Course Description

Title: Algebra Code: BS1MA101

L-T-P scheme: 3-1-0 C**redit: 4**

Prerequisite: Students must have basic knowledge of systems of linear equations, matrices.

Objective:

This course aims to provide a first approach to the subject of algebra, which is one of the basic pillars of modern mathematics. The focus of the course will be the study certain structures called groups and some related structures and Application of matrices. Algebra gives to student a good mathematical maturity and enables to build mathematical thinking and skill.

Learning Outcomes:

Course Outcome	Description
CO1	Familiarize with relations, equivalence relations and partitions
CO2	Work within various algebraic structures
CO3	Understand the importance of algebraic properties with regard to working within various number systems.
CO4	Recognize consistent and inconsistent systems of linear equations by the row echelon form of the augmented matrix, using rank.
CO5	Compute rank of matrix, solution of system of LE. and find kernel of homomorphism. Find eigenvalues and corresponding eigenvectors for a square matrix
CO6	Think critically by interpreting theorems and apply relating results to problems in other mathematical disciplines

Course Contents:

Unit-I : Introduction of matrices, Elementary operations of matrices. Inverse of a matrix. Rank of a matrix.

Unit-2 : Application of matrices to the system of linear equations, Consistency of the system.

Unit-3: Division algorithm, Divisibility and Euclidean algorithm, Congruence relation between integers, Fundamental Theorem of Arithmetic.

Unit-4: Definition of a group with examples and simple properties, Abelian group, Subgroups, Generation of groups, Cyclic groups.

Unit-5 : Coset decomposition, Lagrange's theorem and its consequences, Normal subgroups.

Teaching Methodology:

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lectures assignments/ quizzes in the form of questions will also be given.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Algebra (will be added from time to time): Digital copy will be available on the JUET server.

Text books:

[1]. I. N. Herstein , Topics in Algebra, Wiley Eastern Ltd. New Delhi, 1975.
[2]. D.T. Finkbeiner, Introduction to Matrices and Linear transformations, CBS Publishers, New Delhi, 1986.
[3]. K.B. Datta, Matrix and Linear Algebra, PHI Pvt. Ltd. New Delhi, 2000.
[4]. P.B. Bhattacharya, S.K.Jain , S.R. Nagpal, First Course in Linear Algebra, Wiley Eastern Ltd. New Delhi, 1983.
[5]. S. Singh, Modern Algebra, Vikas Publ. House, India.

Title: **Calculus** Code: **BS1MA102**
L-T-P scheme: 3-1-0 C**redit: 4**

Objective:

The objective of this course is to be able to write rigorous mathematical proofs for basic theorems in single -variable calculus involving the fundamental tools such as continuity and differentiability. This course is essential for any student majoring in mathematics.

Learning Outcomes:

Course Contents:

Course Outcome	Description
CO1	Define Limit, Continuity, Discontinuity, properties of Continuous functions.
CO2	Calculate the Differentiability, Chain rule of differentiation,
CO3	Understand the Mean value theorems, Taylor's and Maclaurin theorems.
CO4	Application of differential calculus in curve sketching.
CO5	Ilaborate Integral Calculus: Integration of ational and Irrational fractions,
CO6	Discuss Integration of Transcendental functions, Definite Integrals, Areas of curves, lengths of curves, Volumes and Surfaces of solids of revolution.

Unit 1. Differential Calculus: Successive differentiation and Leibnitz theorem. Limit, Continuity, Discontinuity, properties of Continuous functions.

Unit 2. Differentiability, Chain rule of differentiation, Mean value theorems, Taylor's and Maclaurin theorems.

Unit 3. Application of differential calculus in curve sketching.

Unit 4. Integral Calculus: Integration of ational and Irrational fractions, Integration of Transcendental functions.

Unit 5. Definite Integrals, Areas of curves. lengths of curves, Volumes and Surfaces of solids of revolution.

Teaching Methodology:

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lectures assignments/ quizzes in the form of questions will also be given.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Calculus (will be added from time to time): Digital copy will be available on the JUET server.

Text books:

[1]. Gorakh Prasad, Differential Calculus, Pothishala Pvt. Ltd. Allahabad, 2000.
[2]. Gorakh Prasad, Integral Calculus, Pothishala Pvt. Ltd. Allahabad, 2000.
[3]. Gabriel Klambauer, Mathematical Analysis, Marcel Dekkar Inc. New York 1975.
[4.] Shanti Narayan, Elements of Real Analysis, S. Chand & Company, New Delhi

Title of Course: Linear Algebra **Course code: BS1MA201**
L-T-P Scheme: 3 -1 - 0 **Course Credit: 4**

Prerequisite: Students should have basic knowledge of group and field theory.

Objectives: The course is intended to prepare the students for mathematical theory and methods of linear algebra, in particular vector spaces over the real or complex numbers, linear transformation, diagonalization and orthogonality .

Learning Outcomes:

Course Outcome	At the end of the course, the student is able to:
CO1	Understand the concepts of vector spaces, subspaces, bases, dimension and their properties.
CO2	Determine linear independence for vectors in R^n, rank and nullity of linear transformation.
CO3	Derive the matrix representing a linear under a given basis, and determine how the matrix changes if the basis is changed.
CO4	Use characteristic polynomials to compute eigenvalues and eigenvectors,
CO5	Recognize definite integral as an inner product, orthogonality of vectors and its use in projecting vectors into subspaces and decomposing vectors into components.
CO6	Apply the theory, methods and techniques of the course to solve mathematical problems.

Course Contents:

Unit 1: Vector spaces, subspaces and linear spans, linear dependence and independence. Finite dimensional vector spaces.

Unit 2: Linear transformations and their matrix representations. Algebra of linear transformations, the rank and nullity theorem. Change of basis. Dual spaces, bi dual space and natural isomorphism.

Unit 3: Eigen values and Eigen vectors of LT, Diagonalization, Cayley Hamilton theorem.

Unit 4: Inner product spaces, Cauchy-Schwarz inequality, orthogonal vectors. Orthonormal basis, Bessel's inequality, Gram-Schmidt orthogonalization process.

Methodology

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lectures assignments/ quizzes in the form of questions will also be given.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Syllabus covered upto Test-1
Test-2	25 Marks	Syllabus covered upto Test-2
Test-3	35 Marks	Full Syllabus
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	

Learning Resources:

Tutorials and lecture slides on linear algebra (will be added from time to time): Digital copy will be available on the JUET server.

Books:

1. N. Herstain, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.
2. K. Hoffman and R. Kunze, Linear Algebra, Prentice-Hall of India, New Delhi, 1971.
3. N. Jacobson, Basic Algebra, Vols I & II, W.H. Freeman, 1980
4. K.B. Dutta, Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd, New Delhi, 2000.
5. I.S. Luther and I.B.S. Passi, Algebra, Vol. I - Groups, Narosa Publishing House, Vol. I 1996.

Course Title: Discrete Mathematics **Course Code: BS1MA201**
L-T-P Scheme: 3 -1 - 0 **Course Credit: 4**

Objectives:

The aim of the course is to cover the basic principles sets relations functions partially ordered set, lattice, Boolean algebra and its applications. The main objective of the course is to develop in student, an intuitive understanding of graphs by emphasizing on the real world problems.

Learning Outcomes:

CO1	Employ De Moivre's theorem in a number of applications to solve numerical problems.
CO2	Appreciate the definition and basics of graphs along with types and their examples.
CO3	Visualize the applications of graph theory to network flows. Understand the notion of planarity and coloring of a graph. Relate the graph theory to the real-world problems.
CO4	Understand the definition of a tree and learn its applications to fundamental circuits.
CO5	Solve real-life problems using finite-state and Turing machines
CO6	Learn about partially ordered sets, lattices and their types, Boolean algebra and Boolean functions, logic gates, switching circuits and their applications.

Course Contents:

Unit 1: Basics of set theory, Mathematical induction. Relations, Equivalence relation, partial-ordered relation algorithms and functions.

Unit 2: Big O notation, Proposition, Basic logical operators, Propositional functions and Quantifiers.

Unit 3: Graphs and related definitions, Eulerian and Hamiltonian graphs, Graph colorings. Trees, Algebraic expressions and Polish notation, shortest path.

Unit 4: Algebraic Systems. Lattice and Boolean Algebra.

Unit 5: Language, Finite State Automata and Machines. Grammars.

Methodology:

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lectures assignments/ quizzes in the form of questions will also be given.

References:

1. B. A, Davey & H. A. Priestley (2002). "Introduction to Lattices and Order" (2nd edition) Cambridge University, Press.
2. Edgar, G. Goodaire & Michael M. Parmenter (2018). "Discrete Mathematics with Graph Theory" (3rd edition). Pearson Education.
3. Rudolf Lidl & Günter Pilz (1998). "Applied Abstract Algebra" (2nd edition). Springer.
4. Kenneth H. Rosen (2012). "Discrete Mathematics and its Applications: With Combinatorics and Graph Theory" (7th edition), McGraw-Hill.
5. C. L. Liu (1985). "Elements of Discrete Mathematics" (2nd edition). McGraw-Hill.

Evaluation plan:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Course Title: Ordinary Differential Equations **Course Code: BS1MA201**
L-T-P Scheme: 3 -1 - 0 **Course Credit: 4**

Objectives:

The aim of the course is to cover the basic of first and higher order differential equations The main objective of the course is to develop in student, an intuitive understanding of differential equations emphasizing on its applications in various engineering fields.

Learning Outcomes:

CO1	Understand the genesis of ordinary differential equations.
CO2	Learn various techniques of getting exact solutions of solvable first order differential equations and linear differential equations of higher order.
CO3	Know Picard's method of obtaining successive approximations of solutions of first order differential equations, passing through a given point in the plane and Power series method for higher order linear equations, especially in cases when there is no method available to solve such equations.
CO4	Grasp the concept of a general solution of a linear differential equation of an arbitrary order and also learn a few methods to obtain the general solution of such equations.
CO5	Solve various heat flow equations using higher order differential equations
CO6	Formulate mathematical models in the form of ordinary differential equations to suggest possible solutions of the day to day problems arising in physical, chemical and biological disciplines

Course Contents:

Unit-1: First Order Differential Equations Basic concepts and genesis of ordinary differential equations, Order and degree of a differential equation, Differential equations of first order and first degree, Equations in which variables are separable, Homogeneous equations, Linear differential equations and equations reducible to linear form, Exact differential equations, Integrating factor.

Unit-2: First order higher degree equations solvable for x, y and p. Clairaut's form and singular solutions. Picard's method of successive approximations and the statement of Picard's theorem for the existence and uniqueness of the solutions of the first order differential equations.

Unit-3: Second Order Linear Differential Equations Statement of existence and uniqueness theorem for linear differential equations, General theory of linear differential equations of second order with variable coefficients, Solutions of homogeneous linear ordinary differential equations of second order with constant coefficients, Transformations of the equation by changing the dependent/independent variable, Method of variation of parameters and method of undetermined coefficients, Reduction of order, Coupled linear differential equations with constant coefficients.

Unit-4: Higher Order Linear Differential Equations Principle of superposition for a homogeneous linear differential equation, Linearly dependent and linearly independent solutions on an interval, Wronskian and its properties, Concept of a general solution of a linear differential equation, Linear homogeneous and non-homogeneous equations of higher order with constant coefficients, Euler-Cauchy equation, Method of variation of parameters and method of undetermined coefficients, Inverse operator method.

Unit-5: Series Solutions of Differential Equations Power series method, Legendre's equation, Legendre polynomials, Rodrigue's formula, Orthogonality of Legendre polynomials, Frobenius method, Bessel's equation, Bessel functions and their properties, Recurrence relations.

Methodology:

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lectures assignments/ quizzes in the form of questions will also be given.

References:

1. Belinda Barnes & Glenn Robert Fulford (2015). Mathematical Modelling with Case Studies: A Differential Equation Approach Using Maple and MATLAB (2nd edition). Chapman & Hall/CRC Press, Taylor & Francis.
2. H. I. Freedman (1980). Deterministic Mathematical Models in Population Ecology. Marcel Dekker Inc.
3. Erwin Kreyszig (2011). Advanced Engineering Mathematics (10th edition). Wiley.
4. Daniel A. Murray (2003). Introductory Course in Differential Equations, Orient.
5. B. Rai, D. P. Choudhury & H. I. Freedman (2013). A Course in Ordinary Differential Equations (2nd edition). Narosa.
6. Shepley L. Ross (2007). Differential Equations (3rd edition), Wiley India.
7. George F. Simmons (2017). Differential Equations with Applications and Historical Notes (3rd edition). CRC Press. Taylor & Francis.

Evaluation plan:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Course Title: Group Theory **Code:** BS1MA304

L-T-P scheme: 3-1-0 **Credits: 3+1**

Prerequisite: Students should have basic knowledge of Algebra

Objective: This course is aimed to introduce the fundamental theory of groups and their homomorphisms. Symmetric groups and group of symmetries are also studied in detail. Fermat's Little theorem as a consequence of the Lagrange's theorem on finite groups.

Learning Outcomes:

Course Outcome	This course will enable the students to:
CO1	Recognize the mathematical objects that are groups, and classify them as abelian, cyclic and permutation groups, etc.
CO2	Link the fundamental concepts of groups and symmetries of geometrical objects.
CO3	Explain the significance of the notions of cosets, normal subgroups, and factor groups.
CO4	Apply the Internal Direct Product Theorem in simple cases and understand and use the properties of group actions
CO5	Learn about structure preserving maps between groups and their consequences.
CO6	Analyze consequences of Lagrange's theorem.

Course Contents:

Unit-1: Homomorphism and Isomorphism. Quotient group, Fundamental theorem of Homomorphism. The Isomorphism theorems for groups. Permutation groups and Cayley's theorem.

Unit-2: Automorphism, inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups, Characteristic subgroups, Commutator subgroup and its properties.

Unit-3: Properties of external direct products, the group of units modulo n as an external direct product, internal direct products, Fundamental Theorem of finite abelian groups.

Unit-4: Group actions, stabilizers and kernels, permutation representation associated with a given group action.

Unit-5: Applications of group actions: Generalized Cayley's theorem, Index theorem. Groups acting on themselves by conjugation, class equation and consequences, conjugacy in Sn, p-groups, Sylow's theorems and consequences, Cauchy's theorem, Simplicity of An for $n \geq 5$, non-simplicity tests.

Methodology:

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lectures, assignments and quizzes in the form of questions will also be given for practice.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Syllabus covered upto Test-1
Test-2	25 Marks	Syllabus covered upto Test-2
Test-3	35 Marks	Full Syllabus
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials, lecture slides and books on Group theory will be available on the JUET server.

Recommended Books:

1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
3. Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa Publishing House, New Delhi, 1999.
4. Joseph J. Rotman, An Introduction to the Theory of Groups, 4th Ed., Springer Verlag, 1995.
5. I.N. Herstein, Topics in Algebra, Wiley Eastern Limited, India, 1975.

Partial Differential Equations Code: BS1MA401

L-T-P scheme: 3-1-0 C**redit: 4**

Prerequisite: Students must have already studied course, "Calculus".

Objective:

In this course we have studied the Partial Differential techniques which consist of applying your mathematical skills to obtain useful answers to real problems. Equations are used in a very wide range of applications, some of which do not appear initially to be mathematical in nature. Learning to apply mathematical skills is very different from learning mathematics itself.

Learning Outcomes:

Course Contents:

Course Outcome	Description
CO1	Introduce and derive of partial differential equation, Linear partial differential equations of first order
CO2	Discuss Lagrange's linear equation, Lagrange's solution of the linear equation, Geometrical interpretation of Lagrange's linear equation
CO3	Understand the linear equations with n independent variables, special types of equations, Non linear PDE of first order, solve using Charpit's method, .
CO4	Illaborate Linear partial differential equation of second and higher order of homogeneous and non- homogeneous forms with constant coefficients
CO5	Solve using Variable seperable method
CO6	Apply in finding the solution of heat and wave equations in one dimension

Unit-1: Introduction and derivation of partial differential equation, Linear partial differential equations of first order

Unit-2: Lagrange's linear equation, Lagrange's solution of the linear equation, Geometrical interpretation of Lagrange's linear equation

Unit-3: linear equations with n independent variables, special types of equations, Non linear PDE of first order, Charpit's method.

Unit-4: Linear partial differential equation of second and higher order of homogeneous and non-homogeneous forms with constant coefficients, Solution of heat and wave equations in one dimension by method of separation of variables.

Teaching Methodology:

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lectures assignments/ quizzes in the form of questions will also be given.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Partial Differential Equations (will be added from time to time): Digital copy will be available on the JUET server.

Text books:

[1]. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Son Inc., New York, 1999.
[2]. Ian N. Sneddon, Elements of Partial Differential Equations, McGraw-Hill Book Company, 1988.
[3]. S.B. Rao and H.R. Anuradha, Differential Equations, University Press, 1996.
[4]. W.T.H. Piaggio, Elementary Treatise on Differential Equations and their applications, CBS Publishers N.Delhi, 1985.

Title: Real Analysis Code: BS1MA303

L-T-P scheme: 3-1-0 C**redit: 4**

Prerequisite: Students must have basic knowledge of calculus.

Objective:

The course will develop a deep and rigorous understanding of real line and of defining terms to prove the results about convergence and divergence of sequences and series of real numbers. These concepts has vide range of applications in real life scenario.

Learning Outcomes:

Course Outcome	Description
CO1	Understand many properties of the real line and learn to define sequence in terms of functions from to a subset of
CO2	Recognize bounded, convergent, divergent, Cauchy and monotonic sequences
CO3	To calculate their limit superior, limit inferior, and the limit of a bounded sequence.
CO4	Determine various applications of the fundamental theorem of integral calculus.
CO5	Relate concepts of uniform continuity, differentiation, integration and uniform convergence.
CO6	Apply the ratio, root, alternating series and limit comparison tests for convergence and absolute convergence of an infinite series of real numbers.

Course Contents:

Unit-1: Review of Algebraic and Order Properties of R, -neighborhood of a point in R, Idea of countable sets, uncountable sets and uncountability of R. Bounded above sets, Bounded below sets, Bounded Sets, Unbounded sets, Suprema and Infima, The Completeness Property of R, The Archimedean Property.

Unit-2: Limit points of a set, Isolated points, Illustrations of Bolzano-Weierstrass theorem for sets. Sequences, Bounded sequence, Convergent sequence, Limit of a sequence. Limit Theorems,

Unit-3: Monotone Sequences, Monotone Convergence Theorem. Subsequences, Divergence Criteria, Monotone Subsequence Theorem (statement only),

Unit-4: Bolzano Weierstrass Theorem for Sequences. Uniform Convergence. Cauchy sequence, Cauchy's Convergence Criterion.

Unit-5: Infinite series, convergence and divergence of infinite series, Cauchy Criterion, Tests for convergence: Comparison test, Limit Comparison test, Ratio Test, Cauchy's nth

root test, Integral test, Alternating series, Leibniz test, Absolute and Conditional convergence.

Teaching Methodology:

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lectures assignments/ quizzes in the form of questions will also be given.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Real Analysis (will be added from time to time): Digital copy will be available on the JUET server.

Text books:

1. T. M. Apostol (2008). Mathematical Analysis: A Modern Approach to Advanced Calculus. Pearson Education.
2. Charalambos D. Aliprantis &) Owen Burkinshaw1998). Principles of Real Analysis (3^{rd} edition). Academic Press.
3. Robert G. Bartle & Donald R. Sherbert (2015). Introduction to Real Analysis (4^{th} edition).Wiley India.
4. Gerald G. Bilodeau, Paul R. Thie & G. E. Keough (2015). An Introduction to Analysis (2^{nd} edition), Jones and Bartlett India Pvt. Ltd.

Title: Advanced Calculus Code: BS1MA301

L-T-P scheme: 3-1-0 C**redit: 4**

Prerequisite: Students must have already studied course, “Calculus”.

Objective:

The objective of this course is to be able to write rigorous mathematical proofs for basic theorems in multi-variable calculus involving the fundamental tools such as continuity and differentiability. This course is essential for any student majoring in mathematics.

Learning Outcomes:

Course Outcome	Description
CO1	Assimilate the notions of limit of a sequence and convergence of a series of real numbers.
CO2	Calculate the limit and examine the continuity of a function at a point.
CO3	Understand the consequences of various mean value theorems for differentiable functions.
CO4	Sketch curves in Cartesian and polar coordinate systems
CO5	Find points of discontinuity for functions and classify them.
CO6	Apply derivative tests in optimization problems appearing in social sciences, physical sciences, life sciences and a host of other disciplines.

Course Contents:

Unit-1: Limit, Continuity, Partial derivatives, Directional derivatives, differentiability of functions of several variables.

Unit-2: Sufficient conditions for continuity and differentiability in terms of partial derivatives, algebra of differentiable functions, differentiability of composite functions.

Unit-3: Chain rule of differentiation, total differentiations and mean value theorem for real valued functions.

Unit-4: Homogeneous functions and Euler’s theorem, Equality of mixed derivatives, Higher Differentials.

Unit-5: Change of Variable of integration, Double integral in polar form, area of region by double integral, Triple integral.

Teaching Methodology:

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lectures assignments/ quizzes in the form of questions will also be given.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Advanced Calculus (will be added from time to time): Digital copy will be available on the JUET server.

Text books:

[1] Mathematical analysis, S.C.malik,
[2] Advanced calculus, D.Widder
[3] Function of several variables, Pramila Srivastava, Allahabad Mathematical Society,1990.
[4] Gorakh Prasad, Differential Calculus (19th edition). Pothishala Pvt. Ltd, 2016.

Course Title: Analytical geometry **Course Code: BS2MA604**
L-T-P scheme: 3-1-0 **Credit: 4**

Objectives:

The aim of the course is to cover the basic concept of Equations of straight line, Equation of Plane, General form, Intercept and Normal form, Bisectors of angles between two intersecting planes. The main objective of the course is to develop in student, an intuitive understanding of the three dimension curves and its properties.

Learning Outcomes:

CO1	Study the basic concept of Equations of straight line, Equation of Plane, General form, Intercept and Normal form, Bisectors of angles between two intersecting planes.
CO2	Visualize the applications of General homogeneous second degree equation in understanding the three dimension curves Sphere, Cone and Right circular cone.
CO3	Analyse the three dimensional curves by evaluating tangents and normals and discuss its properties.
CO4	Understand the definition of Radical Plane, Parallelism and perpendicularity of two planes.
CO5	Study about the Cylinder, Generators parallel to either of the axes, general form of equation and Right- circular cylinder.
CO6	Learn about Section of cone by a plane as a conic and as a pair of lines, Condition for three perpendicular generators, Reciprocal cone.

Course Contents:

Unit-1: Equations of straight line, Equation of Plane, General form, Intercept and Normal form, Bisectors of angles between two intersecting planes.

Unit-2: Radical Plane, Parallelism and perpendicularity of two planes.

Unit-3: Sphere, General Equation, Tangent, Normal, Cone, Right circular cone, General homogeneous second degree equation,

Unit-4: Section of cone by a plane as a conic and as a pair of lines, Condition for three perpendicular

generators, Reciprocal cone.

Unit-5: Cylinder, Generators parallel to either of the axes, general form of equation and Right-circular cylinder.

Methodology:

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lectures assignments/ quizzes in the form of questions will also be given.

References:

1. Robert J. T. Bell: Co-ordinate Geometry of Three Dimensions
2. C. smith: Solid Analytic Geometry
3. S. L. Loney: Co-ordinate Geometry
4. N. Saran and R. S. Gupta: Analytical Geometry of three dimension

Evaluation plan:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Course Title: Numerical Analysis **Code: BS1MA403**

L-T-P scheme: 3-1-0 **Credits: 4**

Prerequisite: Students should have basic knowledge of calculus, differential equations and matrix algebra.

Course Objectives:

The aim of this course is to teach the applications of various numerical techniques for a variety of problems occurring in daily life.

Learning Outcomes:

Course Outcome	This course will enable the students to:
CO1	Demonstrate common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.
CO2	Analyze and evaluate the accuracy of the numerical solutions. Learn various techniques of getting numerical solutions of system of linear equations and nonlinear equations.
CO3	Understand the concepts of finite differences, interpolation, extrapolation and approximation.
CO4	Solve initial and boundary value problems in differential equations using numerical methods.
CO5	Work out numerical differentiation and integration whenever and wherever routine methods are not applicable.
CO6	Apply numerical methods to diverse situations in physics, engineering and in other mathematical contexts.

Course Contents:

Unit-1: Errors in computation, Algebraic and Transcendental equations: Bisection method, Secant method, Regula-Falsi method, Newton's method, Rate of convergence. Newton's method for complex roots. Generalized Newton's method.

Unit-2: System of linear equations: Gauss Elimination, Gauss Jordan, factorization methods, Gauss Jacobi method, Gauss Seidel method, Power method for finding largest/smallest Eigen value.

Unit-3: Lagrange's interpolation, Hermite interpolation, Finite difference operators, Divided difference operators. Newton's forward and backward difference interpolation. Newton's divided difference formula.

Unit-4: Numerical Differentiation and integration: Approximation for first and second order derivatives, Trapezoidal rule, Simpson's 1/3rd- rule, Simpsons 3/8th rule, Boole's Rule and Weddle's Rule. (Order of Error in each case)

Unit-5: Initial and Boundary Value Problems of Differential Equations: Taylor series method**,** Picard method, Euler's method, Modified-Euler's method, Runge-Kutta methods of orders two, three and four, Partial differential equations.

Methodology:

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lectures, assignments and quizzes in the form of questions will also be given for practice.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Syllabus covered upto Test-1
Test-2	25 Marks	Syllabus covered upto Test-2
Test-3	35 Marks	Full Syllabus
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials, lecture slides and books on numerical analysis will be available on the JUET server.

Text Books

[1] "Introductory Methods of Numerical Analysis", S.S. Sastry, PHI Ltd., 2005.

[2] "Numerical Methods for Scientific and Engineering Computation ", Jain, Iyengar &Jain, New age International Publication (P) Ltd, 2012.

[3] "Applied Numerical Analysis", Gerald C.F., Wheatley P.O., Pearson Education India; 7e, 2007.

[4] "Numerical Methods in Engineering and Science", Grewal, B. S., Khanna Publisher; Eleventh edition, 2013.

[5] "Numerical mathematical Analysis", James B., Scarborough. Baltimore, Johns Hopkins Press,1950.

Course Title: Vector and Tensor Analysis **Code: BS1MA402**

L-T-P scheme: 3-1-0 **Credits: 4**

Prerequisite: Students should have basic knowledge of calculus and vector algebra.

Objective:

The aim of the course is to introduce and develop the methods of vector and tensor analysis. These methods provide a natural aid to the understanding of geometry and some physical concepts. They are also a fundamental tool in many theories of Applied Mathematics.

Learning Outcomes:

Course Outcome	This course will enable the students to:
CO1	Use vector function to represent space curves and surfaces; find Arc Length, Curvature, Torsion and various other quantities.
CO2	Know physical and geometrical important concepts related to gradient, divergence and curl of vector field.
CO3	Evaluate integrals of vector valued function over curves, surfaces and domains in two- and three-dimensional space.
CO4	Realize importance of Green, Gauss and Stokes' theorems in other branches of mathematics.
CO5	Understand concept of tensor variables and difference from scalar or vector variables.
CO6	Apply vector and tensor calculus in mechanics, fluid flow, heat flow, electrostatics etc.

Course Content:

Unit 1: Vector Differentiation, Space Curve, Arc Length, Curvature and Torsion, Physical Properties of a Particle Moving Along a Space Curve.

Unit 2: Differential Operators, Scalar Fields and Vector Fields, Flow Line, Gradient, Divergence, Curl, Laplacian, Vector Identities.

Unit 3: Vector Integration, Line Integral, Classification of a Region of Points, Conservative Field, Oriented Surface, Surface Integral, Volume Integral, Divergence Theorem, Green's Theorem, Green's Identities, Stokes' Theorem.

Unit 4: Tensor Analysis: Tensor, Introduction, Summation Convention, Transformation of co-ordinates, Tensor of order zero, Kronecker delta, Contra-variant and covariant vectors, Tensors of higher order, symmetric and skew-symmetric tensors, addition of tensors, Outer product of two tensors and Contraction of tensors.

Methodology:

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lectures, assignments and quizzes in the form of questions will also be given for practice.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Syllabus covered upto Test-1
Test-2	25 Marks	Syllabus covered upto Test-2
Test-3	35 Marks	Full Syllabus
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials, lecture slides and books on vector and tensor analysis will be available on the JUET server.

Books

1. Introduction to Vector Analysis**,** Harry F Davis and Arthur David Snider 2nd Edn., Allyn and Bacon, Inc., (1979).

2. Complex Analysis with Vector Calculus**,** T.M.J.A. Coorey, Narosa Publishing House.

3. Tensor Analysis, Edward Nelson, Princeton University press.

4. A course in vector analysis and its applications, M.A.Tiwari and R.S.Sengar.

5. Applied vector analysis, Rahman matiur and mulolani, Isaac, CRC, press, New York.

6. Tensor Calculus, U.C.De, A.A.Shaikh, J. Sengupta, Narosa publishing house (2008).

Title: Abstract Algebra Code: BS1MA502

L-T-P scheme: 3-1-0 C**redit: 4**

Prerequisite: Students must have basic knowledge of the course Algebra.

Objective:

The objective of this course is to introduce the fundamental theory of rings, integral domain and field, and their corresponding homomorphisms.. The focus of the course will be the study certain basic structures called groups and some related structures and application in ring theory and field theory. Abstract algebra gives to student a good mathematical maturity and enables to build mathematical thinking and skill.

Learning Outcomes:

Course Outcome	Description
CO1	To develop various algebraic structures
CO2	Recognize the mathematical objects called groups
CO3	Explain the significance of the notions of cosets, normal subgroups, and factor groups.
CO4	Know the fundamental concepts in ring theory such as the concepts of ideals, quotient rings, integral domains.
CO5	Know the fundamental concepts in field theory.
CO6	Learn in detail about polynomial rings, fundamental properties of finite field extensions, and classification of finite fields. Apply the basic concepts to develop theorems.

Course Contents:

Unit-1: Definition and examples of rings, properties of rings, subrings, integral domains, characteristic of a ring. Ideal, ideal generated by a subset of a ring, factor rings, operations on ideals, prime and maximal ideals.

Unit-2: Ring homomorphisms, properties of ring homomorphisms, Isomorphism theorems I, II and III, field of quotients.

Unit-3: Polynomial rings over commutative rings, division algorithm and consequences, principal ideal domains, factorization of polynomials, reducibility tests, irreducibility tests, Eisenstein criterion, unique factorization in Z[x]**.**

Unit-4: Divisibility in integral domains, irreducibles, primes, unique factorization domains, Euclidean domains.

Unit-5: Definition of field, Subfield, Finite and algebraic extensions, Geometric constructions, Splitting fields, Finite fields, Irreducible polynomials over finite fields, Quadratic reciprocity.

Teaching Methodology:

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lectures assignments/ quizzes in the form of questions will also be given.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Abstract Algebra (will be added from time to time): Digital copy will be available on the JUET server.

Text books:

[1]. Gallian, Joseph A. Contemporary Abstract Algebra. 4th Ed., Delhi: Narosa Publishing House, 1999. Print.

[2]. D.T. Finkbeiner, Introduction to Matrices and Linear transformations, CBS Publishers, New Delhi, 1986.

[3]. Fraleigh, John B. A First Course in Abstract Algebra. 7th Ed., India: Pearson, 2002. Print..

[4]. P.B. Bhattacharya, S.K.Jain , S.R. Nagpal, First Course in Linear Algebra, Wiley Eastern Ltd. New Delhi, 1983.

[5]. Dummit, David S., and Richard M. Foote. Abstract Algebra. 3rd Ed., Singapore: John Wiley and Sons (Asia) Pvt. Ltd., 2004. Print.

Course Title: Analysis **Code:** BS1MA501

L-T-P scheme: 3-1-0 **Credits: 3+1**

Prerequisite: Students who have taken a first course in calculus and real analysis are suitable for this course

Course Objectives: The aim of this course is to introduce students properly to rigorous analysis and develop basic analytic concepts of limit, uniform convergence, Reimann integration and improper integrals.

Learning Outcomes:

Course Outcome	This course will enable the students to:
CO1	Recognize bounded, convergent, divergent, Cauchy and monotonic sequences and to calculate their limit superior, limit inferior, and the limit of a bounded sequence.
CO2	Understand and perform simple proofs.
CO3	Answer question concerning uniform convergence of sequences and series of functions.
CO4	Evaluate an integral over an infinite interval and a closed interval with an infinite discontinuity within the interval.
CO5	Learn some of the properties of Riemann integrable functions, and the applications of the fundamental theorems of integration.
CO6	Apply the Weierstrass M-test and the uniform convergence theorem for integrals to examples.

Course Contents:

Unit-1: Pointwise and uniform convergence of sequence of functions. Theorems on continuity, derivability and integrability of the limit function of a sequence of functions. Series of functions; Theorems on the continuity and derivability of the sum function of a series of functions; Cauchy criterion for uniform convergence and Weierstrass M-Test.

Unit-2: Limit superior and Limit inferior. Power series, radius of convergence, Cauchy Hadamard Theorem, Differentiation and integration of power series; Abel's Theorem; Weierstrass Approximation Theorem.

Unit-3: Riemann integration; inequalities of upper and lower sums; Riemann conditions of integrability. Riemann sum and definition of Riemann integral through Riemann sums; equivalence of two definitions.

Unit-4: Riemann integrability of monotone and continuous functions, Properties of the Riemann integral; definition and integrability of piecewise continuous and monotone functions.

Unit-5: Intermediate Value theorem for Integrals; Fundamental theorems of Calculus. Improper integrals; Convergence of Beta and Gamma functions.

Methodology:

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lectures, assignments and quizzes in the form of questions will also be given for practice.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Syllabus covered upto Test-1
Test-2	25 Marks	Syllabus covered upto Test-2
Test-3	35 Marks	Full Syllabus
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials, lecture slides and books on Analysis will be available on the JUET server.

Recommended Books:

1. Rudin, W. Principles of Mathematical Analysis, 3rd Edition. New Delhi: McGraw-Hill Inc., 1976.

2. Berberian, S.K. A First Course in Real Analysis. New York: Springer Verlag, 1994.

3. Thomson, B.S., A.M. Bruckner and J.B. Bruckner. Elementary Real Analysis. Prentice Hall, 2001.

4. Apostol, T. M., Calculus-I &II (2nd edition). New Delhi: Wiley, 1969.

Course Title: Mathematical Modelling **Code:** BS2MA507

L-T-P scheme: 3-1-0 **Credits: 3+1**

Prerequisite: Students should have basic knowledge of calculus and differential equations.

Course Objectives: The focus of the course will be on seeking the connections between mathematics and physical systems, studying and applying various modeling techniques to creating mathematical description of these systems, and using this analysis to make predictions about the system's behavior.

Learning Outcomes:

Course Outcome	This course will enable the students to:
CO1	Grasp the concept of a general solution of a linear differential equation of an arbitrary order and also learn series solution methods to obtain the general solution of such equations.
CO2	Know about piecewise continuous functions, Laplace transforms, its properties and Solve initial value problems using Laplace transforms.
CO3	Analyze and solve linear programming models of real life situations.
CO4	Model real-world problems mathematically and analyze those models using their mastery of the core concepts.
CO5	Create mathematical models of empirical or theoretical phenomena in domains such as the physical, natural, or social science;
CO6	Make predictions of the behavior of a given physical system based on the analysis of its mathematical model.

Course Contents:

Unit-I: Power series solution of a differential equation about an ordinary point, solution about a regular singular point, Bessel's equation and Legendre's equation,

Unit-II: Laplace transform and inverse transform, application to initial value problem up to second order.

Unit-III: Monte Carlo Simulation Modeling: simulating deterministic behavior (area under a curve, volume under a surface), Generating Random Numbers: middle square method, linear congruence, Queuing Models: harbor system, morning rush hour,

Unit-IV: Overview of optimization modeling, Linear Programming Model: geometric solution algebraic solution, simplex method, sensitivity analysis

Methodology:

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lectures, assignments and quizzes in the form of questions will also be given for practice.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Syllabus covered upto Test-1
Test-2	25 Marks	Syllabus covered upto Test-2
Test-3	35 Marks	Full Syllabus
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials, lecture slides and books on mathematical modeling will be available on the JUET server.

Recommended Books:

1. Tyn Myint-U and Lokenath Debnath, *Linear Partial Differential Equation for Scientists and Engineers*, Springer, Indian reprint, 2006.

2. Frank R. Giordano, Maurice D. Weir and William P. Fox, *A First Course in Mathematical Modeling*, Thomson Learning, London and New York, 2003.

Course Title: Graph Theory **Course Code:** BS2MA503
L-T-P scheme: 3-0-0 **Credits: 3**

Objectives:

The aim of the course is to cover the basic principles of graphs and trees.. The main objective of the course is to develop in student, an intuitive understanding of graphs by emphasizing on the real world problems.

Learning Outcomes:

At the end of the course, the student is able to:

CO1	Employ De Moivre's theorem in a number of applications to solve numerical problems.
CO2	Appreciate the definition and basics of graphs along with types and their examples.
CO3	Visualize the applications of graph theory to network flows. Understand the notion of planarity and coloring of a graph. Relate the graph theory to the real-world problems.
CO4	Understand the definition of a tree and learn its applications to fundamental circuits.
CO5	Solve real-life problems using finite-state and Turing machines
CO6	Learn about partially ordered sets, lattices and their types, Boolean algebra and Boolean functions, logic gates, switching circuits and their applications.

Course Contents:

Unit 1: Graph and related definitions, Matrix representation of graphs.

Unit 2: Isomorphism, Euler and Hamiltonian graphs , Planar Graphs and Graph Colouring Fleury algorithm.

Unit 3: Tree and related definitions, Binary and rooted tree, spanning trees, fundamental circuits, cutsets and Network flows.

Unit 4: Connectivity and separability , 1 and 2-isomorphism., geometrical and combinational duals. Vector spaces of a graph, Enumeration of graph.

Unit 5: Polya counting theorem. Algorithms and computer programs of graph theory.

Methodology:

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lectures assignments/ quizzes in the form of questions will also be given.

Evaluation plan:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Books:

[1]Edgar, G. Goodaire & Michael M. Parmenter (2018). “Discrete Mathematics with Graph Theory” (3rd edition). Pearson Education.
[2] Rudolf Lidl & Günter Pilz (1998). “Applied Abstract Algebra” (2nd edition). Springer.
[3] Kenneth H. Rosen (2012). “Discrete Mathematics and its Applications: With Combinatorics and Graph Theory” (7th edition), McGraw-Hill.
[4] C. L. Liu (1985). “Elements of Discrete Mathematics” (2nd edition). McGraw-Hill.

Title: Linear Programming Code: BS2MA502

L-T-P scheme: 3-1-0 C**redit: 3**

Prerequisite: Students must have already studied course, “Linear Algebra”.

Objective:

The objective of this course is to understand the theory of optimization methods and algorithms developed for solving various types of optimization problems. To familiar students with the basic mathematical concepts of optimization. To provide students with the modeling skills necessary to describe and formulate optimization problems to solve and interpret optimization problems in engineering. To apply the mathematical results and numerical techniques of optimization theory to concrete Engineering problems.

Learning Outcomes:

Course Outcome	**Description**
CO1	Solve linear programming problems by different methods.
CO2	Provide graphical solutions of linear programming problems with two variables, and illustrate the concept of convex set and extreme points.
CO3	Know about the relationships between the primal and dual problems, and to understand sensitivity analysis. Understand duality and dual simplex method.
CO4	Understand transportation model and finding solution of transportation problem.
CO5	Understand assignment problem and method for solving it.
CO6	Analyze and apply linear programming models of real life situations Learn about the applications to transportation, assignment in real world.

Course Contents:

Unit-1: linear programming problems Canonical and standard forms, Graphical method; Extreme points; Formulation, Feasible Solutions Basic solutions, Basic Feasible Solutions, Reduction of feasible solution to basic feasible solution, Correspondence between basic feasible solutions and extreme points.

Unit-2: Optimality criterion, Improving a basic feasible solution, Unboundedness, Unique and alternate optimal solutions; Simplex algorithm and its tableau format; Artificial variables, Two-phase method, Big-M method.

Unit-3: Formulation of the dual problem, Duality theorems, Complimentary slackness theorem, Dual-simplex method.

Unit-4: Sensitivity Analysis, Changes in the cost vector, right-hand side vector and the constraint matrix of the linear programming problem.

Unit-5: Transportation problem and its Mathematical formulation, North-west corner method, Matrix Minima Method, Row Minima Method, Column Minima Methods, Vogel's Approximation Method. Techniques for Obtaining Optimal Basic Feasible Solution. Assignment problem and its Mathematical formulation, Hungarian Method for Assignment Problems.

Teaching Methodology:

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lectures assignments/ quizzes in the form of questions will also be given.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Linear Programming (will be added from time to time): Digital copy will be available on the JUET server.

Text books:

1. Taha, H.A.: Operations Research- An Introduction, New York, Macmillan, 1992.
2. Harvey M. Wagner: Principles of Operations Research with Applications to Managerial Decisions, Prentice Hall of India Pvt. Ltd 1975.
3. Hadley, G.: Linear Programming, Massachusetts: Addison- Wesley, 1962.
4. Hiller, F.S.and Lieberman G.J.: Introduction to Operations Research, San Francisco: Holden-Day, 1995.

Title: Differential Geometry Code: BS1MA602

L-T-P scheme: 3-1-0 C**redit: 4**

Prerequisite: Students must have already studied multivariate calculus and Linear Algebra

Objective:

The aim of the course is to provide knowledge of the geometry of curves and surfaces. The course integrates concepts from different parts of mathematics, such as linear algebra, calculus and differential equations. It also provides intuitive examples for many concepts in linear algebra, calculus and differential equations..

Learning Outcomes:

Course Outcome	Description
CO1	Explain the basic concepts of tensors
CO2	Understand role of tensors in differential geometry.
CO3	Learn various properties of curves including Frenet□Serret formulae and their applications.
CO4	Know the Interpretation of the curvature tensor, Geodesic curvature, Gauss and Weingarten formulae.
CO5	Understand the role of Gauss's Theorema Egregium and its consequences.
CO6	Apply problem-solving with differential geometry to diverse situations in physics, engineering and in other mathematical contexts.

Course Contents:

Unit-1: Theory of space curves: Space curves, Planer curves, Serret-Frenet formulae. Osculating circles and spheres.

Unit-2: Existence of space curves and evolutes and involutes.Theory of surfaces: Parametric curves on surfaces.

Unit-3: Direction coefficients. First and second Fundamental forms. Principal and Gaussian curvatures.

Unit-4: Lines of curvature, Euler's theorem. Rodrigue's formula, Conjugate and Asymptotic lines.

Unit-5: Developables, Developable associated with space curves, Developable associated with curves on surfaces. Minimal surfaces.

Teaching Methodology:

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lectures assignments/ quizzes in the form of questions will also be given.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Differential Geometry (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

[1] T.J. Willmore - An Introduction to Differential Geometry. Oxford UniversityPress.1965.
[2] B. B. Sinha, Differential Geometry, An Introduction. Shyam Prakashan Mandir Allahabad, 1978.
[3] J.A. Thorpe, Introduction to Differential Geometry, Springer-Verlog.
[4] M. Docarmo, Differential Geometry of Curves and Surfaces, Prentice-Hall, 1976.
[5] C.E. Weatherburn, Differential Geometry of Three Dimensions, Cambridge Univ. Press, 1955.

Course Title: Discrete Mathematics **Course Code: BS2MA604**
L-T-P scheme: 3-1-0 **Credit: 4**

Objectives:

The aim of the course is to cover the basic principles sets relations functions partially ordered set, lattice, Boolean algebra and its applications. The main objective of the course is to develop in student, an intuitive understanding of graphs by emphasizing on the real world problems.

Learning Outcomes:

CO1	Employ De Moivre's theorem in a number of applications to solve numerical problems.
CO2	Appreciate the definition and basics of graphs along with types and their examples.
CO3	Visualize the applications of graph theory to network flows. Understand the notion of planarity and coloring of a graph. Relate the graph theory to the real-world problems.
CO4	Understand the definition of a tree and learn its applications to fundamental circuits.
CO5	Solve real-life problems using finite-state and Turing machines
CO6	Learn about partially ordered sets, lattices and their types, Boolean algebra and Boolean functions, logic gates, switching circuits and their applications.

Course Contents:

Unit 1: Basics of set theory, Mathematical induction. Relations, Equivalence relation, partial-

ordered relation algorithms and functions.

Unit 2: Big O notation, Proposition, Basic logical operators, Propositional functions and

Quantifiers.

Unit 3: Graphs and related definitions, Eulerian and Hamiltonian graphs, Graph colorings.

Trees, Algebraic expressions and Polish notation, shortest path.

Unit 4: Algebraic Systems. Lattice and Boolean Algebra.

Unit 5: Language, Finite State Automata and Machines. Grammars.

Methodology:

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lectures assignments/ quizzes in the form of questions will also be given.

References:

1. B. A, Davey & H. A. Priestley (2002). "Introduction to Lattices and Order" (2nd edition) Cambridge University, Press.
2. Edgar, G. Goodaire & Michael M. Parmenter (2018). "Discrete Mathematics with Graph Theory" (3rd edition). Pearson Education.
3. Rudolf Lidl & Günter Pilz (1998). "Applied Abstract Algebra" (2nd edition). Springer.
4. Kenneth H. Rosen (2012). "Discrete Mathematics and its Applications: With Combinatorics and Graph Theory" (7th edition), McGraw-Hill.
5. C. L. Liu (1985). "Elements of Discrete Mathematics" (2nd edition). McGraw-Hill.

Evaluation plan:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Title: Mechanics Code: BS1MA604

L-T-P scheme: 3-0-0 C**redit: 3**

Prerequisite: Students must have already studied vector analysis, statics and dynamics .

Objective:

The course aims at understanding the various concepts of physical quantities and the related effects on different bodies using mathematical techniques. It emphasizes knowledge building for applying mathematics in physical world.

Learning Outcomes:

Course Outcome	Description
CO1	Know the significance of mathematics involved in physical quantities and their uses.
CO2	Understand necessary conditions for the equilibrium of particles acted upon by various forces and learn the principle of virtual work for a system of coplanar forces acting on a rigid body.
CO3	Determine the centre of gravity of some materialistic systems and discuss the equilibrium of a uniform cable hanging freely under its own weight.
CO4	Deal with the kinematics and kinetics of the rectilinear and planar motions of a particle including the constrained oscillatory motions of particles.
CO5	Learn that a particle moving under a central force describes a plane curve and know the Kepler's laws of the planetary motions, which were deduced by him long before the mathematical theory given by Newton.
CO6	Identify the stress developed in beams due to forces applied.

Course Contents:

Unit-1: Forces in three dimensions, Poinsot's central axis, Wrenches, Null lines and planes.

Unit-2: Motion of particle in three dimensions: acceleration in trems of different coordinate systems.

Unit-3: Rigid dynamics: Moments and product of inertia, principal axes, D'Alembert's principal.Motion about fixed axis.

Unit-4: Hydrodynamics: Lagrangian and Eulerian approaches, equation of continuity, boundary surface, streamlines, velocity potential.

Unit-5: Euler's equation of motion, steady motion, Bernoulli's equation.

Teaching Methodology:

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lectures assignments/ quizzes in the form of questions will also be given.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Mechanics (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

[1] J.N. Kapoor and J.D. Gupta: A text book of Dynamics, 1999.
[2] F. Chorlton: Text book of fluid dynamics, C.B.S. Pub. 2004.
[3] S.L. Loney: The elements of Statics and dynamics, Cambridge Univ. Press.
[4] A.S. Ramsey: A treatise on hydrodynamics, Bell and sons Ltd, London.

Title: Operational Research Code: BS1MA602

L-T-P scheme: 3-0-0 C**redit: 3**

Prerequisite: Students must have already studied course, “Linear Algebra”.

Objective:

The objective of this course is to understand the theory of optimization methods and algorithms developed for solving various types of optimization problems. To familiar students with the basic mathematical concepts of optimization. To provide students with the modeling skills necessary to describe and formulate optimization problems to solve and interpret optimization problems in engineering. To apply the mathematical results and numerical techniques of optimization theory to concrete Engineering problems.

Learning Outcomes:

Course Outcome	Description
CO1	Solve linear programming problems by different methods.
CO2	Understand duality and dual simplex method.
CO3	Understand assignment problem and method for solving it.
CO4	Understand transportation model and finding solution of transportation problem.
CO5	Solve Integer programming problems by different methods. Solve nonlinear programming problem by Lagrangian multiplier method.
CO6	Learn about the applications to transportation, assignment in real world.

Course Contents:

Unit-1: Definition of Linear Programming Problems, Formulation of Linear Programming Problems and their Graphical Solutions.,

Unit-2: Simplex Method, Artificial Variable Method, Two Phase Method, Big-M Method, Revised Simplex Method, Duality

Unit-3: Dual Simplex Method, Integer Linear Programming Problems, Mixed Integer Linear Programming Problems, Cutting Plane Method, Branch and Bound Method

Unit-4: Introduction to Transportation Model, Matrix Form of TP, Applications of TP Models, Basic Feasible Solution of a TP, Degeneracy in TP, Formation of Loops in TP, Solution Techniques of TP, Different Methods for Obtaining Initial Basic Feasible

Basic Feasible Solutions viz. Matrix Minima Method, Row Minima Method, Column Minima Methods, Vogel's Approximation Method. Techniques for Obtaining Optimal Basic Feasible Solution. Definition, Hungarian Method for Assignment Problems.

Unit-5: Introduction to Non- Linear Programming Problems, Formulation of Non- Linear Programming Problems and their Graphical Solutions. Kuhn- Tucker Conditions.

Teaching Methodology:

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lectures assignments/ quizzes in the form of questions will also be given.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Operational Research (will be added from time to time): Digital copy will be available on the JUET server.

Text books:

1. Taha, H.A.: Operations Research- An Introduction, New York, Macmillan, 1992.
2. Harvey M. Wagner: Principles of Operations Research with Applications to Managerial Decisions, Prentice Hall of India Pvt. Ltd 1975.
3. Hadley, G.: Linear Programming, Massachusetts: Addison- Wesley, 1962.
4. Hiller, F.S.and Lieberman G.J.: Introduction to Operations Research, San Francisco: Holden-Day, 1995.

Course Title: Analytical Geometry **Course Code: BS2MA604**
L-T-P scheme: 3-1-0 **Credit: 4**

Objectives:

The aim of the course is to cover the basic concept of Equations of straight line, Equation of Plane, General form, Intercept and Normal form, Bisectors of angles between two intersecting planes. The main objective of the course is to develop in student, an intuitive understanding of the three dimension curves and its properties.

Learning Outcomes:

At the end of the course, the student is able to:

CO1	Study the basic concept of Equations of straight line, Equation of Plane, General form, Intercept and Normal form, Bisectors of angles between two intersecting planes.
CO2	Visualize the applications of General homogeneous second degree equation in understanding the three dimension curves Sphere, Cone and Right circular cone.
CO3	Analyse the three dimensional curves by evaluating tangents and normals and discuss its properties.
CO4	Understand the definition of Radical Plane, Parallelism and perpendicularity of two planes.
CO5	Study about the Cylinder, Generators parallel to either of the axes, general form of equation and Right- circular cylinder.
CO6	Learn about Section of cone by a plane as a conic and as a pair of lines, Condition for three perpendicular generators, Reciprocal cone.

Course Contents:

Unit-1: Equations of straight line, Equation of Plane, General form, Intercept and Normal form, Bisectors of angles between two intersecting planes.

Unit-2: Radical Plane, Parallelism and perpendicularity of two planes.

Unit-3: Sphere, General Equation, Tangent, Normal, Cone, Right circular cone, General homogeneous second degree equation.

Unit-4: Section of cone by a plane as a conic and as a pair of lines, Condition for three perpendicular generators, Reciprocal cone.

Unit-5: Cylinder, Generators parallel to either of the axes, general form of equation and Right-circular cylinder.

Methodology:

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lectures assignments/ quizzes in the form of questions will also be given.

References:

1. Robert J. T. Bell: Co-ordinate Geometry of Three Dimensions
2. C. smith: Solid Analytic Geometry
3. S. L. Loney: Co-ordinate Geometry
4. N. Saran and R. S. Gupta: Analytical Geometry of three dimension

Evaluation plan:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	