	4
Total						**20**

Year: 2nd **Semester: IV**

Course Category	Course Code	Course Title	L	T	P	Credit
CC	MA-216	Probability Distributions & Regression Analysis	3	1	0	4
CC	MA-217	Introduction to Abstract Algebra &Number Theory	3	1	0	4
CC	MA-218	Complex Analysis	3	1	0	4
GEC	CH-201	Environmental Science	3	0	0	3
GEC	CA-112	Data Structure	3	0	2	4
Total						**19**

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Year: 3rd **Semester: V**

Course Category	Course Code	Course Title	L	T	P	Credit
CC	MA-306	Mathematical Modeling	3	1	0	4
CC	MA-307	Differential Geometry	3	1	0	4
CC	MA-308	Mathematical Methods	3	1	0	4
CC	MA-309	Discrete Mathematics	3	1	0	4
PRJT	MA311	Project-I	0	0	0	8
Total						**24**

Year: 3rd **Semester: VI**

Course Category	Course Code	Course Title	L	T	P	Credit
CC	MA-316	Integral Equations	3	1	0	4
CC	MA-317	Graph Theory	3	1	0	4
DSE		Elective – 1	3	1	0	4
DSE		Elective – 2	3	0	2	4
PRJT	MA-312	Major Project	0	0	0	8
Total						**24**

Elective-1	**L-T-P**
MA346- Metric Spaces	3 1 0
MA347-Special Theory of Relativity	3 1 0
MA348-Statistical Inference	3 1 0

Elective-2	**L-T-P**
CS342- Linux Administration & Shell Programming	3 0 2
CS203-Computer Networks	3 0 2
CS345-Web Technology	3 0 2

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Summary of the Credit

Year	Semester	Credit
1	1	21.5
	2	19.5
2	3	20
	4	19
3	5	24
	6	24
Total		**128**

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Applicable for Batch: 2019-22

Subject Code	PY107	Subject Title	MECHANICS						
LTP	3 1 4	Credit	6	Subject Category	UC	Year	1st	Semester	I

Course Outline:

This course starts with the basic concepts of work, energy and collisions between particles. The course then covers the angular motion of bodies and moment of inertia, elasticity, fluid motion, laws of gravitation and special theory of relativity.

Course Objective:

The aim of this course is to introduce students to both elementary classical mechanics and the basic ideas of Special Relativity

Course Pre/Co- requisite (if any) : Basic knowledge of vectors

Detailed Syllabus

UNIT 1: Work, Energy and Collisions

Work and Kinetic Energy Theorem.Conservative and nonconservative forces.Potential Energy.Energy diagram.Stable and unstable equilibrium.Elastic potential energy. Force as gradient of potential energy. Work & Potential energy.Work done by non-conservative forces.Law of conservation of Energy.Elastic and inelastic collisions between particles.

UNIT 2: Rotational Dynamics

Angular momentum of a particle and system of particles.Torque.Principle of conservation of angular momentum.Rotation about a fixed axis.Moment of Inertia.Calculation of moment of inertia for rectangular, cylindrical and spherical bodies.Kinetic energy of rotation. Motion involving both translation and rotation

Elasticity: Relation between Elastic constants. Twisting torque on a Cylinder or Wire.

Fluid Motion: Kinematics of Moving Fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube

UNIT 3: Gravitation and Central Force Motion

Law of gravitation.Gravitational potential energy.Inertial and gravitational mass.Potential and field due to spherical shell and solid sphere.

Motion of a particle under a central force field.Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler's Laws.Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness.Basic idea of global positioning system (GPS).Physiological effects on astronauts.

UNIT 4: Non-Inertial Systems

Non-inertial frames and fictitious forces.Uniformly rotating frame.Laws of Physics in rotating coordinate systems.Centrifugal force.Coriolis force and its applications. Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems

UNIT 5: Special Theory of Relativity

Postulates of Special Theory of Relativity.Lorentz Transformations.Simultaneity and order of events.Lorentz contraction.Time dilation.Relativistic transformation of velocity, frequency and wave number.Relativistic addition of velocities.Variation of mass with velocity.Massless Particles.Mass-energy Equivalence.Transformation of Energy and Momentum.

Learning Outcome

Having successfully completed this course the student will be able to:

1. To know Newton's laws of motion, potentials, conservation of energy, momentum and angular momentum, and be able to apply them to projectiles, circular motion, and gravity
2. Demonstrate rigid body and rotational dynamics using the concept of angular velocity and momentum.
3. Demonstrate an understanding of intermediate mechanics topics such as co-ordinate transformations, oscillatory motion, gravitation etc.
4. Understand the concept of non-inertial frames of reference, coriolis and centripetal accelerations and their applications

5. Understand the postulates of Special Relativity and their consequences in terms of Time dilation and length contraction, Lorentz transformations, relativistic kinematics and the relation between mass and energy

Text book [TB]:

1. Mechanics – D.S. Mathur, S. Chand & Co., 2012.
2. Introduction to Mechanics – D. Kleppner& R. Kolenkow, Cambridge University Press, 2017
3. Berkeley Physics, Mechanics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
4. Arthur Beiser, Concepts of Modern Physics, Sixth Edition, Tata McGraw-Hill.

Reference books [RB]:

1. G.R. Fowles and G.L. Cassiday, Analytical Mechanics,. 2005, Cengage Learning.
2. R. Resnick, Introduction to Special Relativity, 2005, John Wiley and Sons.
3. F.W Sears, M.W Zemansky, H.D Young, University Physics. 13/e, 1986, Addison Wesley.
4. M.R. Spiegel, Theoretical Mechanics, 2006, Tata McGraw Hill.

Course Structure& Syllabus of B.Sc. (Hons.) – Mathematics

Applicable for Batch: 2019-22

Subject Code	MA106	Subject Title	LINEAR ALGEBRA						
LTP	3 1 0	Credit	4	Subject Category	Dept. Core	Year	1st	Semester	I

OBJECTIVES: Students will learn about Algebraic 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.

UNIT I: Matrices

Review of matrix algebra and determinants, Inverse of square matrix, Matrix form of linear systems of equations, 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.

UNIT II: Vector Space

Review of algebraic properties of R, R^2 *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 III: Linear Transformations

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

UNIT IV: Diagonalization

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 V: Inner Product Spaces and Quadratic Forms

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-Jordon 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..

Course Structure& Syllabus of B.Sc. (Hons.) – Mathematics

Applicable for Batch: 2019-22

Subject Code	MA107	Subject Title	CALCULUS-I						
LTP	3 10	Credit	4	Subject Category	DC	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: Sequences and Series

Convergence of sequences, Subsequences, Bolzano-Weierstrass theorem, Monotone and bounded sequences, Cauchy criteria, Convergence of infinite series, Comparison test, D'Alembert's Ratio test, Cauchy's Root test, Condensation test and Cauchy's Integral tests, Alternating series, Leibnitz test Uniform convergence.

UNIT II: Continuity and Differentiability

Review of functions of single variable, Limit, continuity and differentiability, Properties of continuous functions, Exponential, Logarithmic and Hyperbolic functions, 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

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

UNIT IV: Integral Calculus

Review of indefinite and definite integrals, Fundamental theorem of integral calculus, a, Are Volume and surface of revolution, Arc lengths, Improper integral, Beta and Gamma functions, Double and triple integrals, Change of order of integration, Change of variables, Dirichlet integral, Application of multiple integrals.

Learning Outcome: Students will be able to

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

Reference Books:

1. 1. R. K. Jain, & S. R. K. Iyenger, "Advanced Engineering Mathematics", 4th Edition, Narosa Publishing House, New Delhi, India, 2014.
2. E. Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John & Wiley Sons, U.K., 2016.

Course Structure& Syllabus of B.Sc. (Hons.) – Mathematics

Applicable for Batch: 2019-22

Subject Code	CA102	Subject Title	PROGRAMMING IN C						
LTP	3 0 2	Credit	4	Subject Category	Univ. Core	Year	1st	Semester	I

Course Objective:
The objective of the course is to make the students to learn to make the computer programs using C language and explore various features of C.

Unit I

Problem analysis, Need for programmed languages, Introduction to algorithms, Algorithmic representations, Pseudo codes flow charts and decision tables, Structured programming and modular programming.

Unit II

Overview of C, Constant, Variables, Data, Types and size, Variable declaration, Operators and expressions, Type conversion, Conditional expression, Special operators, Precedence rules, Decision making, Looping and control structures, Data input/output, Input/output, Unformatted & formatted I/O function in C, Input functions viz. scanf(), getch(), getche(), getchar(), gets(), output functions viz. printf(), putch(), putchar(), puts().

Unit III

Arrays and String: Defining and processing an array, One dimensional arrays, Multidimensional arrays, Passing arrays to functions, Handling of character strings, Pointers: Declaration, Operations on pointers, Array of pointers, Pointers to arrays, Structure and Unions: Defining and processing a structure, User defined data types, Structure and pointers, Nested structure, Self-referential structures and unions.

Unit IV

Program structure: Storage classes, Automatic, External and static variables, Data files: Opening, Closing, Creating and processing and unformatted data field.

Unit V

File Management in C: Introduction to data files, Opening & closing a file, File types, fopen, fgets, fputs, fscanf, fprintf, fclose.

Learning Outcome: A student who successfully completes the course will have the ability to

- understand the basic terminology used in computer programming.
- write, compile and debug programs in C language.
- use different data types in a computer program.
- design programs involving decision structures, loops and functions.
- use different data structures and create/update basic data files.

Text Book:

1. E. Balaguruswamy, "Programming in ANSI C", 4th Edition, Tata McGraw-Hill, 2008.

2. Jeri R. Hanly and P. Elliot**, "**Problem Solving and Program Design in C**",** 7thEdition, Pearson, 2013.

Reference Books:

1. Dennis Ritchie, "The C programming Language", 6th Edition, Pearson, 2015.

2. Forouzan Ceilber, "Structured programming approach using C", 3rd Edition, Thomson learning publication, 2007.

3. Yashwant Kanetkar, "Pointers in C", 3rd Edition, BPB Publication, 2003.

List of practicals:

1. Program to find area and circumference of circle.
2. Program to find the simple interest.
3. Program to convert temperature from degree centigrade to Fahrenheit.
4. Program to calculate sum of 5 subjects & find percentage.
5. Program to show swap of two no's without using third variable.
6. Program to find that entered year is leap year or not.
7. Program to find whether given no is even or odd.
8. Program to find whether given no is a prime no or not.
9. Program to display sum of series 1+1/2+1/3+…….+1/n.
10. Program to add two number using pointer.
11. Program to show sum of 10 elements of array & show the average.
12. Program to find sum of two matrices.

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Applicable for Batch: 2019-22

Subject Code	HS101	Subject Title	PROFESSIONAL COMMUNICATION						
LTP	2 1 1	Credit	3.5	Subject Category	AEC	Year	1st	Semester	I

Course Objective:

- To develop the LSRW skills of students for effective communication
- To equip the students for business environment
- To prepare the students understand and present themselves effectively

Unit-I

Effective Communication7 L

Communication: Meaning, Types of Communication: General & Technical Communication

Barriers to Communication, Overcoming strategies.

Unit II

Effective Non Verbal Communication3 L

Knowledge and adoption of Non Verbal cues of communication: Kinesics, Proxemics, Chronemics, Oculesics, Haptics, Paralinguistics

Unit III

Effective Listening & Speaking Skills 7 L

Listening Comprehension: identifying General & Specific information, Note taking and drawing inferences

Introduction to Phonetics : Articulation of consonants and vowel sounds.

Public Speaking

Discussion Techniques

Unit IV

Reading Skills 4 L

Reading Strategies and Vocabulary Building

Reading Comprehension

Unit V

Effective Technical Writing Skills 9 L

Paragraph development

Technical Articles, Research Articles, Plagiarism

Intra office Correspondence: Notice, Agenda, Minutes and Memorandum,

Technical Proposal & Report

Learning Outcome:

At the end of this course, the student will be able to

CO 1 Communicate smoothly

CO 2 Write formal documents

CO 3 Present themselves effectively

TEXT BOOKS

1. Rizvi, Ashraf. Effective Technical Communication, McGraw Hill, New Delhi. 2005.
2. Raman, Meenakshi and Sangeeta Sharma,. Technical Communication: Principles and Practice, 2nd Edition. New Delhi: Oxford University Press. 2011.

REFERENCE BOOKS

1. Aslam, Mohammad. Introduction to English Phonetics and Phonology Cambridge.2003.
2. Ford A, Ruther. Basic Communication Skills; Pearson Education, New Delhi.2013.
3. Gupta, Ruby. Basic Technical Communication, Cambridge University Press, New Delhi.2012.

4. Kameswari, Y. Successful Career Soft Skills and Business English, BS Publications, Hyderabad.2010.
5. Tyagi, Kavita & Padma Misra. Basic Technical Communication, PHI, New Delhi. 2011.

LAB

Course Objective:

- To put the LSRW skills of students into practical use.
- To equip the students for business environment
- To prepare the students understand and present themselves effectively

Lab 1 Neutralization of Mother Tongue Influence through manner of articulation, Introductionto Speech Sounds – Practicing Vowel and Consonant sounds

Lab 2 Listening (Biographies through software)

Lab 3 Presentation of Biographies

Lab 4 Role Play on Situational Conversation

Lab 5 Role Play on Situational Conversation

Lab 6 Public Speaking

Lab 7 Public Speaking

Lab 8 Group Discussion

Lab 9 Group Discussion

Lab 10 Final evaluation based on Extempore

Lab 11 Final evaluation based on Extempore

Learning Outcome:

The student will be able to

- Communicate smoothly in appropriate situations
- Think creatively and express themselves fluently
- Present themselves effectively

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Tutorial

Course Objective:

- To put the LSRW skills of students into practical use.
- To equip the students for business environment
- To prepare the students understand and present themselves effectively

Tutorial 1 Body Language (Visual Presentation of Gestures, Postures, Facial Expression etc followed by an activity)

Tutorial 2 Listening (Audio Clip to be played and Listening comprehension assessed through Question Answers or Note - taking)

Tutorial 3 Pronunciation (common errors in spoken words)

Tutorial 4 Speaking (exercise grid in similar sounding words with different spellings)

Tutorial 5 Reading Comprehension

Tutorial 6 Vocabulary Building exercise, Use of Dictionary

Tutorial 7 Paragraph Writing/ Story Writing/Picture Composition

Tutorial 8 Notice, Agenda, Minutes of Meeting

Tutorial 9 Proposal Writing

Tutorial 10 Report Writing

Learning Outcome:

The student will be able to

- Communicate smoothly in appropriate situations
- Think creatively and express themselves fluently
- Present themselves effectively

Course Structure& Syllabus of B.Sc. (Hons.) – Mathematics
Applicable for Batch: 2019-22

Subject Code	MA108	Subject Title	CALCULUS-II						
LTP	3 1 0	Credit	4	Subject Category	DC	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

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

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

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 to evaluate area of plane region.

UNIT IV: Surface Integrals

Parametric representations of surfaces (cylinder, sphere and cone), Tangent plane and surface normal, Surface area and Surface integrals, Orientation of surfaces, Mobius strip, Application of Surface integral to find area of sphere & torus and to find mass & moment of inertia.

UNIT V: Relation of Vector Integrals with Double and Triple Integrals

Review of double and triple integration, 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, Evaluation of line integral by Stokes theorem, Stokes theorem applied to path independence, Work done in displacement around a closed curve.

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 Khaleq Hazra, "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. (Hons.) – Mathematics

Applicable for Batch: 2019-22

Subject Code	MA109	Subject Title	SOLID GEOMETRY						
LTP	3 1 0	Credit	4	Subject Category	DC	Year	1st	Semester	II

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

Unit I. Three dimensional geometry

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.

Unit II: Planes

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

Vector form of Sphere, Distance of point from sphere, Equation of tangent and normal to the sphere.

Unit IV: Conicoids

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.

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”, Narosa Publishing House, New Delhi.

Course Structure& Syllabus of B.Sc. (Hons.) – Mathematics

Applicable for Batch: 2019-22

Subject Code	CA118	Subject Title	COMPUTER ORGANIZATION						
LTP	31 0	Credit	4	Subject Category	AEC	Year	1st	Semester	II

Course Objective:

This course will introduce students to the fundamental concepts underlying modern computer organization and architecture. Main objective of the course is to familiarize students about hardware design including logic design

Detailed Syllabus

UNIT 1

Register Transfer and Micro Operations: Register Transfer Language, Register Transfer, Bus and Memory Transfer, Arithmetic Micro Operations, Logic Micro Operations, Shift Micro Operations

UNIT 2

Basic Computer Organization and Design: Instruction Codes, Computer Registers, Computer Instruction, Timing and Control, Instruction Cycle, Memory Reference Instruction, Input-Output Interrupt, Design of Basic Computer, Design of Accumulator Logic

UNIT 3

Central Processing Unit: Introduction, General Register Organization, Stack Organization, Instruction Format, Addressing Modes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer.

UNIT 4

Computer Arithmetic: Introduction, Addition and Subtraction, Multiplication Algorithms, Division Algorithm, Floating-Point Arithmetic Operation, Decimal Arithmetic Unit.

UNIT 5

Input-Output and Memory Organization: Peripheral Devices, Input-Output Interface, AsynchronousData Transfer, Modes of Transfer, Direct Memory Access, Input-Output Processor, Memory Hierarchy, Associative Memory, Cache Memory, VirtualMemory

Learning Outcome

By the end of this course, students should be able to:

- understand the basics of computer hardware and how software interacts with computer hardware
- analyze and evaluate computer performance
- understand how computers represent and manipulate data
- use Boolean algebra as related to designing computer logic, through simple combinational and sequential logic circuits

Text book [TB]:

1. **M.Morris Mano**-Computer System Architecture, 3rd Edition, Pearson Education, NewDelhi, 2006.

Reference Books:

1. W.Stallings- Computer Organization & Architecture, 7th Edition, Pearson Education,New Delhi, 2006

2. N. Carter- Computer Architecture, Schaums Outline Series, TMH, New Delhi, 2006, Pearson Higher

Course Structure& Syllabus of B.Sc. (Hons.) – Mathematics
Applicable for Batch: 2019-22

Subject Code	MA116	Subject Title	ORDINARY DIFFERENTIAL EQUATION AND LAPLACE TRANSFORM						
LTP	3 1 0	Credit	4	Subject Category	UC	Year	1st	Semester	II

OBJECTIVE

This course provides an introduction to the fundamentals of ordinary differential equations and their solutions. It also provides a tool to determine analytical solution of initial value problems by method of Laplace transform.

UNIT I: Introduction to Differential Equations (ODE)

Review of Ordinary Differential Equations, Types of differential equations, Order, Degree, Linear & Non-Linear differential equations, Solution & Formation of differential equations, Linearly dependent and independent set of functions, Wronskian and its properties.

UNIT II: Differential Equations of first Order & first Degree

Differential Equations of first Order & first Degree: Separation of variables, Homogenous differential equations, Linear differential equations, Bernoulli's equation, Exact differential equations.

ODE of First Order but not of First Degree: Ricatti & Clairaut's equation, Singular solution, Orthogonal trajectories, Equations of the type $\frac{d^2y}{d^2x} = f(y)$.

UNIT III: Second and Higher Order ODE

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: Laplace Transform

Definition of Laplace transform, Existence conditions for the Laplace Transform, Shifting theorems, Laplace transform of derivatives and integrals, Inverse Laplace transform and their properties, Convolution theorem, Initial and final value theorem, Laplace transform of periodic functions, Error functions, Heaviside unit step function and Dirac delta function, Applications of Laplace transform to solve ordinary differential equations.

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.
- To understand and apply Laplace transform to determine the solution of initial value problems.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, 2012.

2. G. F. Simmons and G. Krantz Steven, "Differential Equations", 17th Reprint, McGraw Hill Education (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. M. D. Raisinghania, "Ordinary and Partial Differential Equations", 19th Edition, S. Chand Publications, 2017.

Course Structure& Syllabus of B.Sc. (Hons.) – Mathematics

Applicable for Batch: 2019-22

Subject Code	HS102	Subject Title	CORPORATE COMMUNICATION & SOFT SKILLS						
LTP	2 1 1	Credit	3.5	Subject Category	SEC	Year	1st	Semester	II

Unit I

Business Communication10 hrs

Importance & Features of Business Communication, Flow of Communication: Channels &Networks
Communication: E mails & E- Tools
Business Presentation
Business Etiquette, Telephonic Etiquette
Business Letter Writing
Job Application Letter & Resume
Interview Skills, Impression Management

Unit II

Personal Skills for Corporate Communication **10 hrs**

SWOT Analysis: Self-Assessment, Identifying Strength & Weakness
Self-Awareness, Self-Disclosure & Self-Management (Stress, Anger)
Goal Setting: Personal & Professional Goals, SMART-ER Goals
Human Perception: Understanding People, Perceptions, Attitudes
Personality (Personality Test)

Unit III **10 hrs**

Professional Skills for Corporate Communication

Decision Making: Techniques, Six Thinking Hats
Creative Thinking, Lateral Thinking
Team Building & Leadership Skills
Time Management: Planning Organizing, Time Wasters
Conflict Resolution Skills
Negotiation Skills

REFERENCE BOOKS

1. The Seven Habits of Highly Effective People by Steven R. Covey. 2007.
2. How to win Friends and influence People by Dale Carnegie. 2009.
3. Soft Skills : Know Yourself & Know the World by Dr. Alex . S. Chand Publications 2001.
4. The ACE of Soft Skills: Attitude, Communication and Etiquette for Success by Gopalswamy Ramesh. 2008.
5. Managing Soft skills for Personality development by B. N Ghosh. 2006.
6. Personality Development by Elizabeth B. Hurlock. TMH Publication. 2010.

Course Structure& Syllabus of B.Sc. (Hons.) – Mathematics

Applicable for Batch: 2019-22

LAB

Lab 1	Telephone Etiquette: Making an appointment, answering calls (Role Play)
Lab 2	Telephone Etiquette: Making an appointment, answering calls (Role Play)
Lab 3	Business Presentations (PPT Presentation)
Lab 4	Business Presentations (PPT Presentation)
Lab 5	Interview Skills: Mock Interview
Lab 6	Interview Skills: Mock Interview
Lab 7	Panel Discussion
Lab 8	Panel Discussion
Lab 9	Conflict & Negotiation (Situational Role Play)
Lab 10	Conflict & Negotiation (Situational Role Play)
Lab 11	Evaluation
Lab 12	Evaluation

TUTORIAL

Tutorial 1 Writing Practice **(**2 Types of Business Letters)

Tutorial 2 Writing Practice(Job Application Letter & Resume)

Tutorial 3 Personality Test

Tutorial 4 SWOT Analysis (Exercise)

Tutorial 5 Team Building (Exercise)

Tutorial 6 Time Management(Exercise)

Tutorial 7 Case Studies (Goal setting, Perception ,)

Tutorial 8 Case Studies (Decision making , Lateral thinking)

Tutorial 9 Case Studies (Leadership)

Tutorial 10 Group Discussion

Course Structure& Syllabus of B.Sc. (Hons.) – Mathematics

Applicable for Batch: 2019-22

Subject Code	MA206	Subject Title	COMPUTER BASED NUMERICAL AND STATISTICAL TECHNIQUES (CBNST)						
LTP	3 0 2	Credit	4	Subject Category	DC	Year	2nd	Semester	III

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:

Errors: Approximations and Errors in Computation.

Solution of Polynomial and Transcendental Equations: Bisection method, Regula-Falsi method, Newton-Raphson meth od, rate of convergence.

Unit II: Interpolation

Finite differences, Newton's forward and backward interpolation formula, Central difference interpolation, Gauss's forward and backward interpolation formula, Stirling's interpolation formula, Divided differences, Lagrange, Newton's Divided difference formula.

Unit III: Numerical Differentiation and Numerical Integration

First and second order derivatives of Newton's forward & backward interpolation, Newton - Cote's Quadrature Formula: Trapezoidal, Simpson's rules, Gaussian quadrature formula.

Unit IV: Solution of Simultaneous Linear Algebraic Equations

Direct methods: Gauss elimination, Gauss Jordan method, LU Decomposition method; Iterative methods: Gauss – Jacobi iteration method, Gauss - Seidal iteration method.

Principle of Least Square and Curve Fitting: Fitting a straight line, Parabola and exponential curve.

Unit V:

Numerical Solution of Ordinary Differential Equations: Single step methods: Picard's method, Taylor series method, Euler's method, Modified Euler's method, Runge - Kutta method of fourth order (First order, Second order & Simultaneous Differential Equations), Predictor - Corrector methods: Milne's method, Adams - Bashforth method.

LEARNING OUTOCOME: Students will be able to:

- obtain an intuitive and working understanding of numerical methods.
- apply numerical methods to basic problems of numerical methods.
- use various software tools for the implementation and application of numerical methods Basics of different types of measuring instruments based on the fundamental theory of operation.
- implement frequency chart, regression analysis, linear square fit and polynomial fitting methods of problem solving.

Text Book:

1. Curtis F. Gerald and Patrick O. Wheatley, **"**Applied Numerical Analysis"**,** 7th Edition, Pearson Education Lt, 2004.

Reference Books

1. S.S. Sastry, "Introductory Methods of Numerical Analysis", 5th Edition, PHI learning Pvt. Ltd, 2012.
2. M.K Jain, S.R.K Iyengar and R.K Jain, "Numerical Methods for Scientific and Engineering Computation", 6thEdition, New age International Publishers, 2012.
3. F. B. Hildebrand, "Introduction to Numerical Analysis", 2nd Edition, McGraw-Hill Book Company Inc. 1974.
4. B. S. Grewal, "Numerical Methods in Engineering and Science", 10th Edition, Khanna Publishers, New Delhi, India, 2013.

List of Practicals:

(1) Bisection Method.	(2) Simpson's $\frac{3}{8}rd$ rule.
(3) Regula Falsi Method.	(4) Gauss Elimination Method.
(5) Newton Raphson Method.	(6) Gauss Jordan Method.
(7) Newton's Forward Interpolation Formula.	(8) Gauss - Jacobi Method.
(9) Newton's Backward Interpolation Formula.	(10)Gauss - Seidal Method
(11)Newton's Divided Difference Formula.	(12)Fitting a Straight Line and Parabola.
(13)Trapezoidal rule.	(14)Modified Euler's Method.
(15)Simpson's $\frac{1}{3}rd$ rule.	(16)Fourth Order Runge - Kutta Method.

Course Structure& Syllabus of B.Sc. (Hons.) – Mathematics

Applicable for Batch: 2019-22

Subject Code	MA207	Subject Title	REAL ANALYSIS						
LTP	3 1 0	Credit	4	Subject Category	DC	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: Sequence

Real Numbers, Field of Real Numbers, Ordering properties, Finite, Infinite, Countable, Uncountable and Bounded sets, Intervals, Supremum, Infimum, Completeness, Concept of sequence and subsequence, Limit points of a sequence, Limit inferior and superior, Convergent and divergent sequences with related theorems, Cauchy's general principle of convergence, Monotonic increasing and decreasing sequences, Bolzano-Weierstrass theorem.

Unit-II: Riemann Integration

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 – III : Improper Integral

Improper integrals and their convergence, Comparison tests, Abel's and Dirichlet's tests, Frullani's integral, Integral as a function of a parameter. Continuity, Differentiability and integrability of an integral of a function of a parameter.

Unit – IV : Sequences and Series of Functions

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:

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

Course Structure& Syllabus of B.Sc. (Hons.) – Mathematics
Applicable for Batch: 2019-22

Subject Code	MA208	Subject Title	PARTIAL DIFFERENTIAL EQUATIONS					
LTP	3 1 0	Credit	4	Subject Category	DC	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

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

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

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

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 equations and 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:

7. S.L. Ross, "Differential Equations", 3rdEdition, John Wiley and Sons, India, 2004.

8. Martha L Abell and James P Braselton, "Differential Equations with MATHEMATICA", 3rdEdition, Elsevier, Academic Press, 2004.

9. Sneddon, I. N., Elements of Partial Differential Equations, McGraw Hill, 2006.

Course Structure& Syllabus of B.Sc. (Hons.) – Mathematics

Applicable for Batch: 2019-22

Subject Code	MA 209	Subject Title	INTRODUCTION TO STATISTICAL METHODS						
LTP	3 1 0	Credit	4	Subject Category	DC	Year	2nd	Semester	III

Objective: To introduce the basic concepts of probability theory, distributions and statistical measures.

Unit I: Statistical Methods

Concepts of statistical population and sample from a population, Quantitative and qualitative data, Nominal, Ordinal data, Discrete and continuous data, Measures of central tendency and measures of dispersion. Central moments, Non-central moments, Measures of Skewness and measures of Kurtosis

Unit II: Probability Theory

Random experiments, sample point and sample space, Definition of Probability and axioms of probability, Conditional probability, Independent events, Bayes theorem and its applications

Unit III: Random Variables

Discrete and continuous random variables, Probability mass function, Probability density function, Cumulative distribution function, Illustrations of random variables and its properties.

Unit IV: Mathematical Expectation

Expectation of random variable and its properties, Parameters of distribution, Moments, Cumulants, Moment generating function, Cumulant generation function and Characteristic function

Unit V: Bivariate Probability Distributions

Two dimensional random variables, Joint probability mass function, Joint probability density function, Joint distribution function, Marginal and conditional distributions, Conditional probability and stochastic independence of variates.

LEARNING OUTCOMES: Students shall be able to

- enlarge their minds regarding the occurrence of events
- apply statistical tools to the problems related to the real life problems
- analyze data pertaining to different experiments/events
- carry out some project or research work base on analysis of the data

Text Book:

1. S.C. Gupta, and V.K. Kapoor, "Fundamentals of Mathematical Statistics", 11th Edition (Reprint), Sultan Chand and Sons, 2013.
2. V. K. Rohatgi, and A. K. Md. E. Saleh, "An Introduction to Probability and Statistics", 2nd Edition, (Reprint). John Wiley and Sons, 2009.

Reference Books:

1. A.M. Goon, M.K. Gupta and B. Dasgupta, "Fundamentals of Statistics", Vol. I, 8th Edition, World Press, Kolkata, 2005.
2. A.M. Goon, M.K. Gupta and B. Dasgupta, "An Outline of Statistical Theory", Vol. I, 4th Edition, World Press, Kolkata, 2003.
3. Miller, Irwin and Miller, Marylees, John E. Freund's, "Mathematical Statistics with Applications", 7th Edition, Pearson Education, Asia, 2006.
4. A.M. Mood, F.A. Graybill and D.C. Boes "Introduction to the Theory of Statistics", 3rd Edition, (Reprint), Tata McGraw Hill Pub. Co. Ltd., 2007.

Course Structure& Syllabus of B.Sc. (Hons.) – Mathematics

Applicable for Batch: 2019-22

Subject Code	MA219	Subject Title	LINEAR PROGRAMING						
LTP	3 1 0	Credit	4	Subject Category	DC	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

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

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

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

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 analyze the sensitivity of a decision variable.

Text Book:

1. Hamdy A. Taha, "Operations Research: An Introduction", 9th Edition, Pearson Publications; 2010.
2. J K Sharma, "Operations Research Theory & Applications, Macmillan India Ltd, 2007.

Reference Books:

1. P. SankaraIyer, "Operations Research", Tata McGraw Hill, 2008.
2. A.M. Natarajan, P. Balasubramani, A. Tamilarasi, "Operations Research", Pearson Education, 2005.
3. P. K. Gupta and D. S. Hira, "Operations Research", S. Chand & Co., 2007.

Course Structure& Syllabus of B.Sc. (Hons.) – Mathematics

Applicable for Batch: 2019-22

Subject Code	MA216	Subject Title	PROBABILITY DISTRIBUTIONS & REGRESSION ANALYSIS						
LTP	3 1 0	Credit	4	Subject Category	DC	Year	2nd	Semester	IV

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. To familiarize the students with specific statistical rules which include some basic inequalities. 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.

Unit I : Standard Discrete Probability Distributions

Binomial, Poisson, Geometric, Negative Binomial, Hypergeometric distributions and their parameters. Applications of the discrete probability distributions

Unit II: Standard continuous probability distributions

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

Unit III

Convergence of random variables, Statement and application of Markov's inequality, Chebyshev's inequality, weak laws of large numbers (WLLN) & strong laws of large numbers (SLLN), Kolomogorov's SLLN, Central limit theorem (CLT) for i.i.d. variates, and its applications, De Moivre's Laplace Theorem

Unit IV: 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

LEARNING OUTCOME: Students shall have

- good knowledge of statistical distributions and their real life applications.
- better understanding of the bivariate data and its graphical as well as numerical interpretations.
- ability to differentiate between the mathematical models and the probabilistic models and, hence, the regression models.
- ideas to perform regression analysis and prediction of the data points based on regression model

Text Book:

1. S.C. Gupta, and V.K. Kapoor, "Fundamentals of Mathematical Statistics", 11th Edition, Sultan Chand and Sons, 2013.
2. V. K. Rohatgi, "Introduction to Probability Theory and Mathematical Statistics", Wiley Eastern, 1988.

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. N.L. Johnson, S. Kotz, and N. Balakrishnan, "Discrete Univariate Distributions", John Wiley, 1994.
4. Sheldon Ross, "Introduction to Probability Models", 9th Edition, Academic Press, Indian Reprint, 2007.

Course Structure& Syllabus of B.Sc. (Hons.) – Mathematics

Applicable for Batch: 2019-22

Subject Code	MA217	Subject Title	INTRODUCTION TO ABSTRACT ALGEBRA& NUMBER THEORY						
LTP	3 1 0	Credit	4	Subject Category	DC	Year	2nd	Semester	IV

Objective: To introduce the students algebraic structures which include groups, rings, fields, modules and elementary number theory.

Unit I: Number System and Number Theory

Binary operations +,., - and ÷ in natural numbers (N), Integers (Z), Rational numbers (Q), Real numbers (R) & Complex numbers (C) with their properties. Division algorithm, Factorization, Prime numbers in N, Fundamental theorem of arithmetic, gcd and lcm of a given set of integers, Congruence relation in Z and properties, Euler's ϕ-Function, Theorems of Euler, Fermat & Wilson, Residue modulo m, Linear Congruence, Chineese remainder theorem

Unit II: Groups

Definition, Examples, Basic properties, Order, Subgroups, Cossets, Normal subgroup of a group, Abelian and Non-Abelian groups, Fundamental theorem of Homomorphism, Isomorphism theorems, Examples from Number Theory, Cyclic group, Finite and Infinite groups, Permutation groups and their properties, Automorphism groups, Finite basis theorem for abelian groups

Unit III: Rings

Definition, Examples, Basic properties, Subring, Ideal, Quotient Ring of a given ring, Fundamental theorems of Homomorphism and Isomorphism's, Commutative and Non-Commutative rings and their properties, Prime and Maximal Ideals, Integral Domain, Ring of polynomials over the set of real numbers and its ideals, Division algorithm, Principal Ideal Ring, Euclidian Ring and Unique Factorization Domain.

Unit IV: Fields and Modules

Definition, Examples, Basic properties of a Field, Finite fields, Quotient field of an Integral Domain, Quotient field of the ring of polynomials over the set of real numbers and their properties, Definition Examples, Basic properties of an R-module, Sub-module, Cyclic Sub-module, Homomorphism and Isomorphism theorems for Modules.**,**

Learning Outcome: Students will learn about

- algebraic structures called groups, rings, fields and some related properties
- results involving divisibility and greatest common divisors, solve systems of linear congruences etc.
- abstract mathematical thinking and skill.

TEXT BOOKS:

1. H. Neal McCoy and J. Janusz **Gerald**, "Introduction to Abstract Algebra", 7th Edition,Trustworthy Communications, LLC, 2009.
2. M. K. Sen, S. Ghosh, P. Mukopadhyay, S.K. Maity, "Topics in Abstract Algebra", 3rd Edition, Universities Press, 2019.

REFRENCE BOOKS:

1. I. N. Herstein, "Topics in Algebra", Wiley Eastern Ltd., New Delhi.
2. N. Jacobson, "Basic Algebra, Vol. I & II", 2nd Edition, Dover Publications, 2009.

Course Structure& Syllabus of B.Sc. (Hons.) – Mathematics

Applicable for Batch: 2019-22

Subject Code	MA218	Subject Title	COMPLEX ANALYSIS						
LTP	3 1 0	Credit	4	Subject Category	DC	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

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

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

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

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.

Unit V: Conformal Mapping

Conformal mapping: Definition, Conformality, Theorem, Bilinear (Mobius) Transformation.

Learning Outcome: Students will be able to

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

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. (Hons.) – Mathematics

Applicable for Batch: 2019-22

Subject Code	CH201	Subject Title	ENVIRONMENTAL SCIENCE						
LTP	2 0 0	Credit	2	Subject Category	AEC	Year	2nd	Semester	IV

OBJECTIVE

To impart basic knowledge about the environment and its allied problems and to develop an attitude of concern for the environment. Further the course structure will create the awareness about environmental problems among students and motivate the students to participate in environment protection and environment improvement programs. The course aims to develop skills to help the concerned individuals in identifying and solving environmental problems.

Unit 1: Basics of Environment and Natural Resources: 04 Hrs

Definition and Concept of Environment, Multidisciplinary nature of environmental studies. Scope and importance of environmental studies, Need for public awareness, Environmental concerns and people. Introduction and classification of natural resources. Energy Resources, Water Resources, Land Resources, Forest Resources, Food Resources, Mineral Resources, Case studies related to over exploitation of resources and their impacts. Role of an individual in conservation of natural resources, Sustainable lifestyles.

Unit 2: Ecosystems: 04 Hrs

Definition and concept of ecology, Structure and Function of an Ecosystem, Energy Flow in Ecosystems, Biogeochemical cycles (Nitrogen, Carbon, Phosphorus, Oxygen, Hydrological). Species interactions in ecosystems. Ecological succession and ecological pyramids. Characteristic features of grassland, pond, desert and forest ecosystems. Ecosystem services and conservation.

Unit 3: Biodiversity and its conservation: 04 Hrs

Introduction and types of biodiversity. Bio-geographic classification of India, Value and significance of biodiversity, Biodiversity at global, national and local levels, India: A mega-diversity nation, Biodiversity hotspots, Threats to Biodiversity: Poaching and man-wildlife conflicts, IUCN Red Data Book and endangered & endemic species of India. Biodiversity conservation strategies, Institutes and organizations.

Unit-4 Environmental Pollutions: 05 Hrs

Introduction and Definition. Causes, consequences and control measures of: Air pollution, Water pollution, Noise pollution, Nuclear pollution, Soil pollution, Thermal and Marine pollution. Solid waste management, Bio-medical waste management. Disasters and its mitigation strategies, Global warming, Climate change, Acid rain, Ozone depletion and Smog. Pollution case studies. Role of an individual in pollution prevention.

Unit-5 Social Issues and Environment: 04 Hrs

Sustainable Development: Concept and importance, Environmental Impact Assessment (EIA), GIS, Remote sensing. Water conservation and rain water harvesting. Resettlement and rehabilitation problems, Environmental audit, eco-labeling and eco-friendly business. Environmental Legislation in India, Population explosion and its impact on environment and human health, Value Education and environmental ethics.

Field work: 03 Hrs

- Visit to a local area to document environmental asset: river/forest/grassland/hill/mountain
- Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
- Study of common flora and fauna.
- Study of a common ecosystem-pond, river, hill slopes, etc.

Course Outcome:

At the end of the course, the student will be able to:
CO1. Demonstrate depleting nature of Environmental Resources and Ecosystem concepts.
CO2. Able to identify the structure and functioning of natural ecosystems.
CO3. Establish man-wildlife harmonious relationship.
CO4. Adapt to 3R (Reuse, Recovery, Recycle).Identify the causes and control measures related to Pollutions.
CO 5. Illustrate and analyse various Case Studies related to Environmental issues and Env. Legislation.

TEXT BOOKS

1. BharuchaErach, 2004. Textbook for Environmental Studies, University Grants Commission, New Delhi.
2. Kaushik A & Kaushik C P. 2007. Perspectives in Environmental Studies, New Age International Publ.
3. S. Deswal & A. Deswal 2015. A Basic Course in Environmental Studies. Dhanpat Rai & Co.

REFERENCES

1. Miller T.G. Jr. 2002. Environmental Science, Wadsworth Publishing Co. (TB).
2. De A.K.,1996. Environmental Chemistry, Wiley Eastern Ltd.
3. Sharma, P.D. 2005. Ecology and environment, Rastogi Publication.

Course Structure& Syllabus of B.Sc. (Hons.) – Mathematics

Applicable for Batch: 2019-22

Subject Code	CA112	Subject Title	Data Structures in C						
LTP	302	Credit	4	Subject Category	DC	Year	1	Semester	2

Course Objective: The objectives of this course are

- To develop students' knowledge and understanding of the fundamental principles of data structures.
- Develop students' skills in analyzing data structures.
- Build up students' capacity to evaluate different algorithmic techniques.

Detailed Syllabus

UNIT 1

Introduction and Overview: Definition, Elementary data organization, Data Structures, data structures operations, Abstract data types, algorithms complexity, time-space tradeoff. Preliminaries: Mathematical notations and functions, Algorithmic notations, control structures, Complexity of algorithms, asymptotic notations for complexity of algorithms. String Processing: Definition, Storing Stings, String as ADT, String operations, word/text processing, Pattern Matching algorithms.

UNIT 2

Arrays: Definition, Linear arrays, arrays as ADT, Representation of Linear Arrays in Memory, Traversing Linear arrays, Inserting and deleting, Sorting: Bubble sort, Insertion sort, Selection sort, searching: Linear Search.

UNIT 3

Linked list: Definition, Representation of Singly linked list in memory, Traversing a Singly linked list, Searching a Singly linked list, Memory allocation, Garbage collection, Insertion into a singly linked list, Deletion from a singly liked list; Doubly liked list, Header liked list, Circular linked list.

UNIT 4

Stacks–Definition, Array representation of stacks, Linked representation of stacks, Stack as ADT, Arithmetic Expressions: Polish Notation, Application of Stacks, Recursion, Towers of Hanoi, Implementation of recursive procedures by stack.Queues–Definition, Array representation of queue, Linked list representation of queues Types of queue: Simple queue, Circular queue, Double ended queue, Priority queue, Operations on Queues, Applications of queues.

UNIT 5

Graphs: Graph theory terminology, Sequential representation of Graphs: Adjacency matrix, traversing a Graph. Tree–Definitions, Binary trees, Representing binary trees in memory,Traversing,Binary Trees, Binary Search Trees, Searching, Inserting and Deleting in a Binary Search Tree

Learning Outcome

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

- Describe the basic operations on arrays, lists, stacks and queue data structures.
- Explain the notions of hashing, trees and binary search trees.
- Describe the efficiency of algorithms with respect to the choice of data structures.
- Explain the basic concepts of object-oriented programming.

Text book [TB]:

1.**Data Structure** ,SeymourLipschutz, Tata-McGraw-Hill, 10th Edition, 2014

2. **Fundamentals of Data Structures in C**, Horowitz, Sahni& Anderson-Freed, University Press, 2nd Edition 2009.

Reference Books

1. **An Introduction to Data Structures with Applications**. , Jean-Paul Tremblay & Paul G, Mc Graw Hill Publishing, 7th Edition, 2014.

2.**Data Structures: A Pseudo-code approach with C**, Gilberg&Forouzan, Thomson Learning, 3rd Edition 2010.

Course Structure& Syllabus of B.Sc. (Hons.) – Mathematics
Applicable for Batch: 2019-22

Subject Code	MA306	Subject Title	MATHEMATICAL MODELING						
LTP	3 1 0	Credit	4	Subject Category	DC	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

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

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

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

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

Learning Outcome: Students will able to

- Understand the basic components of Mathematical 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. (Hons.) – Mathematics

Applicable for Batch: 2019-22

Subject Code	MA307	Subject Title	DIFFERENTIAL GEOMETRY						
LTP	3 1 0	Credit	4	Subject Category	DC	Year	3rd	Semester	V

OBJECTIVE: Introduce students about the key concepts and techniques of Surfaces in Euclidean space; General differentiable manifolds; Tangent spaces and vector fields; Differential forms; Riemannian manifolds and Gauss-Bonnet theorem in Differential Geometry and other courses.

Unit-I: Theory of Space Curves

Space curves, Planer curves, Curvature, Torsion, Osculating circles, Osculating circles and spheres, Normal lines and normal planes, Rectifying plane, Existence of space curves.

Unit II: Theory of Surfaces

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, Mainardi Codazzi equations, Weingarten equations

Unit III: Developable

Developable associated with space curves and curves on surfaces, Minimal surfaces.

Unit IV: Geodesics

Canonical geodesic equations, Nature of geodesics on a surface of revolution, Clairaut's theorem, Normal property of geodesics, Torsion of a geodesic, Geodesic curvature, Gauss-Bonnet theorem, Surfaces of constant curvature, Conformal mapping, Geodesic mapping, Tissot's theorem.

Learning Outcome: Students will have

- knowledge and skills about the concepts and language of differential geometry and its role in modern mathematics.
- Capability to solve complex problems using appropriate techniques from differential geometry.
- Capability to solving live problems in physics having diverse situations with differential geometry.

Text Books:

1. Christian Bär, "Elementary Differential Geometry", Cambridge University Press, 2010. T.J.
2. Willmore, "An Introduction to Differential Geometry", Dover Publications, 2012.

Reference Books:

1. B.O'Neill, "Elementary Differential Geometry", 2nd Edition, Academic press, 2006.

Course Structure& Syllabus of B.Sc. (Hons.) – Mathematics

Applicable for Batch: 2019-22

Subject Code	MA308	Subject Title	MATHEMATICAL METHODS						
LTP	3 1 0	Credit	4	Subject Category	DC	Year	3rd	Semester	V

OBJECTIVE: Learning about determining solutions of differential equation having continuous coefficients, Fourier-transform and Z- transforms, apply them to live discrete and continuous problems.

UNIT-I: Series Solution

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

UNIT-II: Special Function

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 $J_n(x)$, Legendre's equation, Legendre's polynomial $P_n(x)$, Legendre's function of the second kind $[Q_n(x)]$, 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 –III:Fourier Transform

Fourier integrals, Fourier sine and cosine integrals, Complex form of Fourier integral representation, Fourier transform, Fourier transform of derivatives and integrals, Fourier sine and cosine transforms and their properties, Convolution theorem, Application of Fourier transforms to Boundary Value Problems.

UNIT-IV: Z-Transform

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.

Learning Outcome: Students will be able to:

- Find series solution for second order linear differential equations, both at ordinary points and at regular singular points.
- Determine Fourier and Z-Transforms for various functions.
- Use properties of Fourier and Z-Transforms to solve physical problems.

Text Books:

1. W.W. Bell, "Special Functions for Scientist and Engineers", Dover Publication, New York, 1996.
2. 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, Narosa Publishing House, New Delhi, India, 2014.

Course Structure& Syllabus of B.Sc. (Hons.) – Mathematics

Applicable for Batch: 2019-22

Subject Code	MA309	Subject Title	DISCRETE MATHEMATICS						
LTP	3 1 0	Credit	4	Subject Category	DC	Year	3rd	Semester	V

OBJECTIVE: Learnthe properties of relations and functions, partial order relation, concepts in basic logic and set theory, understand the core ideas in combinatorial mathematics.

Unit I: Set Theory

Definition of Sets, Venn Diagrams, Complements, Cartesian products, Power sets, Counting principle, Cardinality and countability (Countable and Uncountable sets), Proofs of some general identities on sets, Pigeonhole principle.

Unit II: Relationsand Function

Relation: Definition, Types of relation, Composition of relations, Domain and range of a relation, Pictorial representation of relation, Properties of relation, Partial Ordering Relation.

Function: Definition and types of function, Composition of functions, Recursively defined functions.

Unit III: Propositional logic

Proposition logic, Basic logic, Logical connectives, Truth tables, Tautologies, Contradiction, Normal forms (conjunctive and disjunctive), Modus ponens and modus tollens, Validity, Predicate logic, Universal and existential quantification, (Notion of proof):by implication, Converse, Inverse, Contrapositive, Negation, and contradiction, Direct proof, Proof by using truth table and by counter example.

Unit IV: Combinatorics

Mathematical induction, Recursive mathematical definitions, Basics of counting, Permutations, Combinations, Inclusion-exclusion, Recurrence relations (n^{th} order recurrence relation with constant coefficients, Homogeneous recurrence relations, and Inhomogeneous recurrence relation), and generating function (closed form expression, properties of G.F., solution of recurrence relation using G.F, solution of combinatorial problem using G.F.), Pigeon Hole principle.

Learning Outcome: Students will be able to

- use properties of sets in the design and analysis of algorithms.
- use properties of logic sentence in terms of predicates, quantifiers, and logical connectives.
- evaluate Boolean functions and simplify expressions using the properties of Boolean algebra

Text Books:

1. Kenneth H. Rosen, “Discrete Mathematics and its Applications”, McGraw Hill, 2016.
2. J.P.Tremblay& R. Manohar, “Discrete Mathematical Structure with Applications to Computer Science” Mc.Graw Hill, 1975.

Reference Books:

1. V. Krishnamurthy, “Combinatorics:Theory and Applications”, East-West Press, 2008.
2. Seymour Lipschutz, M. Lipson, “Discrete Mathematics”, Tata McGraw Hill, 2005.
3. C. L. Liu, “Elements of Discrete Mathematics”, Tata McGraw Hill, 4th edition.

Course Structure& Syllabus of B.Sc. (Hons.) – Mathematics

Applicable for Batch: 2019-22

Subject Code	MA316	Subject Title	INTEGRAL EQUATIONS						
LTP	3 1 0	Credit	4	Subject Category	DC	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

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

Iterated kernel, Resolvent kernel, Solution of Fredholm integral equation of second kind by successive substitution, Solution of Volterra integral equation of the second kind by successive substitution.

Unit-III

Solution of Fredholm integral equation of second kind by successive approximation, Solution of Volterra integral equation of second kind by successive approximation, Iterative method, Neumann series, Classical Fredholm theory.

Unit-IV

Green's function and its application in Initial and Boundary Value Problems to integral equations, Conversion of a Boundary Value Problem into Fredholm integral equation.

Unit-V

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 substitution.
- 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. (Hons.) – Mathematics

Applicable for Batch: 2019-22

Subject Code	MA317	Subject Title	GRAPH THEORY						
LTP	3 1 0	Credit	4	Subject Category	DC	Year	3rd	Semester	VI

OBJECTIVE: The objective of the course is to explain basic concepts in combinatorial graph theory Define how graphs serve as models for many standard problems discuss the concept of graph, tree, Euler graph, cut set and Combinatorics.

Unit I

Preliminaries: Graphs (Walks, trails, paths, connected graphs, connectivity, distance), Isomorphism, Subgraphs, Matrix representations, Degree, Operations on graphs, Degree sequences, Connected graphs and shortest paths and its algorithms, cut-vertices, cut-edges, blocks, weighted graphs.

Unit II

Trees: Characterizations, Number of trees, Minimum spanning tree.

Bipartite graphs, Line graphs, Chordal graphs Eulerian graphs, Fleury's algorithm, Chinese-postman-problem, Hamilton graphs.

Unit III

Independent sets, Coverings, Matchings, Basic equations, Matchings in bipartite graphs, Perfect matchings, Greedy and approximation algorithms, vertex colorings, Chromatic number and cliques, greedy coloring algorithm, coloring of chordal graphs, Brook's theorem Edge colorings, Class-1 graphs and Class-2 graphs, equitable edge-coloring.

Unit IV

Planar graphs, Eulers formula, Polyhedrons, Planarity testing, 5-color-theorem, Directed graphs, Eulerian directed graphs, Hamilton directed graphs, Tournaments.

Learning Outcome: Student will be able to

- formulate problems in graph theoretic terms and have increased ability in graph theoretic problem solving.
- Deal with various versions of connectedness of a graph.
- formulate applied problems as coloring problems.
- Construct different models of random graphs (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.

Reference Books:

1. J. A. Bondy and U. S. R. Murty, "Graph Theory", Springer, 2008.
2. R. Diestel, "Graph Theory", Springer, 2000.

Course Structure& Syllabus of B.Sc. (Hons.) – Mathematics

Applicable for Batch: 2019-22

Subject Code	MA346	Subject Title	METRIC SPACES						
LTP	3 1 0	Credit	4	Subject Category	DE	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

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

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

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

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.

Course Structure& Syllabus of B.Sc. (Hons.) – Mathematics

Applicable for Batch: 2019-22

Subject Code	MA347	Subject Title	SPECIAL THEORY OF RELATIVITY						
LTP	3 1 0	Credit	4	Subject Category	DE	Year	3rd	Semester	VI

OBJECTIVE: Learn about Newtonian Relativity and related conservation laws, Clock paradox, Geometrical Interpretation of Lorentz transformation and its applications.

Unit-I : Classical Theory of Relativity

Review of Newtonian Mechanics (Inertial System, Event), Newtonian Relativity, Conservation laws in Newtonian Mechanics, Ether, Maxwell's electromagnetic theory, The Michelson-Morley experiment, Fitzgerald and Lorentz Contraction hypothesis.

Unit-II: Lorentz Transformations

Einstein's Special Relativity Theory, Einstein's Principle of Relativity, Principle of Constancy of Light Speed, Lorentz Transformation, Lorentz- Fitzgerald length contraction, Time Dilation, Clock paradox or twin paradox, Simultaneity, Geometrical Interpretation of LT, Group property of Lorentz Transformations and Examples.

Unit-III : Relativistic Kinematics

Introduction, Transformation of Particle Velocity, Relativistic addition law for velocities, Transformation of the Lorentz contraction factor $(1- v^2/c^2)^{1/2}$, The Transformations for the acceleration of a particle.

Unit-IV : Relativistic Mechanics

Introduction (Mass and Momentum). $M= \frac{m_0}{\sqrt{1-\frac{u^2}{c^2}}}$, The mass of moving particle, Relativistic Expression for Force, Transverse and Longitudinal mass of the particle, Mass energy equivalence $E= mc^2$, Transformation equations for mass, Transformation equations for momentum and energy, Deduction to prove that $p^2 – E^2/c^2$ is Lorentz invariant, Minkowski Space (Four Dimensional Continuum), Time-like, Space-like, Light-like (null) intervals, Events occurring at the same point and the same time.

Learning Outcome: Students will be able to understand

- Concept of relativity and its applications.
- Lorentz transformation and its use in physical problems.
- Minkowski Space and events occurring at the same point and the same time

Text Books:

1. J. K. Goyal and K. P. Gupta, "Theory of Relativity", Krishna Prakash Media (P) Ltd., 2006.
2. L. D. Landau and E. M. Lifshitz, "Mechanics", Butterworth, 1998.

Reference Books:

1. T. M. Karade, "Relativity and Tensor Calculus", Einstein Foundation International, 1980.
2. C. Moller, "The theory of Relativity", Oxford University Press, 1982.

Course Structure& Syllabus of B.Sc. (Hons.) – Mathematics

Applicable for Batch: 2019-22

Subject Code	MA348	Subject Title	STATISTICAL INFERENCE						
LTP	3 1 0	Credit	4	Subject Category	DE	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

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

Unit II: Statistical Inference

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

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

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.
- The course outcome includes the application of various inferential test procedures in case of small and large sample sizes.
- Students shall be able to use the distribution-free tests and their identification with parametric test.

Text Books:

1. S.C. Gupta, “Fundamentals of Statistics, 7th Edition, 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.

roduction to Probability and Statistics”, 2nd Edition, John Wiley and Sons, 2009.

Course Structure& Syllabus of B.Sc. (Hons.) – Mathematics

Applicable for Batch: 2019-22

Subject Code	CS342	Subject Title	LINUX ADMINISTRATION AND SHELL PROGRAMMING						
LTP	3 0 2	Credit	4	Subject Category	GEC	Year	3rd	Semester	VI

OBJECTIVES: This course is designed to get the exposure to the students about the functioning and shell programming in Linux operating system.

UNIT I 8L

Introduction to Linux and UNIX, What is an operating system?, A brief history of UNIX, Architecture of the Linux operating system, Logging into (and out of) UNIX systems, Changing your password, General format of UNIX commands. The UNIX filesystem, Typical UNIX directory structure ,Directory and file handling commands, Making hard and soft (symbolic) links, Specifying multiple filenames, Quotes.

UNIT II 8L

File and directory permissions ,Inspecting file content ,Finding files, Finding text in files, Sortingfiles, File compression and backup, Handling removable media, Processes, Pipes, Redirecting input and output, Controlling processes associated with the current shell ,Controlling other processes

UNIT III 7L

Connecting to remote machines, Network routing utilities, Remote file transfer, Other Internet related utilities, User Information and Communication, Printer control, Email utilities. Server Configuration in Linux environment: Telnet, FTP.

UNIT IV 7L

Introduction to vi, Basic text input and navigation in vi ,Moving and copying text in vi,Searching for and replacing text in vi,Other useful vi commands, Quick reference for vi ,Introduction to emacs, Basic text input and navigation in emacs, Moving and copying text in emacs, Searching for and replacing text in emacs, Other useful emacs commands ,Other UNIX editors. The superuserroot, Shutdown and system startup, Adding users, Controlling user groups, Reconfiguring and recompiling the Linux kernel ,Cronjobs, Keeping essential system processes alive.

UNIT V 8L

Unix Shell programming: Types of Shells, Shell Metacharacters, Shell variables, Shell scripts, Shell commands, the environment, Integer arithmetic and string Manipulation, Special command line characters, Decision making and Loop control, controlling terminal input, trapping signals, arrays. C/C++ code execute in Linux platform.

LEARNING OUTCOMES

After the completion of the course the students will able to learn:

CO1**.** About the Linux installation & working of Linux commands.

CO2. Know the network related activities on the computer system.

CO3. Expertise in shell programming using Linux.

CO4. The student will learn about System Administration in Linux.

Text Book:

1. Sumitabh Das, “Unix Concepts and applications”, TMH, 2003

2. *Mike Joy, Stephen Jarvis, Michael Luck, “Introducing Unix and Linux”, Palgrave Macmillan.*

Reference Book:

1. O'Reilly Media “Linux System Administration”

Course Structure& Syllabus of B.Sc. (Hons.) – Mathematics

Applicable for Batch: 2019-22

Subject Code	CS203	Subject Title	Computer Networks						
LTP	3 0 2	Credit	4	Subject Category	DSE	Year	3rd	Semester	VI

OBJECTIVE:

The objective of this course is familiarizing the students with the concepts of networking in computers, routing of data packets on the network and protocols followed in the networked computers.

Unit 1: Introduction to Computer Network (8)

Introduction: Motivation, OSI model, Signals and media, Bits over signals, Synchronous communication, Modulation and modems, Bandwidth, Throughput, and noise, Time division and Frequency division multiplexing, Standards, Switching methods, ISDN.

Unit 2: Data Link Protocol (8)

Packet Transmission: Multiplexing, Frames, Error correction techniques, LAN/WAN/MAN, Topology, CSMA/CD,LAN protocol, Elementary Data link protocol- Sliding window protocols, Token passing rings, FDDI, IEEE 802.3, 802.5.

Unit 3 Routing algorithms of Data Packets in networked computers (8)

Routing Algorithms: Distance-Vector, Link-State, Shortest path computation, Dijkstra's algorithm, Congestion control, WAN technologies including frame relay, X.25, ATM.

Unit-4 Interworking & IP addressing (8)

Internetworking: Motivation, Concept, Goals, TCP/IP model, IP addressing with sub netting, Address binding with ARP, IP Datagram, Encapsulation IP fragmentation and reassembly, ICMP,IGMP,TCP.

Unit- 5: Introduction to Network Services (8)

Network Services: Electronic mail, File transfer, Access and management, Virtual terminals, Remote procedure call.

COURSE OUTCOME:

At the end of the course, the student can:

CO1. An ability to perform Design and simulation of protocol using simulation tool.

CO2. Ability to create reliable communication using communication model with high quality of service.

CO3. Able to understand the data Packet Routing in networked computers.

CO4. Able to understand the protocols followed used in computer networks.

Course Structure& Syllabus of B.Sc. (Hons.) – Mathematics

Applicable for Batch: 2019-22

Subject Code	CS345	Subject Title	WEB TECHNOLOGY						
LTP	3 0 2	Credit	4	DSE	Year	3rd	Semester	VI	DSE

OBJECTIVES: Students undergoing this course are exposed to

- Get introduction about various Scripting Languages.
- Familiar with an up-to-date survey of developments in. Web Technologies.
- To know techniques involved to support real-time Software development.

UNIT 1 **(6 L)**

Web Essentials: Clients, Servers, and Communication. The Internet - Basic Internet Protocols - The World Wide Web-HTTP request message - response message - Web Clients Web Servers.

Markup Languages: An Introduction to HTML History-Versions-Basic Syntax and Semantics-Some Fundamental HTML Elements-Relative URLs-Lists-tables-Frames-Forms, Pages style sheets-CSS- Core Syntax- Properties-Box Model Normal Flow Box Layout-Other Properties.

UNIT 2 **(8 L)**

Client- Side Programming: The JavaScript Language-History and Versions Introduction JavaScript in Perspective-Syntax - Variables and Data Types – Statements – Operators – Literals – Functions – Objects – Arrays - Built-in Objects - JavaScript Debuggers, Browsers and the DOM.

PHP: Starting to script on server side, Arrays, function and forms, Advance PHP.

UNIT 3 **(8 L)**

Representing Web Data: XML-Documents and Vocabularies-Versions and Declaration-Namespaces JavaScript and XML: Ajax-DOM based XML processing Event-oriented Parsing: SAX-Transforming XML Documents-Selecting XML Data: XPATH-Template based Transformations: XSLT-Displaying XML Documents in Browsers-Case Study- Related Technologies, Introduction to JQuery.

UNIT 4 **(8 L)**

Web Services: Introduction to Web Services, UDDI, SOAP, WSDL, Developing and deploying web services. Ajax – Improving web page performance using Ajax, Programming in Ajax.

UNIT 5 **(7 L)**

Web 2.0: Interactive and social web**:** Blogs, wikis, and social networking sites – The technology behind these applications - AJAX, Open APIs.

Web 3.0: Semantic Web, Mashups, RDF, Web based Information Systems, Search engines, Recommender Systems, Web Mining.

LEARNING OUTCOMES

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

CO1.Design a basic web site using HTML, XML, XHTML.

CO2. Use client side technology to design web site.

CO3.Recognize and evaluate website organizational structure and design elements.

CO4. The students will be able to do programming in Ajax

Text Book:

1. Jeffrey C.Jackson, "Web Technologies--A Computer Science Perspective", Pearson Education, 2006.
2. Robert. W. Sebesta, "Programming the World Wide Web", Fourth Edition, Pearson Education, 2007.

Reference Book:

1. Deitel, Deitel, Goldberg, "Internet & World Wide Web How To Program", Third Edition, Pearson Education, 2006.
2. Marty Hall and Larry Brown,"Core Web Programming" Second Edition, Volume I and II, Pearson Education, 2001.
3. Bates, "Developing Web Applications", Wiley, 2006