COURSE: REAL ANALYSIS [As per Choice Based Credit System (CBCS) Scheme] Semester –I (Mathematics)			
Course Code	**19MAT11**	**Maximum Marks (CIE)**	**50**
Number of Teaching Hours/Week	**04**	**Maximum Marks (SEE)**	**50**
Total No of Teaching Hours	**64**	**Exam Hours**	**03**
CREDITS-04			

Course Objectives: this course will enable students to:

- Have the knowledge of basic properties of the field of real numbers, of real functions-limits of functions and their properties, series of real numbers and convergence.
- Studying Stone –Weirstrass Theorem and Cauchy criteria. Studying the differentiability of real. Functions
- The aim is to provide the development of subject matter which is honest, rigorous, at the same time not too pedantic

MODULES	Teaching Hours
MODULE I: The Riemann-Stieltjes Integrals: The Least Upper Bound Property (LUB Property) and the Greatest Lower Bound Property (GLB Property). Definitions and existence of integral properties of the integral function of bounded variation.	14 hours
MODULE II: Integral and differentiation. First and second Mean value theorem. Change of variables. Sequences and Series Functions. Absolute and conditional convergence of series.	12 hours
MODULE III: Uniform Convergence and continuity, uniform convergence and integration, uniform convergence and differentiation, uniform convergence and bounded variations, Equi-continuous families of functions. The Stone-Weirstrass theorem.	14 hours
MODULE IV: Functions of Several Variables: Maxima and minima of functions of several variables, linear transformations, differentiations, the contractions principles and the inverse function theorem, the implicit function theorem and the rank theorem.	12 hours
MODULE V: Archimedean Property. Biography of Srinivas Ramanujam, Biography of Aryabhata, Biography of Bhaskaracharya, Biography of Leonhard Euler, Biography of Gottfried W Leibnitz. The Existence of Density of Rational Numbers.	12 hours

Course Outcomes:

After studying this course, students will be able to:

- Understand the History of mathematicians and the basic concepts related to mathematics and real numbers, recognize the basic properties of the field of real numbers real functions and its limits
- Define and recognize Stone- Weirstrass theorem ability to apply the theorem in a correct mathematical way.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- H. L. Royden, P M Fitzpatrick, Real Analysis, PHI Publication, (2010).
- Shanti Narayn, Elements of Real Analysis, S. Chand Publication, (1986).
- S. C Malik, Principles of Real Analysis, New age international Publications, (2017).
- Walter Rudin, Principles of Mathematical Analysis, (1976).
- S. L. Gupta and N. R. Gupta: Principles of Real Analysis, Second Edition, Pearson Education (2003).
- C. Goffman, Real functions, Holt, Rinehart and Winston Inc. New York (1953).

PAPER: ALGEBRA-I
[As per Choice Based Credit System (CBCS) Scheme]
Semester –I (Mathematics)

Course Code	**19MAT12**	**Maximum Marks (CIE)**	**50**
Number of Teaching Hours/Week	**04**	**Maximum Marks (SEE)**	**50**
Total No of Teaching Hours	**64**	**Exam Hours**	**03**

CREDITS-04

Course Objectives: this course will enable students to:

- This approach to teaching algebra should help students attach meaning to the abstract concepts of algebra.
- These standards require students to use algebra as a tool for representing and solving a variety of practical problems.
- Tables and graphs will be used to interpret algebraic expressions, equations and inequalities and to analyze behaviors of functions.
- Graphing calculators, computers and other appropriate technology tools will be used to assist in teaching and learning.

MODULES	**Teaching Hours**
MODULE I: Natural numbers, Properties of natural numbers, Natural numbers as a Well-ordered set, Sets. Power set, factor, divisibility, Peason's Axiom (Statement) The integers Relatively prime, First and second principle of induction, fundamental theorem of arithmetic.	14 hours
MODULE II: Equivalence relation Counjugacy, self conjugate, normalized class equation permutation groups and their properties Group, subgroup-definition, monoid sub-monoid, normal sub group elementary properties, Normal subgroup and quotient group, Group homomorphisms, Isomorphism theorems and the correspondence theorem.	12 hours
MODULE III Cauchy's Theorem Cyclic group, Center of a group and commutate subgroup of a group solvable group, Sylow's theorems and its applications, direct product products and types, finite abelian groups has direct product of cyclic group.	14 hours
MODULE IV: Ring Definition sub ring and types, Field of quotients of an integral domain, Euclidean Rings, Fermat's theorem, Einstein Criterion, Unique Factorization Theorem and Domain, Modulus and rings.	12 hours
MODULE V: Extension Fields, Algebraic and Transcendental extensions, Roots of Polynomial splitting Fields, Finite Fields, Perfect Fields, Simple Fields.	12 hours

Course Outcomes:

After studying this course, students will be able to:

- Apply problem-solving techniques to model both mathematical and real-world contexts.
- Use mathematical language and symbols as a means of communication while reading, writing. Speaking and listening.
- Apply critical thinking and analytical reasoning skills in mathematical settings.
- Make connections between mathematical problem solving and its application in other settings.
- Identify and evaluate incorrect solutions.
- Repeat exercises that were incorrectly answered.
- Identify areas of strength and weakness.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- C. C. Pinter, Set Theory, Addison-Wesley Publishing Co. Reading, Massechusetts (1971).
- I. N. Herstein, Topics in Algebra, 2nd Edition, John-Wiley & Sons, New York (1975).
- Y. F. Lin & S. Y. T. Lin, Set Theory-An Intuitive Approach, Houghton Mifflin Company, Boston (1974).
- Surjit Singh and Qazi Zameeruddin, Modern Algebra, Vikas Publishing House (1990).
- S. K. Jain, P. B. Bhattacharya & S. R. Nagpaul, Basic Abstract Algebra, Cambridge University Press (1997).
- J. J. Rotman, The Theory of Groups, an Introduction, Allya & Bacon (1965).
- S. Maclane & G. Birkhoff, Algebra, Mc Millan Co., New York (1967).
- S. M. Srivastava, A Course on Borel Sets (Chapter – I), Springer-Verlag, New York (1998).
- M. Artin, Algebra, Prentice Hall of India (2004).

COURSE: ORDINARY DIFFERENTIAL EQUATIONS [As per Choice Based Credit System (CBCS) Scheme] Semester –I (Mathematics)			
Course Code	**19MAT13**	**Maximum Marks (CIE)**	**50**
Number of Teaching Hours/Week	**04**	**Maximum Marks (SEE)**	**50**
Total No of Teaching Hours	**64**	**Exam Hours**	**03**
CREDITS-04			

Course Objectives: this course will enable students to:

- Understand the basics of differential equation, they identifies the different form of ordinary differential equations and applications.
- Understand the new techniques to solve the differential equation

MODULES	Teaching Hours
MODULE I: Ordinary differential equation: Differential equation and classification Linear-Differential equation, fundamental sets of solution and their standard properties, the Wronskian, existence and uniqueness theorem. Singular solution of first order ODE's, System of First order PDE	14 hours
MODULE II: Introduction The Adjoint equation self-Adjoint equation and standard properties, the Sturm theorem Abel's formula sturm separation theorem sturm comparison theorem Conversion of standard theorem from normal form	14 hours
MODULE III: Boundary Value problems: Two point Boundary value problems, Sturm-Liouville problem, Solution by Green's function Eigen Function and expansion formula, comparison and separation theorem on the zeroth solution of the Sturm-Liouville equations.	12 hours
MODULE IV: Riccati's Equation: Riccati's differential equations, General solution of Riccati's equation, a theorem on particular integrals a of Riccati's equations, illustrative examples.	12 hours
MODULE V: Power Series Solution of Differential Equation: Basic concepts of power series solutions, Examples, Power series solutions about an ordinary point, examples, The working rule of Frobenius method, Examples, Existence theorem, uniqueness theorem, existence theorem and uniqueness theorem (The general case).	12 hours

Course Outcomes:

After studying this course, students will be able to:

- Solve separable, homogeneous, exact and linear first-order differential equations with and without initial conditions.
- Find the inverse Laplace function of a function. Use the Translation Theorems to find Laplace transforms derivatives, integrals and periodic functions.
- Solve initial-value problems for linear differential equations with constant coefficients.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- E.A. Coddington, Introduction to Ordinary Differential Equations (1961).
- Boyce and Diprima, Elementary Differential Equations and Boundary Value Problems, J.Wiley (1965).
- Gupta, Malik and mittal, differential equation 3ed, (1995).
- G.F.Simmons, Introduction to Differential Equations, Tata McGraw (2017).

COURSE: GENERAL TOPOLOGY
[As per Choice Based Credit System (CBCS) Scheme]
Semester –I (Mathematics)

Course Code	**19MAT14**	**Maximum Marks (CIE)**	**50**
Number of Teaching Hours/Week	**04**	**Maximum Marks (SEE)**	**50**
Total No of Teaching Hours	**64**	**Exam Hours**	**03**

CREDITS-04

Course Objectives: this course will enable students to:

- Learn the fundamental applications in set.
- Learn the fundamentals of algebraic topology
- Be prepared to begin with all concepts of topology and its applications in research.

MODULES	Teaching Hours
MODULE I: Topological Spaces: Definition of topology, types of topologies, neighborhoods ,closed sets, closure operations and their equivalence, neighborhood systems, limit points, closure, interior, and boundary of a set.	14 hours
MODULE II: Base, sub base, sub space, continuous map, open and closed maps. **Separation Axioms**: T_0, T_1, T_2, spaces, regular spaces, normal space, Urysohn's characterization of normality, T3, T4, T5, spaces.	14 hours
MODULE III: Countability axioms, Separable space, And convergence of a sequence, **Connectedness:** Connected and disconnected spaces, components, connectedness and continuous map.	12 hours
MODULE IV: Compactness: cover, sub cover, compactness, characterizations, Heine-Borel theorem, compactness, and continuous map, finite intersection property, one point-compactification.	12 hours
MODULE V: Metric space: Metric on a set, open spheres, topology induced by a metric, equivalent metric spaces, diameter, continuity. **Lindelof space:** Lindelofness and countability, continuity and other Properties of Lindelofness.	12 hours

Course Outcomes:

- Students will know the definitions of standard terms in topology, the several operators in topology, and its applications in the form of mathematical statement.
- They will construct their own theorem formulation and solution, it built the own thinking and research methodology. Students will be able to clearly communicate ideas and proofs.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- G. F. Simmons: Introduction to Topology and Modern Analysis, McGraw Hill, (1963).
- J. T. Munkers: A First Course in Topology, PHI, (1998).
- W. J. Pervin: Foundations of General Topology, AP, (1972).
- J. L. Kelly: General Topology, Van Nostrand, (1955).
- J.Dugundji: Topology USB Pub.New Delhi, Allyn & Bacon, (1997).
- K D Joshi: Introduction to General Topology, New Age Intn. (P) Ltd, (1983).
- Willard: General Topology, Hocking and Young Pub.
- Mundars C.F: Algebric topology, academic press.
- W. Massey: Introduction to algebraic Topology, New Delhi.

COURSE: DISCRETE MATHEMATICS [As per Choice Based Credit System (CBCS) Scheme] Semester –I (Mathematics)			
Course Code	**19MAT15**	**Maximum Marks (CIE)**	**50**
Number of Teaching Hours/Week	**04**	**Maximum Marks (SEE)**	**50**
Total No of Teaching Hours	**64**	**Exam Hours**	**03**
CREDITS-04			

Course Objectives: this course will enable students to:

- Demonstrate their understanding by using mathematical terminology and notation.
- Construct correct direct and indirect proofs.
- Apply logical reasoning to solve a variety of problems.
- Use finite-state machines to model computer operations

MODULES	Teaching Hours
MODULE I: Boolean Algebra and Lattices: Partially ordered sets. Lattices, distributive, complemented lattices. Boolean lattice and algebra, unions and finite functions and Boolean algebra. Boolean functions and Boolean expressions, Propositional calculus, design and implementation of digital networks and switching circuits	14 hours
MODULE II: Combinatorics: Basic counting principles, permutations and combinations, principles of inclusion and exclusion, recurrence relations and generating functions, applications. Pigeonhole Principle	12 hours
MODULE III: Graphs: Basic terminology multi- graphs, weighted graphs, paths and circuits, Eulerian and Hamiltonian paths and circuits	12 hours
MODULE IV: Adjacency and incidence matrices, minimal paths, trees, transport networks, applications-flow charts and state transition graphs.	14 hours
MODULE V: Coding Theory: Semi groups, monoids and group codes and group codes, Coding of binary information and error detection, decoding and error correction.	12 hours

Course Outcomes:

After studying this course, students will be able to:

- Identify and apply basic concepts of set theory, arithmetic, logic, proof techniques, binary relations, graphs and trees.
- Communicate both technical and non-technical information in a range of forms (written, oral, electronic, graphic,) and work as an effective team member.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- C. L. Liu: Elements of discrete Mathematics, McGraw Hill, International (1986).
- B. Kolman, R. C. Busby and S. Ross: Discrete Mathematical structures, Prentice Hall of India, New Delhi (1998).
- J. P. Tremblay and R. Manohar: Discrete Mathematical structure with Applications to Computer Science, Tata McGraw Hill Edition (1997).
- N. Deo, Graph Theory with Applications to Engineering and Computer Sciences, Prentice Hall of India (1974).
- F. Harary, Graph Theory, Narosa Publishing House, New Delhi (2001).
- L. Lovasz, J. Pelikan, K. Vesztergombi, Discrete Mathematics, Springer, Second Edition (2004).
- V. Krishnamurthy, Combinatorics, Theory and Applications, Affiliated East-West Press Pvt. Ltd (2008).

COURSE: FUZZY SETS AND FUZZY SYSTEM [As per Choice Based Credit System (CBCS) Scheme] Semester –I (Mathematics)			
Course Code	**19MAT16**	**Maximum Marks (CIE)**	**50**
Number of Teaching Hours/Week	**04**	**Maximum Marks (SEE)**	**50**
Total No of Teaching Hours	**64**	**Exam Hours**	**03**
CREDITS-04			

Course Objectives: this course will enable students to:

- To develop familiarity with the physical concepts and facility with the mathematical methods of Fuzzy sets.
- Develop skills in formulating and solving Fuzzy sets problems.
- To gain an understanding of the history and knowledge of physics and the Fuzzy sets principles that shape our world.

MODULES	Teaching Hours
MODULE I: Basic Fuzzy concept: introduction. Crisp set, Fuzzy sets, types of Fuzzy sets, basic, concepts, properties of cuts, preparation of fuzzy sets, extension principle of fuzzy sets.	12 hours
MODULE II: Fuzzy Relations on Sets and Fuzzy Sets, Operation Fuzzy sets: Types of operations Fuzzy complements, Fuzzy intersections, Properties of the Min-Max Composition	14 hours
MODULE III: t-co-norms, combinations, aggregation operations Compositions of Fuzzy Relations Fuzzy Arithmetic Fuzzy numbers Linguistic variables, Linguistic table Arithmetic operations on Fuzzy numbers Lattice of Fuzzy numbers,	14 hours
MODULE IV: Fuzzy equations Fuzzy Relations and Fuzzy Graphs , Properties of the Min-Max Composition Fuzzy Analysis, Fuzzy Functions on Fuzzy Sets, Extreme of Fuzzy Functions ,	12 hours
MODULE V: Fuzzy Logic and Approximate Reasoning, Classical Logics Revisited, Approximate and Plausible Reasoning, Fuzzy Languages, Support Logic Programming and Fril.	12 hours

Course Outcomes:

After studying this course, students will be able to:

- Demonstrate an intermediate knowledge of Fuzzy sets.
- Demonstrate a basic knowledge of t-norms. Fuzzy unions; t-co-norms.
- Apply advanced Linguistic variables Arithmetic operations on Fuzzy numbers.
- Demonstrate an intermediate knowledge of Fuzzy unions; t-co-norms, combinations, aggregation operations.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- George J.Klor and Yuan Fuzzy set and Fuzzy logic theory and applications. PHI George J.Klor and Tina a. Fotger. Fuzzy set unceratinity and information PHI (1994).
- Kaufman A., introduction to Fuzzy set subset-vol Academic press (1975).
- Driankov D and others, An introduction to Fuzzy set (1993).
- B.Kosko & others, Fuzzy logic with engineering Applications, PHI (1997).

COURSE: MAXIMA LAB [As per Choice Based Credit System (CBCS) Scheme] Semester –I (Mathematics)			
Course Code	**19MATL17**	**Maximum Marks (CIE)**	**50**
Number of Teaching Hours/Week	**02**	**Maximum Marks (SEE)**	**50**
Total No of Teaching Hours	**32**	**Exam Hours**	**03**
CREDITS-04			

Course Objectives: this course will enable students to:

- Arm the students with the basic programming concepts of maxima.
- Understand can solve the problems by using maxima software.
- Understand and develop well-structured programs using maxima.
- Learn the basic data structures through implementing in research.

1	Introduction to Numerical Computation.
2	History and Installations.
3	Command Prompts.
4	Working with Maxima and Maxima files.
5	Formatting command prompt display.
6	Pre define constants.
7	Common mathematical Functions.
8	Operators, Variables.
9	Program for set theory
10	Program for Newton method
11	Program for measures of central Tendency
12	Program for Laplace transform
13	Function program: and Limit
14	Program for integration by parts
15	Program for integration by substitution
16	Program for LPP using simplex method
17	Compute a program for simultaneous equation by elimination method

Course Outcomes:

After studying this course, students will be able to:

- Arm the students with the basic programming concepts of maxima.
- Solve the problems by using maxima software.
- Develop well-structured programs using maxima.
- Implement using basic data structures in research.

Question Paper Pattern:

- The question paper having two questions.
- 15% for write up of program.
- 25% for execution of given programs.
- 10% viva-voce.

PAPER: SCILAB [As per Choice Based Credit System (CBCS) Scheme] Semester –I (Mathematics)			
Subject Code	**19MATL18**	**IA Marks**	**50**
Number of Lecture Hours/Week	**02**	**Exam Marks**	**50**
Total No of Lecturer Hours	**32**	**Exam Hours**	**03**
CREDITS-02			

Course Objectives: this course will enable students to:

- Arm the students with the basic programming concepts.
- understand Scilab and its roles in problem solving techniques in research
- Understand and develop well-structured programs using Scilab.
- Solve complicated problems easily in Scilab.
- Save time in calculation and drawing graphs for their research
- To learn the basic data structures through implementing in Scilab

1	Introduction to Numerical Computation
2	History and installations.
3	Command Prompts.
4	Working with Scilab and Scilab files.
5	Formatting command prompt display.
6	Pre define constants.
7	Common mathematical Functions.
8	Operators, Variables.
9	Boolean Data.
10	Working with numbers system (Complex Number, real number).
11	Working with Arrays.
12	Working with Matrix Operations.
13	Finding Roots for sets of Linear Equations.
14	Plotting

Course Outcomes:

After studying this course, students will be able to:

- Problem solving through computer programming
- Write clear, elementary Scilab.
- Understand algorithmic thinking and apply it to programming.
- Understand problem-solving techniques.
- Code with Arithmetic, increment, decrement, assignment, relational, equality and logical operators.

Question Paper Pattern:

- The question paper having two questions.
- 15% for write up of program.
- 25% for execution of given programs.
- 10% viva-voce.

COURSE: PARTIAL DIFFERENTIAL EQUATIONS
[As per Choice Based Credit System (CBCS) Scheme]
Semester –II (Mathematics)

Course Code	**19MAT21**	**Maximum Marks (CIE)**	**50**
Number of Teaching Hours/Week	**04**	**Maximum Marks (SEE)**	**50**
Total No of Teaching Hours	**64**	**Exam Hours**	**03**

CREDITS-04

Course Objectives:

This course will enable students to:

- Introduce students to partial differential equations, and solve linear Partial Differential with different methods.
- Introduce students to some physical problems in Engineering and Biological models that Results in partial differential equations.

MODULES	**Teaching Hours**
MODULE I: Partial Differential Equations of First Order: Introduction, classification of the first order partial differential equations, solution of partial differential equations of the first order, integral surfaces passing through curve Surface orthogonal to a given system of surfaces, geometrical proof of Lagrange's differential equation, non-linear partial differential equations of the first order, compatible systems of first order equations, condition of compatibility particular case examples Jacobi's method examples, the method of characteristics for semi linear, quasilinear equations	14 hours
MODULE II: Partial Differential Equations of Second Order: Origin of second order equations, classification of Partial Differential Equations, Partial differential equation of second order with variable coefficient and its different types	12 hours
MODULE III: Laplace: Wave equation: Introduction one dimensional wave equation in rectangular co-ordinates, two-dimensional wave equations in rectangular co-ordinates Laplace equation in rectangular co-ordinates, diffusion equation, solution of a linear partial differential equation by separation of variables, solution of one dimensional wave equation by separation of variables, solution of two dimensional wave equation by separation of variables, solution of two dimensional Laplace equation by separation of variables in rectangular co-ordinates,	14 hours
MODULE IV: Reduction of PDE to canonical form: Introduction classification of linear partial differential equation of second order in two independent variables, reduction of canonical forms by Laplace transformation, working	12 hours

method for reducing a hyperbolic, parabolic and elliptic equation to its canonical form	
MODULE V: Non-Linear Partial Differential Equations: Charpit's Method-examples, Jacobi's Method-Examples, Monge's Method: Type1-Rr+Ss+Tt=V leads to two distinct intermediate integrals and both of them are used to get the desired solution, type2-Rr+Ss+Tt=V leads to two distinct intermediate integrals and only one is employed to get the desired result.	12 hours

Course Outcomes:

After studying this course, students will :

- Understand the Transforms which are useful in solving problems and are able to describe real-world systems using PDEs.
- Solve first order PDEs using the method of characteristics, canonical variables for initial-value problems, Separation of Variables and Fourier series for boundary value problems.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- Ian. Sneddon, Elements of Partial Differential equations, International Student Edition.
- F.John, Partial Differential Equations, Springer.
- P.Prasad,R.Ravindran, Introduction to Partial Differential Equations, New.
- Gupta, Malik and Mittal, Differential equations 3rd Edition, Pragati Prakashan, 1995.
- T. Amarnath, an Elementary Course on Partial differential Equations, Narosa.

PAPER: ALGEBRA – II [As per Choice Based Credit System (CBCS) Scheme] Semester –II (Mathematics)			
Subject Code	**19MAT22**	**Maximum Marks (CIE)**	**50**
Number of Lecture Hours/Week	**04**	**Maximum Marks (SEE)**	**50**
Total No of Lecturer Hours	**64**	**Exam Hours**	**03**
CREDITS-04			

Course Objectives: this course will enable students to:

- Approach to teaching algebra should help students attach meaning to the abstract concepts of algebra.
- Standards require students to use algebra as a tool for representing and solving a variety of practical problems.
- Tables and graphs will be used to interpret algebraic expressions, equations and inequalities and to analyze behaviors of functions.
- Graphing calculators, computers and other appropriate technology tools will be used to assist in teaching and learning.

MODULES	Teaching Hours
MODULE I: Linear Algebra: Linear transformation, Algebra of linear transformation, Characteristic roots, interpretation in terms of matrices, vector space.	14 hours
MODULE II: Canonical forms: Triangular Nilpotent, Jordan and rational, trace, transpose and determinant of linear transformation Jordan Forms, The Rational Forms, Bilinear Forms, Definition and Examples, The matrix of a Bilinear Form, Orthogonality, and Classification of Bilinear Forms.	12 hours
MODULE III : Functional and dual spaces: inner product space orthogonal sets, Hermitian Modulery and normal transformations, bilinear, quadratic and hermitian forms.	14 hours
MODULE IV: Number theory**:** Divisibility, Linear diopahantine equation, quadratic congruence.	12 hours
MODULE V: Quadratic residues: sum of two squares, arithmetic functions, Mu, Tau, Phi and Sigma functions, symmetric matrices. Biography of Mathematicians (Srinivas Ramanujam, Aryabhata, Bhaskaracharya, Leonhard Euler, Cottfried W Leibnitz, J.B.J Fourier).	12 hours

Course Outcomes:

After studying this course, students will be able to:

- Apply problem-solving techniques to model both mathematical and real-world contexts.
- Apply critical thinking and analytical reasoning skills in mathematical settings.
- Retrieve and utilize mathematical skills as Modulates arise.
- Make connections between mathematical problem solving and its application in other settings.
- Identify and evaluate incorrect solutions.
- Repeat exercises that were incorrectly answered.
- Identify areas of strength and weakness.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- I. N. Herstein, Topics in Algebra, 2nd Edition, John – Wiley & Sons. New York (1975).
- Surjit Singh & Qazi Zameeruddin, Modern Algebra, Vikas publishing House (1990).
- S. K. Jain, P. B. Bhattacharya & S. R. Nagpaul, Basic Abstract Algebra, Cambridge University Press (1997).
- J. J. Rotman, Galois Theory, 2nd Edition, Universitext, Springer – Verlag (1998).
- I. N. Herstein, Abstract Algebra, Maxwell – McMillan Publication (1990).

COURSE: COMPLEX ANALYSIS [As per Choice Based Credit System (CBCS) Scheme] Semester –II (Mathematics)			
Course Code	**19MAT23**	**Maximum Marks (CIE)**	**50**
Number of Teaching Hours/Week	**04**	**Maximum Marks (SEE)**	**50**
Total No of Teaching Hours	**64**	**Exam Hours**	**03**
CREDITS-04			

Course Objectives: this course will enable students to:

- Learn the geometry of complex numbers, mappings in the complex plane, the theory of multi-valued functions, and the calculus of functions of single complex. Equip students with necessary knowledge and skills to enable them handle mathematical operations, analyses and problems involving complex numbers.

MODULES	Teaching Hours
MODULE I: Analytic functions, Cauchy–Riemann equations, Harmonic functions, Harmonic conjugate functions, and their relation to analytic functions.	14 hours
MODULE II: Complex integration complex valued functions contours, contour integrals, Cauchy-Gourat Theorem, Cauchy integral formula Morera's theorem Liouville's theorem, Fundamental theorem of algebra,	14 hours
MODULE III: Power Series congruence of sequence and series, power series and analytic function Taylor's series, laurent's series, absolute and uniform convergence, integration and differentiation of power series	12 hours
MODULE IV: Taylor and Laurent's expansions, Singularities, Poles, Removable and Isolated essential singularities, Classification of singularities using Laurent's expansion.	12 hours
MODULE V: Behavior of an analytic function in the neighborhood of a singularity. Principles of analytic continuation. Residue theorem and contour integrals. Argument principle. Rouch's theorem. Its applications	12 hours

Course Outcomes:

After studying this course, students will be able to:

- Know basic mathematical operations with complex numbers in Cartesian and polar forms.
- Determine continuity/differentiability/analyticity of a function and find the derivative of a function.
- Rotation and scaling as an example of complex multiplication. Continue to develop proof techniques.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- L. V. Ahlfors, Complex Analysis, Second Edition, McGraw Hill Book Co., New York (1966).
- John B. Conway, Functions of one Complex variable (second edition) SpringerVerlag, New York (1973).
- E. C. Titchruarsh, Theory of Functions, (second edition) Oxford university Press, N. J. Fairlawn (1939).
- T. O. Moore and E. H. Hadlock, Complex Analysis, Allied Publishers Ltd. (1993).
- Serge Lang, Complex Analysis, Addison – Wesley, Publishing Company (1997).

COURSE: OPERATIONS RESEARCH-I [As per Choice Based Credit System (CBCS) Scheme] Semester –II (Mathematics)			
Course Code	**19MATO24**	**Maximum Marks (CIE)**	**50**
Number of Teaching Hours/Week	**04**	**Maximum Marks (SEE)**	**50**
Total No of Teaching Hours	**64**	**Exam Hours**	**03**
CREDITS-04			

Course Objectives: The Subject of Operation research has being growing theoretically and a wide ranging applications in the field of engineering, business, Management, economics and medical sciences etc. It is introduced to the students as a job-oriented course.

- The main aim of this paper is to introduce the fundamentals of operations research and its techniques used in different fields of interest. Operation research is most important in planning, scheduling, and cost and job control for the efficient and economical conduct of industrial Endeavour.

MODULES	Teaching Hours
Module I: Linear Programming: Basic Concepts, convex sets, Open and Closed spaces, Simplex, formulation of linear problems(LPP), Feasible solution , basic feasible solutions , optimal solutions, Graphical Methods, Simplex method, Big-M method.	14 hours
Module II: Transportation Problem: Mathematical Formulation, existence of feasible solution, Transportation table, Initial basic feasible solutions, North-West Corner Rule, Row minima-method, Column minima method, Matrix minima Method, Vogel's Approximation method (VAM), Transportation Algorithm, degeneracy in transportation problem, unbalanced transportation Problem .	14 hours
Module III: Assignment problems: Mathematical Formulation, Assignment algorithm, Routing problem, Travelling Salesman problem.	12 hours
Module IV: Networks: Network Minimization, Shortest Route problem, Shortest route algorithms for acyclic networks, Maximal Flow problem, Linear programming Representation of Networks.	12 hours
Module V: Integer Programming: Methods of Integer Programming problems, Cutting method, Gromory's fractional cut Algorithm.	12 hours

Course Outcomes:

After studying this course, students will be able to:

- Develop operational research models from the verbal description of the real system.
- Understand the mathematical tools that are needed to solve optimization problems. Use mathematical software to solve the proposed models.
- Understandable to the decision-making processes in Management Engineering.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- Taha, H.A., Operation Research-An introduction, Printice Hall of India (2014).
- Gupta, P.K. and Hira, D.S., Operations Research, S. Chand & Co (1976).
- Sharma, S.D., Operation Research, Kedar Nath Ram Nath Publications (2012).
- Sharma, J.K., Mathematical Model in Operation Research, Tata McGraw Hill. (2012).
- S. Kalavati, Operation Research, Vikas pub. (2001)
- Kanti Swarup, Gupta, P.K. and Manmohan: Operations Research, S.Chand and Sons (1980).
- G. Hadley, Linear Programming, Narosa publishing house, New Delhi, (1987).

COURSE: ADVANCED MEASURE THEORY [As per Choice Based Credit System (CBCS) Scheme] Semester –II (Mathematics)			
Subject Code	**19MAT25**	**Maximum Marks (CIE)**	**50**
Number of Lecture Hours/Week	**04**	**Maximum Marks (SEE)**	**50**
Total No of Lecturer Hours	**64**	**Exam Hours**	**03**
CREDITS-04			

Course Objectives: this course will enable students to:

- Gain understanding of the measure theory and definition and main properties of the integral.
- To construct Lebesgue's measure on the real line and in *n*-dimensional Euclidean space.
- To explain the basic advanced directions of the theory.
- The course introduces the basic mathematical framework underlying its rigorous analysis, and is therefore meant to provide some of the tools which will be used in more advanced courses in probability.
- This makes it one of the cornerstones of modern mathematics, with direct application to the theory of integration, probability theory and analysis.

MODULES	Teaching Hours
MODULE I Ring of a set, σ-algebra of sets, T space, Caratheodory's postulates of outer measure, measurable set, problems, related to measure function, ring of set σ-algebra of sets	**12 hours**
MODULE II: Lebesgue, measure of a set, exterior and interior measure, Borel measurable set	**14 hours**
MODULE III: Measurable function, almost everywhere, equivalent function, characteristic function Borel measurable measurability of functions	**14 hours**
MODULE IV: Lebesgue, integral of function, First mean value theorem, convergence in measure, reisz's theorem, D.F. Egoroff's theorem, lebesgue, bounded convergence theorem, fatou's lemma, Absolute continuous function, indefinite integration and differentiation	**12 hours**
MODULE V: Signed measure, positive and negative sets Hahn de-composition theorem, singular measure, Jordan decomposition, absolutely continuous measure function.	**12 hours**

Course outcomes:

After studying this course, students will be able to:

- The students will learn about measure theory, random variables, independence, expectation and conditional expectation, product measures and discrete-parameter martingales.
- Student will have developed in particular his/her capacity in: --
- Choosing and using methods and fundamental tools of calculation to solve mathematical problems.
- recognizing the fundamental concepts of certain current mathematical theories ;
- Establishing the main links between those theories, explaining them and motivating them by examples.
- Identifying the unifying aspects of different situations and phenomena in the mathematical science, thanks to the abstract and experimental approach peculiar to the exact sciences.

Question Paper Pattern:

- The question paper having Five questions
- Each full question consisting of 10 marks.
- There will be 2 full questions (with maximum of two sub questions) from each Module.
- The student will have to answer 5 full questions.

Reference Books

- H.L.Royden: Real Analysis (Chapter 1,3,4,5 and 6).3rd
- Edition,MacMillan,NewYork(1963)
- Inder Kumar Rana, Measure Theory and Integration, Narosa.
- C.Goffman : Real Functions,Holt,Rinehart and Winston Inc.New York (1953)
- P.K.Jain and V.P.Gupta : Lebesgue Measure and Integration, Wiley Eastern Ltd.(1986)
- P.Halmos, Measure Theory, Narosa Publishers.

COURSE: FUZZY LOGIC AND APPLICATIONS [As per Choice Based Credit System (CBCS) Scheme] Semester –II (Mathematics)			
Course Code	**19MAT26**	**Maximum Marks (CIE)**	**50**
Number of Teaching Hours/Week	**04**	**Maximum Marks (SEE)**	**50**
Total No of Teaching Hours	**64**	**Exam Hours**	**03**
CREDITS-04			

Course Objectives:

- The Subject of fuzzy logic and application has being growing theoretically and wide ranging applications in the field of engineering, business, Management, economics and medical sciences etc. It is introduced to the students as a job-oriented course.
- It helps to understand the different lounges in fuzzy and its applications.

MODULES	Teaching Hours
Module I: Basic Concept of Fuzzy Sets: Introduction. Crisp set, Fuzzy sets. Types of Fuzzy sets. Basic concepts, properties of a cuts, representation of Fuzzy sets, extension principle of Fuzzy sets.	12 hours
Module II: Operations on Fuzzy sets: Types of operations Fuzzy complements, Fuzzy intersections, norms. Fuzzy unions. T-co-norms, combinations, aggregation operations.	12 hours
Module III: Fuzzy Arithmetic: Fuzzy numbers, Linguistic variables, Arithmetic operations on Fuzzy numbers, Lattice of Fuzzy numbers, Fuzzy equations.	14 hours
Module IV: Fuzzy Relations: Crisp Versus fuzzy relations. Projections and cylindrical extension, Binary fuzzy relations, on a single set.	12 hours
Module V: Fuzzy and approximate reasoning: Linguistic variables, fuzzy logic, classical logic revisited, linguistic truth table, approximate and possible reasoning, fuzzy laungveges, support logic programming and frill.	14 hours

Course Outcomes:

After studying this course, students will be able to:

- Use mathematical software to solve the proposed models.
- Develop a report that describes the knowledge of fuzzy and logic, its applications.
- Describe and explain the ethical obligations and responsibilities of business.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- Groge J. Klor. And Yuan Fuzzy Logic, Theory and Applications. PHI. Georgo J. Klir and Tina a, Fotger Fuzzy sets uncertainly and information, PHI (1994).
- Kaufmann, A., Introduction to the theory of Fuzzy subsets-vol. Academic press (1975).
- Driankov D and others. An introduction to Fuzzy control.
- B. Kosko and others, Fuzzy logic with Engineering Applications. PHI.

COURSE: PROGRAMMING IN C LAB [As per Choice Based Credit System (CBCS) Scheme] Semester –II (Mathematics)			
Subject Code	**19MATL27**	**Maximum Marks (CIE)**	**50**
Number of Lecture Hours/Week	**2**	**Maximum Marks (SEE)**	**50**
Total No of Lecturer Hours	**32**	**Exam Hours**	**03**
CREDITS-02			

Course Objectives: this course will enable students to:

- Arm the students with the basic programming concepts.
- To understand computer programming and its roles in problem solving
- To understand and develop well-structured programs using C language
- To learn the basic data structures through implementing in C language

I	History and Development of Computer
II	Basic Structure of C program
III	C-tokens, Data Types,
IV	Operators
V	Conditional Control & Looping Statements
1	Write a C Program for Conversion of Temperature from Fahrenheit to Celsius
2	Write a C Program to read the radius of circle and compute its area and circumference
3	Write a C Program to read five digit numbers and print in its reverse order
4	Write a C Program to pick the largest of three numbers
5	Write a C Program to print the given three numbers a, b, c in ascending order
6	Write a C Program to find the root of the quadratic equation
7	Write a C Program to find whether the given year is leap year or not
8	Program to find whether the given three points (x1,y1),(x2,y2) and (x3,y3) are collinear or not
9	Program to add two compatible matrices
10	Program to compute product of two compatible matrices
11	Program to find the smallest element in an array
12	Program to sort the in ascending order
13	Write a C program to calculate the Fibonacci series
14	Program to find the definite integral of given function by using trapezoidal rule
15	Program to find the definite integral of given function by Simpson's 1/3 rule

Course Outcomes:

After studying this course, students will be able to:

- Problem solving through computer programming
- Write clear, elementary C programs.
- Understand algorithmic thinking and apply it to programming.
- Understand problem-solving techniques.
- Code with Arithmetic, increment, decrement, assignment, relational, equality and logical operators.

Question Paper Pattern:

- The question paper having two questions.
- 15% for write up of program.
- 25% for execution of given programs.
- 10% viva-voce.

COURSE: FreeMat LAB [As per Choice Based Credit System (CBCS) Scheme] Semester –II (Mathematics)			
Subject Code	**19MATL28**	**Maximum Marks (CIE)**	**50**
Number of Lecture Hours/Week	**2**	**Maximum Marks (SEE)**	**50**
Total No of Lecturer Hours	**32**	**Exam Hours**	**03**
CREDITS-04			

Course Objectives: this course will enable students to:

- Arm the students with the basic programming concepts.
- To understand computer programming and its roles in problem solving
- To understand and develop well-structured programs FreeMatlab
- To learn the basic data structures through implementing in FreeMatlab

Course Outcomes:

After studying this course, students will be able to:

- Problem solving through computer programming
- Write clear, elementary of FreeMatlab.
- Understand algorithmic thinking and apply it to programming.
- Understand problem-solving techniques.
- Using Mathematical Software They can Implement in Problem solving and Graphical representation

Question Paper Pattern:

- The question paper having two questions.
- 15% for write up of program.
- 25% for execution of given programs.
- 10% viva-voce.

COURSE: GRAPH THEORY [As per Choice Based Credit System (CBCS) Scheme] Semester –III (Mathematics)			
Course Code	**19MAT31**	**Maximum Marks (CIE)**	**50**
Number of Teaching Hours/Week	**04**	**Maximum Marks (SEE)**	**50**
Total No of Teaching Hours	**64**	**Exam Hours**	**03**
CREDITS-04			

Course Objectives: this course will enable the students to:

- Learn basics about graph theory and can draw graphs.
- Learn core ideas in Plane graph and its real world applications.
- Practice creative problem solving and improve skills in this area.
- Learn about coloring, edge coloring, vertex coloring and can know its application.

MODULES	Teaching Hours
MODULE I: Graph, Degree of a vertex spanning sub graph, induced sub graph, walk, trail, path, cycle, girth circumference, component, isomorphism, cut vertex, bridge, regular graph, complimentary of a graph, self-complimentary graph , complete graph, bipartite graph, complete bipartite graph.	**14 hours**
MODULE II: Planar Graph: Operations on graph, combinatorial & geometrical graphs, planar graph, plane graph, maximal planar graph, detection of planarity, sub division of graph, inner vertex set, inner vertex number, outer planar minimally non outer planar graph..	**14 hours**
MODULE III: crossing number and thickness of a graph, coloring, color class chromatic number of a graph, Bi-Chromatic graph, vertex coloring, vertex coloring algorithm, simple sequential algorithm, welsh- Powell algorithm smallest last sequential algorithm.	**12 hours**
MODULE IV: Edge coloring coloring of a plane map Four color problem edge covering number vertex covering number, vertex independence number, edge independence number.Factor of G, n-factorization, 2-facotization,	**12 hours**
MODULE V: Dominating numbers, dominating sets and total dominating sets, total dominating number.	**12 hours**

Course Outcomes:

After studying this course.

- Students can define basics about graph theory and can draw graphs.
- Students learned core ideas in Graphs, Trees and real world applications.
- Students can solve creative problem solving and improve skills in this area.
- Students can solve about networking, flow problems.
- Students having knowledge about Hamiltonian and Eulerian graphs and its difference.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- M. Behzad, G. Charatrand and L. Lesniak-Foster: Graphs and Digraphs, Wadsworth, Belmont, Calif (1981).
- Narasing Deo: Graph Theory with Applications to Engineering and Computer Science, Prentice Hall, India (1995).
- J. A. Bondy and U. S. R. Murthy: Graph Theory with Applications, MacMillan, London (1976).
- F. Buckley and F. Harary: Distance in Graphs, Addison-Wesley (1990).
- Diestel: Graph Theory, Springer-Verlag, Berlin (2002).
- R. Gould: Graph Theory, the Benjamin / Cummings Publ. Co. Inc. Calif (1988).
- F. Harary: Graph Theory, Addison Wesley, Reading mass (1969).

COURSE: COMPUTATIONAL NUMERICAL METHODS [As per Choice Based Credit System (CBCS) Scheme] Semester –III (Mathematics)			
Course Code	**19MAT32**	**Maximum Marks (CIE)**	**50**
Number of Teaching Hours/Week	**04**	**Maximum Marks (SEE)**	**50**
Total No of Teaching Hours	**64**	**Exam Hours**	**03**
CREDITS-04			

Course Objectives: this course will enable students to:

The objective will be to train students to understand why the methods work, what type of errors to expect and when an application might lead to difficulties. In particular,

MODULES	Teaching Hours
MODULE I: Gauss Elimination, Jacobie's Method, LU decomposition Gauss Jordan's Method Gauss Seidel Method, Graeffe's root squaring method Birge-Vieta method, bairstow Method Power Method	**14 hours**
MODULE II: **Numerical Solution of Ordinary Differential Equation IVP** Taylor's Series method, Euler's Method, Modified Euler's method, Explicit Runge-Kutta Methods, I and II order Runge-Kutta methods, Runge-Kutta IV order method, Runge-Kutta method for simultaneous	**14 hours**
MODULE III: higher order differential equations Multi Step Methods, Adam Bash forth's and Milne's Predictor-Corrector Method, **Solution of BVP:** Finite Difference Method, Shooting Method	**10 hours**
MODULE IV: **Numerical Solution of Partial Differential Equation:** **Parabolic PDE:** Crank-Nicholson method, Gauss Seidal iterative scheme for Crank-Nicholson method, Successive Over Relaxation (SOR), ADI method, Parabolic equation in cylindrical & spherical co-ordinates.	**13 hours**
MODULE V: **Elliptical PDE:** Laplace Equation, Poisson Equation, Explicit Finite difference method, Implicit Method, Derivative Boundary Condition, Iterative Method, Hyperbolic PDE, method of Characteristic.	**13 hours**

Course Outcomes:

After studying this course, students will be able to:

- Understand the errors, source of error and its effect on any numerical computations and also analysis the efficiency of any numerical algorithms.
- Learnt how to obtain numerical solution of nonlinear equations using bisection, secant, Newton and fixed-point iteration methods.
- Solve system of linear equations numerically using direct and iterative methods.
- Learn how to solve definite integrals and initial value problems numerically.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- R. K. Jain, S. R. K. Iyengar and M. K. Jain, Numerical methods for scientific and Engineering computation, Wiley Eastern (2001).
- S. D. Conte and Carl De Boor, introduction to Numerical Analysis, McGraw Hill C. E. Froberg, Introduction to Numerical Analysis Addison Wesley (1995).
- Atkinson K.E, An Introduction to Numerical Analysis, 3 rd Ed, John Weiley and sons (1989).
- Hilderband F. B Introduction to Numerical Analysis Ed 5, Tata McGraw Hill, (1986).

COURSE: FLUID MECHANICS [As per Choice Based Credit System (CBCS) Scheme] Semester –III (Mathematics)			
Course Code	**19MAT33**	**Maximum Marks (CIE)**	**50**
Number of Teaching Hours/Week	**04**	**Maximum Marks (SEE)**	**50**
Total No of Teaching Hours	**64**	**Exam Hours**	**03**
CREDITS-04			

Course Objectives: this course will enable students to:

- Provide a strong foundation in Fluid Mechanics to the students of various engineering disciplines and applied mathematics.
- Introduce fundamental aspects of fluid flow behaviour. Also understand basic principles of various mechanical operations, construction and working of the equipments.
- Study analytical solutions to variety of simplified problems

MODULES	Teaching Hours
MODULE I: **Motion of In-viscous fluids:** Introduction, Basic Definitions and types of flows, Lagrange's and Euler's equation of motion, Equation of continuity, Applications of Fluid Mechanics, Local and individual time rate of change.	14 hours
MODULE II: **Boundary surface**: Euler's and Lagrange's equation of continuity, equations of continuity in different co-ordinates, symmetrical forms of equations of continuity, Boundary conditions on velocity, temperate and pressure.	14 hours
MODULE III: **Equation of motion**: pressure equation, Bernoulli's equation, Helmholtz Vorticity equation for impulsive action, equation for impulsive action, Kelvin circulation theorem.	12 hours
MODULE IV: Sources, Sinks, doublets and their images, complex potential, image with respect to a straight line, image with respect to a circle, Milne-Thomson circle theorem, Blasius equation (theorem), equation of motion of circular cylinder with circulation.	12 hours
MODULE V: **General theory of Ir-rotational motion:** Ir-rotational motion, kinetic energy of finite liquid, kinetic energy of infinite liquid, Kelvin's minimum energy theorem, mean value of potential function, Green's theorem.	12 hours

Course Outcomes:

After studying this course.

- The student will understand stress-strain relationship in fluids, classify their behavior and also establish force balance in static systems. Further they would develop dimensionless groups that help in scale-up and scale-down of fluid flow systems.
- Students will be able to apply Bernouli principle and compute pressure drop in flow systems of different configurations.
- Students can develop their carrier in fluid mechanics research field.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- F. Charlton, Fluid Dynamics, C. B. S Publisher Delhi (1985).
- G. K. Batchelor, an Introduction to Fluid Dynamics, Cambridge. (2012).
- Frank M.White, Fluid Mechanics, McGraw Hill, (2011).
- Pijush K. Kundu, lra M. Cohen, David R. Dowling, Fluid Mechanics. (2012).
- Er. R. K. Rajput, A text Book of fluid Mechanics, S. Chand. (2008).
- Yunus A Cengel, John M Cimbala, Fluid mechanicsd fundamentals and applications, (2012).
- A.C.Erign: Mechanics of continua
- W. Prager: Mechanics of continuous media
- A.L.Chorin and A Marsden: A Mathematical introduction to fluid dynamics, springer, Verlag, New Yark, (1993).
- L.D.Landav and E.M.Lipchil: Fluid mechanics, Pragamon press, Londan (1985).
- R.K Rathy : An introduction to fluid dynamics, oxford and IBH pub. Company New Delhi (1976).
- W. H. Besaint, and A. s. Ramsey: A treatise of Hydrodynamics, part II CBS Publishers Delhi, (1988).
- J. L. Bansal, Viscous Fluid Dynamics (1977).
- A. D. Young: Boundary Layers AJAA education Series, Washington. DC (1989).

COURSE: OPERATIONS RESEARCH-II [As per Choice Based Credit System (CBCS) Scheme] Semester –III (Mathematics)			
Subject Code	**19MATO34**	**Maximum Marks (CIE)**	**50**
Number of Lecture Hours/Week	**04**	**Maximum Marks (SEE)**	**50**
Total No of Lecturer Hours	**64**	**Exam Hours**	**03**
CREDITS-04			

Course Objectives: this course will enable students to:

This Module aims to introduce students to use quantitative methods and techniques for effective decisions–making; model formulation and applications that are used in solving business decision problems.

MODULES	Teaching Hours
MODULE I: Linear Programming-I: Artificial variables, Solution of Linear Program Problems (LPP) By method of penalty and two phase simplex method Duality in Linear.	14 hours
MODULE II: Linear Programming-II: Programming concept of Duality, properties, fundamental theorem of Duality, Duality Simplex method, and sensitivity analysis.	14 hours
MODULE III: Theory of Games: Introduction, Maxmini-Minimax principle mixed strategies, Graphical solution of 2 X N and M X 2 games Dominance property.	12 hours
MODULE IV: Queuing theory: Introduction Queue Discipline, Distribution of Inter-Arrival times and service times, queue classification, steady state solution of Markovian Queuing models M/M/1, M/M/1 with limited waiting space.	12 hours
MODULE V: Simulation: Introduction, elements of Simulation model, Event type generation of random Phenomena, Monte-Carlo Technique, steps in simulation, simulation language.	12 hours

Course Outcomes:

After studying this course, students will be able to:

- Identify and develop operational research models from the verbal description of the real system.
- Understand the mathematical tools that are needed to solve optimization problems. Use mathematical software to solve the proposed models.
- Develop a report that describes the model and the solving technique, analyze the results and propose recommendations in language understandable to the decision-making processes in Management Engineering.
- Explain the major concepts in the functional areas of accounting, marketing, finance, and management.
- Describe and explain the ethical obligations and responsibilities of business.
- Apply decision-support tools to business decision making.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- Taha, H.A., Operation Research-An introduction, Printice Hall of India (2014).
- Gupta, P.K. and Hira, D.S., Operations Research, S. Chand & Co (1976).
- Sharma, S.D., Operation Research, Kedar Nath Ram Nath Publications (2012).
- Sharma, J.K., Mathematical Model in Operation Research, Tata McGraw Hill. (2012).

DIFFERENTIAL GEOMETRY [as per Choice Based Credit System (CBCS) Scheme] Semester –III (Mathematics)			
Subject Code	**19MAT344**	**IA Marks**	**50**
Number of Lecture Hours/Week	**03**	**Exam Marks**	**50**
Total No of Lecturer Hours	**48**	**Exam Hours**	**03**
CREDITS-03			

Course Objectives: this course will enables:

- To provide an introduction to the differential geometry of curves and surfaces in space, both in its local and global aspects, with special emphasis on a geometric point of view, as a basis for further study or for applications (especially in physics, chemistry, civil and electrical engineering, graphics).
- Students should be able to communicate mathematics both orally and in well written sentences and should be able to explain solutions to problems.

MODULES	Teaching Hours
MODULE I: Euclidean spaces, tangent vectors, vector fields, directional derivatives, curve in E3, 1- Forms, differential forms, mappings on Euclidean spaces, derivative map, dot product in E3, frame fields.	**11 hours**
MODULE II: Cross product of tangent vectors, curves in E3, arc length, reparametrisation, Frenet formulas, Frenet frame field, curvature, torsion and bitorsion of a MODULE speed curve.	**11 hours**
MODULE III: Arbitrary speed curves, Frenet formulas for arbitrary speed curves, covariant derivatives, Frame field in E3, connection forms of a frame field, Carton's structural equations	**8 hours**
MODULE IV: Calculus on a surface, co-ordinate patch, proper patch, surfaces in E3, Monge patch, examples, differentiable functions and tangent and normal vector fields on a surface. Mapping of surfaces, topological properties of surfaces, Manifolds.	**10 hours**
MODULE V: Shape operators, Normal curvature, Gaussian curvature, computational techniques special curves in surfaces.	**8 hours**

Course Outcomes:

After studying this course, students will be able to:

- Explain the concepts and language of differential geometry and its role in modern mathematics.
- Analyse and solve complex problems using appropriate techniques from differential geometry Apply problem-solving with differential geometry to diverse situations in physics, engineering or other mathematical contexts.
- Apply differential geometry techniques to specific research problems in mathematics or other fields.
- To explain and apply the concepts and techniques of differential geometry of curves and surfaces.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- Barrett O. Neill, Elementary Differential Geometry, Academic Press, New York(1998)
- Andrev Priestly, Differential Geometry, Springer, (2001).
- Nirmala Prakash, Differential Geometry an Integral approach ,Tata McGraw Hill, New Delhi (2001).
- T. J. Willmore, An introduction to Differential Geometry, Oxford University Press(1999).
- S. Kumaresan, Differential Geometry and Lie Groups, TRIM Series, HBA, (2002)

PAPER: COMPUTATIONAL NUMERICAL METHODS LAB
[As per Choice Based Credit System (CBCS) Scheme]
Semester –III (Mathematics)

Subject Code	**19MATL36**	**Maximum Marks (CIE)**	**50**
Number of Lecture Hours/Week	**02**	**Maximum Marks (SEE)**	**50**
Total No of Lecturer Hours	**32**	**Exam Hours**	**04**

CREDITS-02

Course Objectives: this course will enable students to:

- Arm the students with the basic programming concepts of CNM.
- To understand computer programming and its roles in problem solving
- To understand and develop well-structured problems
- To learn the basic data structures through implement.

1	Introduction.
2	Installation and basic operations
3	Trapezoidal Rule
4	Simpson 1/3rd rule
5	Simpson 3/8th rule
6	Bisection Method.
7	Newton's Raphson Method
8	Gauss Elimination Method
9	Gauss Seidal Iteration Method
10	Eigen value Eigen vector
11	Given's Method
12	Forward Difference Table
13	Backward Difference Table

Course Outcomes:

After studying this course, students will be able to:

- Problem solving through computer programming
- Write clear, elementary Mathematical Software programs.
- Understand algorithmic thinking and apply it to programming.
- Understand problem-solving techniques.
- Code with Arithmetic, increment, decrement, assignment, relational, equality and logical operators.
- Also can implement in research problem solving.

Question Paper Pattern:

- The question paper having two questions.
- 15% for write up of program.
- 25% for execution of given programs.
- 10% viva-voce.

PAPER: PROJECT-I [As per Choice Based Credit System (CBCS) Scheme] Semester –III (Mathematics)			
Subject Code	**19MATP37**	**Maximum Marks (CIE)**	**50**
Number of Lecture Hours/Week	**02**	**Maximum Marks (SEE)**	**50**
Total No of Lecturer Hours	**32**	**Exam Hours**	**04**
CREDITS-02			

PAPER: OPERATIONS RESEARCH [As per Choice Based Credit System (CBCS) Scheme] Semester –IV (Mathematics)			
Subject Code	**19MAT414**	**IA Marks**	**50**
Number of Lecture Hours/Week	**03**	**Exam Marks**	**50**
Total No of Lecturer Hours	**32**	**Exam Hours**	**03**
CREDITS-02			

Course Objectives: this course will enable students to:

This Module aims to introduce students to use quantitative methods and techniques for effective decisions–making; model formulation and applications that are used in solving business decision problems.

MODULES	Teaching Hours
Module I Linear Programming: Basic Concepts, convex sets, Open and Closed spaces, Simplex, formulation of linear problems (LPP), Feasible solution, basic feasible solutions, optimal solutions, Graphical Methods, Simplex method, Big-M method.	11 hours
Module II: Mathematical Formulation, existence of feasible solution, Transportation table, Initial basic feasible solutions, North-West Corner Rule, Row minima-method, Column minima method, Matrix minima Method, Vogel's Approximation method (VAM).	11 hours
Module III: Transportation Algorithm, degeneracy in transportation problem, unbalanced transportation Assignment problems: Mathematical Formulation, Assignment algorithm, Routing problem, Travelling Salesman problem.	8 hours
Module IV: Networks: Network Minimization, Shortest Route problem, Shortest route algorithms for acyclic networks, Maximal Flow problem, Linear programming Representation of Networks.	8 hours
Module V Integer Programming: methods of Integer Programming problems, Cutting method, Gromory's fractional cut Algorithm, Mixed Integr Programming Problems, Branch and Bound Method.	10 hours

Course Outcomes:

After studying this course, students will be able to:

- Identify and develop operational research models from the verbal description of the real system.
- Understand the mathematical tools that are needed to solve optimization problems. Use mathematical software to solve the proposed models.
- Develop a report that describes the model and the solving technique, analyze the results and propose recommendations in language understandable to the decision-making processes in Management Engineering.
- Explain the major concepts in the functional areas of accounting, marketing, finance and management.
- Describe and explain the ethical obligations and responsibilities of business.
- Apply decision-support tools to business decision making.

Question Paper Pattern:

- The question paper will have five modules.
- Each module consists of two full questions (with a maximum of two sub questions) and a student can answer any one.
- In all, the student has to answer five full modules.

Reference Books

- Taha, H.A., Operation Research-An introduction, Printice Hall of India (2014).
- Gupta, P.K. and Hira, D.S., Operations Research, S. Chand & Co (1976).
- Sharma, S.D., Operation Research, Kedar Nath Ram Nath Publications (2012).
- Sharma, J.K., Mathematical Model in Operation Research, Tata McGraw Hill. (2012).

COURSE: PROJECT-II **[As per Choice Based Credit System (CBCS) Scheme]** **Semester –IV (Mathematics)**			
Course Code	**19MATP42**	**Maximum Marks (CIE)**	**100**
Number of Tutorial Hours/Week	**08**	**Maximum Marks (SEE)**	**100**
Total No of Teaching Hours		**Exam Hours**	**03**
CREDITS-08			

COURSE: INTERNSHIP [As per Choice Based Credit System (CBCS) Scheme] Semester –IV (Mathematics)			
Course Code	**19MATI43**	**Maximum Marks (CIE)**	**100**
Number of Tutorial Hours/Week	**11**	**Maximum Marks (SEE)**	**100**
Total No of Teaching Hours		**Exam Hours**	**03**
CREDITS-12			