YMCA UNIVERSITY OF SCIENCE AND TECHNOLOGY FARIDABAD

SYLLABUS

M.SC. MATHEMATICS

(w.e.f. 2014-2015)

(*2 Years Full Time: 4 Semesters Programme*)

VISION AND MISSION OF THE UNIVERSITY

VISION

“YMCA University of Science and Technology aspires to be a nationally and internationally acclaimed leader in technical and higher education in all spheres which transforms the life of students through integration of teaching, research and character building.”

MISSION

- To contribute to the development of science and technology by synthesizing teaching, research and creative activities.
- To provide an enviable research environment and state-of-the art technological exposure to its scholars.
- To develop human potential to its fullest extent and make them emerge as world class leaders in their professions and enthuse them towards their social responsibilities.

VISION AND MISSION OF THE DEPARTMENT

VISION

A department that can effectively harness its multidisciplinary strengths to create an academically stimulating atmosphere; evolving into a well-integrated system that synergizes the efforts of its competent faculty towards imparting intellectual confidence that aids comprehension and complements the spirit of inquiry.

MISSION

- To create well-rounded individuals ready to comprehend scientific and technical challenges offered in the area of specialization.
- To counsel the students so that the roadmap becomes clearer to them and they have the zest to turn the blueprint of their careers into a material reality.
- To encourage critical thinking and develop their research acumen by aiding the nascent spirit for scientific exploration.
- Help them take economic, social, legal and political considerations when visualizing the role of technology in improving quality of life.
- To infuse intellectual audacity that makes them take bold initiatives to venture into alternative methods and modes to achieve technological breakthroughs.

COURSE OBJECTIVE

The M.Sc. course in Mathematics aims at developing mathematical ability in students with acute and abstract reasoning. The course will enable students to cultivate a mathematician's habit of thought and reasoning and will enlighten students with mathematical ideas relevant for oneself and for the course itself. The objective of the MSc programme in Mathematics centres on the study and development of techniques to tackle pure and applied mathematical questions.

COURSE OUTCOMES

- Be able to work as a mathematical professional, or are qualified for a training as scientific researcher.
- To impart fundamental knowledge, thinking skills and technical skills for superior mastery in the areas of mathematical science and applications.
- Enable the students to be well placed in leading business organizations anywhere in the world
- To impart knowledge of basic concepts of C , C++ Languages and MATLAB.
- Enable the students to be well prepared for the CSIR–JRF and GATE examinations.

Syllabi & Course Scheme of M.Sc. (Mathematics)

Total Credit required for the course: 95 Max Marks: 2450

Lab: 03

Project:01

Semester I

Subject code	Title	L	T	P	Sessional Marks	Final Exam Marks	Total	Credits	Category Code
MTH 501	Real Analysis	4	0	0	40	60	100	4	DCC
MTH 503	Algebra	4	0	0	40	60	100	4	DCC
MTH 505	Ordinary Differential Equations	4	0	0	40	60	100	4	DCC
MTH 507	Complex Analysis	4	0	0	40	60	100	4	DCC
MTH 509	Programming in C(theory)	4	0	0	40	60	100	4	DCC
MTH 551	Programming in C Lab	0	0	8	40	60	100	4	DCC
Total		2 0		8	240	360	600	24	

Semester II

Subject code	Title	L	T	P	Sessional Marks	Final Exam Marks	Total	Credits	Category Code
MTH502	Mathematical Statistics	4	0	0	40	60	100	4	DCC
MTH 504	Linear Algebra	4	0	0	40	60	100	4	DCC
MTH 506	Methods of Applied Mathematics	4	0	0	40	60	100	4	DCC
MTH 508	Numerical Analysis	4	0	0	40	60	100	4	DCC
MTH 510	Programming in C++ (Theory)	4	0	0	40	60	100	4	DCC
	Audit Course	2	0	0	25	50	75	0	MAC
MTH 552	Programming in C++ Lab	0	0	8	40	60	100	4	DCC
Total		2 2		8	225	350	575	24	

Semester III

Subject code	Title	L	T	P	Sessional Marks	Final Exam Marks	Total	Credits	Category Code
MTH 511	Topology	4	0	0	40	60	100	4	DCC
MTH 513	Mechanics	4	0	0	40	60	100	4	DCC
MTH 515	Partial Differential Equation	4	0	0	40	60	100	4	DCC
MTH 517	Operations Research	4	0	0	40	60	100	4	DCC
	Open Elective	3	0	0	25	50	75	3	OEC
MTH 553	MATLAB	0	0	8	40	60	100	4	DCC
Total		19		8	225	350	575	23	

Semester IV

Subject code	Title	L	T	P	Sessional Marks	Final Exam Marks	Total	Credits	Category Code
MTH 512	Functional Analysis	4	0	0	40	60	100	4	DCC
MTH 514	Differential Geometry	4	0	0	40	60	100	4	DCC
MTH 516	Fluid Dynamics	4	0	0	40	60	100	4	DCC
MTH 518	Advanced Discrete Mathematics	4	0	0	40	60	100	4	DCC
MTH 520	*Discipline Elective	4	0	0	40	60	100	4	DEC
MTH 554	Project	0	0	8	40	60	100	4	DCC
Total		2 0		8	240	360	600	24	

*Discipline Elective

A .Integral equation & calculus of variation

B. Algebraic coding theory

C. Wavelets and its applications

D. Advanced Operation Research

E. Information theory

Grading Scheme

*Percentage	Grade	Grade Points	Category
95-100	O	10	Outstanding
85-95	A+	9	Excellent
75-85	A	8	Very Good
65-75	B+	7	Good
55-65	B	6	Above Average
45-55	C	5	Average
40-45	P	4	Pass
<40	F	0	Fail
......	Ab	0	Absent

*Lower limit included upper limit excluded

The multiplication factor for CGPA is 10.

1. Automatic Rounding
2. Average difference between actual percentage and CGPA percentage ± 2.5%
3. Worst case difference between actual percentage and CGPA percentage ± 5% if somebody in all the 8 semesters in all the exams (around 75 in numbers) consistently scores at the bottom of the range , say 55 of 55-65 which is a very remote possibility.

M.SC MATHEMATICS SEMESTER I

CODE: MTH -501

SUBJECT NAME: REAL ANALYSIS

NO OF CREDITS: 4

		SESSIONAL:	40
L	P	THEORY EXAM:	60
4	0	TOTAL:	100

NOTE: Question paper has two parts. Part-1 has 10 questions each of 2 marks. It covers the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OBJECTIVES

The course will develop a deeper and more rigorous understanding of Calculus including defining terms and proving theorems about functions, sequences, series, limits, continuity, derivatives, the Riemann integrals, and sequences of functions. The course will develop specialized techniques in problem solving. ,prove basic set theoretic statements and emphasize the proofs' development, Riemann integrable and Riemann sums, prove various theorems about Riemann sums and Riemann integral and emphasize the proofs' development

UNIT – I

Sequence and Series of a function, point-wise convergence, uniform convergence, Cauchy criterion for uniform convergence, test for uniform convergence (Weierstrass M-test, Abel's test, Dirichelts test), uniform convergence and integration, uniform convergence and differentiation, Weierstrass approximation theorem.

UNIT - II

R-S integral, definition and existence of integral, condition of integrability, properties of integral, fundamental theorem of calculus, mean value theorem of integral calculus.

UNIT - III

Power series, generic term, definition, uniqueness theorem for power series, properties of function expressed as power series, abel's theorem.

UNIT - IV

Function of several variables, explicit and implicit functions, derivation of higher orders, change of variables, Taylor's theorem, Inverse function theorem, Implicit function theorem, Jacobian, Extreme problems with constraints, Lagrange's multiplier method.

UNIT - V

Lebesgue integral, measurable sets, non-measurable sets, sets of measure zero, borel sets, measurable functions, lebesgue integral, formulation of measurable sets in terms of open sets, closed sets, f sigma sets, g delta sets, integrability and measurability, classical lebesgue dominated convergence theorem, fatou's lemma, Tauber's theorem.

COURSE OUTCOMES

Students will be able to

- prove a basic set theoretic statement
- prove an appropriate statement by induction
- define the limit of a function at a value, a limit of a sequence, and the Cauchy criterion
- prove a theorem about limits of sequences and functions
- define continuity of a function and uniform continuity of a function
- prove a theorem about continuous functions
- define the derivative of a function
- prove a theorem about the derivatives of functions
- define Riemann integrable and Riemann sums
- prove a theorem about Riemann sums and Riemann integrals

REFERENCE BOOKS

1. W. Rudin, Principles of Mathematical Analysis (3rd edition) McGraw-Hill, Kogakusha,1976, International student edition.

2. T.M.Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi,1985.

3. P.K.Jain and V.P.Gupta, Lebesgue Measure and Integration, New Age International (P) Limited Published, New Delhi, 1986 (Reprint 2000).

4. H.L.Royden, Real Analysis, Macmillan Pub. Co. Inc. 4th Edition, New York, 1993.

5.S.C. Malik &SavitaArora, Mathematical Analysis, New Age International (P) Limited Published,2008.

M.Sc. MATHEMATICS SEMESTER I

CODE: MTH -503

SUBJECT NAME: ALGEBRA

NO OF CREDITS: 4

		SESSIONAL:	40
L	P	THEORY EXAM:	60
4	0	TOTAL:	100

NOTE: Question paper has two parts. Part-1 has 10 questions each of 2 marks. It covers the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OBJECTIVES

This course is aimed at mathematics education majors. It is a first course in abstract algebra. In addition to being an important branch of mathematics in its own right, abstract algebra is now an essential tool in number theory, geometry, topology, and, to a lesser extent, analysis. Thus it is a core requirement for all mathematics majors. Outside of mathematics, algebra also has applications in cryptography, coding theory, quantum chemistry, and physics.

UNIT-I

Normal subgroups, Quotient groups, Simple groups, Homomorphisms, Isomorphisms and Automorphisms, Cayley's theorem, Factor's theorem, Cauchy's theorem, Second Fundamental theorem.

UNIT-II

Normal& Composition chains, Jordon Holder's Theorem, Solvable groups, Permutation groups, Alternating groups, Simplicity of An (n>=5), Galois theorem, Conjugacy, Class equations, Sylow's theorems, Direct products, Finite abelian groups, Fundamental theorem on finite abelian groups, Decomposable groups.

UNIT-III

Rings, Ideals, Prime and maximal ideals, Homomorphism, Quotient- rings, Integral domains,

Imbedding of rings, Field, Prime fields, Wilson's theorem, Zorn's lemma, Zrulls theorem, Field of quotients of an Integral domain, Euclidean domains, The ring of Gussian integers, Principal ideal domains, Unique factorization theorem, Fermat's theorem.

UNIT-IV

Polynomial rings over rings and fields, Division algorithm, Gauss lemma, Eisenstein's

irreduciblity criterion, Primitive polynomials, Cyclotomic polynomials, Unique factorization in R[x] where R is a Unique factorization Domain.

UNIT-V

Field extensions, Algebraic and transcendental extensions, Normal extensions, Construction by Ruler and Compass, Finite fields, Structure of finite fields, Subfields of finite fields.

COURSE OUTCOMES

Students should achieve mastery of the topics listed below. This means that they should know all relevant definitions, correct statements of the major theorems (including their hypotheses and limitations), and examples and non-examples of the various concepts. The students should be able to demonstrate their mastery by solving non-trivial problems related to these concepts, and by proving simple (but non-trivial) theorems about the below concepts, related to, but not identical to, statements proven by the text or instructor.

- Group Theory
  - Basic Definitions
  - Examples of groups
  - Subgroups
  - Lagrange's Theorem
  - Homomorphisms
  - Normal Subgroups
  - Quotient Groups
  - Isomorphism Theorems
  - Cauchy's Theorem
  - Direct Products
  - The Symmetric Group
  - Even and odd Permutations
  - Cycle Decompositions
- Ring Theory
  - Basic Definitions
  - Examples of rings (both commutative and noncommutative)
  - Ideals
  - Ring homomorphisms
  - Quotient rings
  - Prime and maximal ideals
  - Polynomial rings
  - Factorization in polynomial rings
  - Field of fractions of a domain
- Field Theory
- Field extensions
- Algebraic and transcendental extensions
- Normal extensions,
- Construction by Ruler and Compass,
- Finite fields, Structure of finite fields, Subfields of finite fields

REFERENCE BOOKS

1. I. N. Herstein, Topics in Algebra, New Age International (P) Limited, New Delhi

2. P. B. Bhattacharya, S.K. Nagpaul, Basic Abstract Algebra (2nd Edition)

3. Cambridge University Press, Indian Edition, 1997.

M.SC MATHEMATICS SEMESTER I

CODE: MTH 505

SUBJECT NAME: ORDINARY DIFFERENTIAL EQUATIONS

NO. OF CREDITS: 4

		SESSIONAL:	40
L	P	THEORY EXAM:	60
4	0	TOTAL:	100

NOTE: Question paper has two parts. Part-1 has 10 questions each of 2 marks. It covers the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OBJECTIVES

The course is designed to develop in students:

Appreciation for ODE and system of ODEs concepts that are encountered in the real world, understand and be able to communicate the underlying mathematics involved to help another person gain insight into the situation.Work with Differential Equations and systems of Differential Equations in various situations and use correct mathematical terminology, notation, and symbolic processes in order to engage in work, study, and conversation on topics involving Differential equations.

The students will learn to solve exact differential equations, linear differential equations and understand the basics of non -linear differential equations. They will develop ability to solve differential equations by variation of parameters, power series solution. They will learn to apply concepts of Sturmian theory.

UNIT - I

Linear Equations

Classification of differential equations, their origin and application,

Exact differential equations and integrating factors, special integrating factors andtransformation ,Basic theory of L.D.E., Method of successive approximation, Lipschitz condition, existence and uniqueness theorem for first order equations. Statement of existence and uniqueness theorem for solution of ordinary differential equations of order n.

UNIT - II

Power Series Solutions : Review of power series, Series solutions of first order equations,Second order linear equations, Ordinary points, Regular singular points, Indicial equations,The point at infinity,Frobenius method, Legendre's polynomial, Bessel's function.

UNIT - III

Sturm Liouville Theory:Sturm separation theorem. Normal form, Sturm's comparison theorem, Sturm liouville problems, Characteristic values and Characteristic functions in Sturm liouville problems.

UNIT-IV

System of Linear Differential Equatins: Basic theory of linear systems in normal form: two equations in two unknown functions, homogeneous linear systems with constant coefficients: two equations in two unknown functions.

UNIT - V

Non-linear equations : Autonomous systems, Critical points, Concepts of Stability, Critical points and paths of linear system, Liapunov's direct method, , Liapunov functions.

COURSE OUTCOMES

Upon completion of course, students will be able to:

- Solve exact differential equations and linear differential equations.
- Solve differential equations by method of variation of parameters.
- Use power series and Frobenius method for solving differential equations.
- Use Sturmian theory for solving problems.
- Ability to use the basic terminology for non linear equations ,find the critical points and analyse stability .
- Work with ODEs and systems of ODEs in various situations and use correct mathematical terminology, notation, and symbolic processes in order to engage in work, study, and conversation on topics involving ODEs and systems of ODEs with colleagues in the field of mathematics, science or engineering.

REFERENCE BOOKS

1. An Introduction to Ordinary Differential Equations – E. A. Coddington,

Prentice-Hall of India Private Ltd., New Delhi, 2001 .

2. Spherical Harmonics – T. M. Mac Robert, Pergamon Press, 1967.

3. Elementary Differential Equations (3rd Edition) – W. T. Martain and E. Relssner,

Addison Wesley Publishing Company, inc., 1995.

4. Theory of Ordinary Differential Equations – E. A. Codington and N. Levinson, Tata

McGraw hill Publishing co. Ltd. New Delhi, 1999.

5. Differential Equations, Dynamical Systems and an Introduction to Chaos – M.W.

Hirsch, S. Smale, and R.L. Devaney, Elsevier (2004).

Picards theorem, Systems, The second order linear equations.

6. Differential Equations By Shepley Ross

M.SC MATHEMATICS SEMESTER I

CODE: MTH-507

SUBJECT NAME: COMPLEX ANALYSIS

NO OF CREDITS: 4

		SESSIONAL:	40
L	P	THEORY EXAM:	60
4	0	TOTAL:	100

NOTE: Question paper has two parts. Part-1 has 10 questions each of 2 marks. It covers the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OBJECTIVES

The main objective of this course is to introduce the basic theory of complex analytic functions and some applications, in order to get acquainted with a number of methods and techniques. The aim of the course is to teach the principal techniques and methods of analytic function theory.

UNIT -I

Function of a complex variable, continuity, differentiability. Analytic functions and their properties, Cauchy-Riemann equations in Cartesian and polar coordinates. Power series, Radius of convergence, Differentiability of sum function of a power series. Branches of many valued functions with special reference to arg z, log z and z^a.

UNIT -II

Path in a region, Contour, Simply and multiply connected regions, Complex integration. Cauchy theorem. Cauchy's integral formula. Poisson's integral formula. Higher order derivatives. Complex integral as a function of its upper limit, Morera's theorem. Cauchy's inequality. Liouville's theorem.

UNIT -III

Zeros of an analytic function, Cassorati- Weierstrass theorem, Limit point of zeros and poles. Maximum modulus principle, Minimum modulus principle. Schwarz lemma. Meromorphic functions. The argument principle. Rouche's theorem, Inverse function theorem.

UNIT - IV

Taylor's and Laurent's Theorem .Calculus of residues. Cauchy's residue theorem. Types of singularities. Application of residue theorem in Evaluation of improper real integrals and Evaluation of sum. Schwarz lemma (Without proof).

UNIT - V

Bilinear transformations, their properties and classifications. Definitions and examples of Conformal mappings. Schwarz lemma (Without proof).

COURSE OUTCOMES

After completing this course satisfactorily, a student will be able to:

- Demonstrate the ability to integrate knowledge and ideas of complex variable continuity and differentiability complex variable.
- Demonstrate ability to think critically by proving mathematical conjectures and establishing theorems from complex analysis.
- Operate with analytic functions, demonstrate knowledge of integration in the complex plane, use the Cauchy integral theorem and Cauchy integral formula, manipulate and use power series, understand residues and their use in integration.
- Develop the understanding of conformal mappings.

REFERENCE BOOKS

1. H.A. Priestly, Introduction to Complex Analysis, Clarendon Press, Oxford, 1990.

2. J.B. Conway, Functions of one Complex variable, Springer-Verlag, International student-Edition, Narosa Publishing House, 1980.

3. S. Lang, Complex Analysis, Addison Wesley, 1977.

4. Mark J. Ablowitz and A.S. Fokas, Complex Variables : Introduction and Applications, Cambridge University Press, South Asian Edition, 1998.

5. S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House,1997.

6. Ruel V. Churchill and James Ward Brown, Complex Variables and Applications, McGraw-Hill Publishing Company.

7. Rudin, Real and Complex Analysis .

8. B. Choudhary, The Elements of Complex Analysis. New Age International.

M.SC MATHEMATICS SEMESTER I

CODE: MTH-509

SUBJECT NAME: PROGRAMMING IN C

NO. OF CREDITS: 4

		SESSIONAL:	40
L	P	THEORY EXAM:	60
4	0	TOTAL:	100

NOTE: Question paper has two parts. Part-1 has 10 questions each of 2 marks. It covers the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OBJECTIVES

This course is designed to provide a comprehensive study of the C programming language. It stresses the strengths of C, which provide students with the means of writing efficient, maintainable, and portable code. The nature of C language is emphasized in the wide variety of examples and applications. To learn and acquire art of computer programming.To know about some popular programming languages and how to choose Programming language for solving problems.

UNIT-I

Computer fundamentals: Computer components, characteristics and classification of computers hardware and software, Peripheral devices. Algorithm development, techniques of problem solving, flow-chart, decision table, structured programming concepts of Moduler programming, algorithm for searching, sorting (exchange and insertion), merging of ordered Programming methodologies top-down and bottom-up design, development of efficientprogram; program correctness; debugging and testing of programs.

UNIT-II

Programming in C:An over view of programming , programming languages, Classifications, Introduction to C, Data type, constants and variable; structure of a C program,operators and expressions, control statements: sequencing, alteration and iteration; functions,recursion, array, string and pointers, file handling, Formatting source files , Continuation character.

UNIT-III

The Preprocessor, Scalar data types –Declarations, different types and kinds of integers, Floating point type, Initialization, mixing types, Explicit conversions-Casts.The void data types, Typedefs.

UNIT-IV

Operators and Expressions: Precedence and associativity, Unary Plus and Minus Operator. Binary comma Operators . relational Operator. Logical Operators, Bit manipulation Operators, Memory Operators, input and out putfunctions. Control flow- Conditional Branching, The switch statement. Looping, Nested Loops. The break and continue statement. The goto statement , infinite loop

UNIT-V

Arrays: Declaring an array ,arrays and memory, initializing arrays ,Strings Functions-Passing argument , declarations and calls. Recursion, the main ( ) function, passing array as function arguments.

Pointers: Pointer arithmetic ,accessing array elements through pointer ,passing pointer as function arguments, array of pointer, pointers to pointers, Complex declarations.

COURSE OUTCOMES

Upon completion of the subject, students will be able to

- Understand the basic terminology used in computer programming
- Write, compile and debug programs in C language.
- Use different data types in a computer program.
- Design programs involving decision structures, loops and functions.
- Explain the difference between call by value and call by reference
- Understand the dynamics of memory by the use of pointers.
- 7.Use different data structures and create/update basic data files.

REFERENCE BOOKS

1. Kenneth, A. : C problem solving and programming, Prentice Hall.

2. Gottfried, B. : Theory and problems of Programming in C, Schaum Series.

3. Kerninghan&Ritchie : The Programming Language, PHI.

4. E. Horowitz and S. Sahani, "Fundamentals of Data Structures", GalgotiaBooksourcePvt. Ltd, 2003

5. R. S. Salaria, "Data Structure & Algorithms", Khanna Book Publishing Co. (P) Ltd.,2002.

6. P. S. Deshpande and O.G. Kakde, "C & Data Structure", Wiley Dreamtech, 1stEdition, 2003.

7. Schaum's outline series, "Data Structure", TMH, 2002

M.SC MATHEMATICS SEMESTER I

CODE: MTH-551

SUBJECT NAME: PROGRAMMING IN C(LAB)

NO. OF CREDITS: 4

		INTERNAL:	40
L	P	EXTERNAL:	60
0	8	TOTAL:	100

COURSE OBJECTIVES

This course is designed to provide a comprehensive study of the C programming language. It stresses the strengths of C, which provide students with the means of writing efficient, maintainable, and portable code. The nature of C language is emphasized in the wide variety of examples and applications.

LIST OF EXPERIMENTS

1. Write a program to add, subtract, multiply and divide two numbers using menu driven program.
2. Write a program to find the largest of three numbers.(using if-then-else)
3. Write a program to find the largest number out of ten numbers (using for- statement)
4. Write a program to find the average male height & average female heights in the class(input is in the form of sex code, height) .
5. Write a program to find roots of quadratic equation using functions.
6. Write a program using arrays to find the largest and second largest number out of given 10 numbers using bubble sort.
7. Write a program to multiply two matrices
8. Write- a program to read a string and write it in reverse order.
9. Write a program to concatenate two strings.
10. Write a program to sort numbers using the Quicksort Algorithm.
11. Represent a deck of playing cards using arrays.
12. Write a program to check that the input string palindrome or not.
13. Write a program to calculate the length of the string
14. Write a program to find factorial of a number using function.
15. Write a program using structure to enter a list of books, their prices and number of pages.

COURSE OUTCOMES

- Understand the basic concept of C Programming, and its different modules that includes conditional and looping expressions, Arrays, Strings, Functions, Pointers, Structures and File programming.
- Acquire knowledge about the basic concept of writing a program.
- Role of constants, variables, identifiers, operators, type conversion and other building blocks of C Language.
- Use of conditional expressions and looping statements to solve problems associated with conditions and repetitions.
- Role of Functions involving the idea of modularity.
- Concept of Array and pointerst.
- Structures and unions through which derived data types can be formed
- File Handling for permanent storage of data or record.
- Near & Huge pointers.
- Applications of Self- referential structure.
- Programming using gcc compiler in Linux.

REFERENCE BOOKS

1. Kenneth, A. : C problem solving and programming, Prentice Hall.

2. Gottfried, B. : Theory and problems of Programming in C, Schaum Series.

3. Kerninghan&Ritchie : The Programming Language, PHI.

4. E. Horowitz and S. Sahani, “Fundamentals of Data Structures”, GalgotiaBooksourcePvt. Ltd, 2003

5. R. S. Salaria, “Data Structure & Algorithms”, Khanna Book Publishing Co. (P) Ltd.,2002.

6. P. S. Deshpande and O.G. Kakde, “C & Data Structure”, Wiley Dreamtech, 1stEdition, 2003.

7. Schaum’s outline series, “Data Structure”, TMH, 2002

M.Sc. MATHEMATICS SEMESTER II

CODE: MTH-502

SUBJECT NAME: MATHEMATICAL STATISTICS

NO. OF CREDITS: 4

		SESSIONAL:	40
L	P	THEORY EXAM:	60
4	0	TOTAL:	100

NOTE: Question paper has two parts. Part-1 has 10 questions each of 2 marks. It covers the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OBJECTIVES

Course is designed to make students capable of using their knowledge in modern industry or teaching, or secure acceptance in high-quality programs/jobs in mathematics and other fields.To formulate and analyze mathematical and statistical problems, precisely define the key terms, and draw clear and reasonable conclusions. The course will help students understand thebasic statistical terms, use of various distributions,Discrete distributions, Estimation theory and application of various tests of hypothesis.

UNIT - I

Review of Mean, Median, Mode. Probability: Rules of probability, Conditional probability, Independent events, Baye's theorem, Probability distribution.

Random variable, Discrete and continuous random variables, Two dimensional random variable, Transformation of one, two and n-dimensional random variables.

UNIT - II

Probability density function, Multivariate distribution, Marginal distribution, Conditional distribution.

Mathematical expectation, Conditional expectation, Chebyshev's theorem, Moment generating function, Product moments, Characteristic functions. Convergence in probability and in distribution, Weak law of large numbers and central limit theorem for independent identically distributed random variables with finite variance.

UNIT - III

Theoretical distributions: Binomial Distribution, Fitting of Binomial Distribution, Poisson Distribution, Fitting of Poisson Distribution, Normal Distribution, Relation between Binomial distribution, Relation between Poisson and Normal Distribution. Properties of Normal Distribution. Area under Normal Probability Curve. Importance of Normal Distribution.

UNIT - IV

Estimation theory: Estimators, Unbiasedness, Efficiency, Consistency, Sufficiency, Method of Point Estimation, Sampling distribution of Statistic and Mean, Centeral limit Theorem, Sampling Distribution of Proportion, Interval Estimation for large samples, Confidence limit for Mean, Proportion, Standard Deviation, Difference of Means, Difference of Proportions, Size of Random Sample for Specified Precision.

UNIT - V

Testing of Hypothesis: Simple and composite hypothesis, Test of Significance, Types of errors, Critical region, one tailed and two tailed tests, Critical value or significant value, Procedure of Testing of Hypothesis. Large sample tests, Chi- Square test, Test of significance based on t, F and z Distributions.

COURSE OUTCOMES

After completion of course ,students will be able to:

- Formulate and analyze mathematical and statistical problems, precisely define the key terms, and draw clear and reasonable conclusions using various discrete distributions and estimation theory techniques.
- Use statistical techniques to solve well-defined problems and present their mathematical work, both in oral and written format.
- Read, understand and construct correct data ,use the data-bases to locate information on mathematical problems.
- Explain the importance of mathematics and its techniques to solve real life problems and provide the limitations of such techniques and the validity of the results
- Propose new hypothesis and testing it for a given data.
- Classify the various types of errors in analysis.
- Acquire mathematical and statistical knowledge of various distributions like binomial, negative binomial, geometric, hyper geometric , poisson, power series etc.

REFERENCES BOOKS

1. Baisnab and Jas,M., Element of Probability and statistics, Tata McGraw Hill.

2. Freund,J.E., Mathematical Statistics, Prentice Hall of India.

3. Hogg,R.V. and Craig,A.T., Introduction to Mathematical Statistics, MawellMcmillian.

4. Gupta, S.C., Mathematical Statistics, Himalayan Publications.

5. Gupta S.C. and Kapoor V.K., Fundamentals of Mathematical Statistics, S. Chand Pub., New Delhi.

6. Speigel, M., Probability and Statistics, Schaum Outline Series.

M.SC. MATHEMATICS SEMESTER II

CODE: MTH-504

SUBJECT NAME: LINEAR ALGEBRA

NO. OF CREDITS: 4

		SESSIONAL:	40
L	P	THEORY EXAM:	60
4	0	TOTAL:	100

NOTE: Question paper has two parts. Part-1 has 10 questions each of 2 marks. It covers the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OBJECTIVES

The aim of the course is to familiarize students with the concept of a Linear Transformation and its algebraic properties and the manipulative techniques necessary to use matrices and determinants in solving applied problems. This course in linear algebra serves as a bridge from the typical intuitive treatment of calculus to more rigorous courses such as abstract algebra and analysis.

UNIT 1.

Linear transformation, Rank and nullity of a linear transformation, Sylvester's law of nullity, Subspaces, Quotient spaces, Basis.

UNIT -II

Algebra of linear transformations, Orthogonal and supplementary linear transformations,Dual space, Linear functional, Bidual, Cannonical isomorphism.

UNIT-III.

Matrix of a linear transformation, Change of basis, Equivalent and similar matrices, Minimal polynomials, Invertible linear transformations.

UNIT IV.

Eigen values, Eigen vectors, More on maximal polynomials, Diagonal vectors of a square matrix, Jordan Block, Jordan Cannonical form, Cyclic linear transformation, Cyclic spaces, Jordan normal form.

UNIT -V

Trace and transpose of a linear transformation, Adjoint,Hermitianadjoint, Unitary and Normallinear operators.

COURSE OUTCOMES

After successful completion of the course students should be able to :

- Effectively express concepts of linear algebra in written form;
- Demonstrate ability to think critically about vector spaces and linear transformations;
- Locate and use information to solve problems of linear transformations and vector spaces;
- Demonstrate ability to integrate knowledge and ideas of matrices in a coherent and meaningful manner.
- Reduce a matrix to a given form using Gauss-Jordan reduction;
- Explain the dimension of a vector space, and rank of a matrix;
- Describe the concept of linear independence, linear transformation and determinants;
- Find eigenvalues and eigenvectors, and diagonalize quadratic forms.

REFERENCE BOOKS

1. I.N. Herstein, Topics in Algebra

2. P.R. Halmos, Linear Algebra with Problems

3. Hoffman &kunze, Linear Algebra

4. Krishnamurthy,An introduction to Linear algebra

M.SC MATHEMATICS SEMESTER II

CODE: MTH -506

SUBJECT NAME: METHODS OF APPLIED MATHEMATICS

NO. OF CREDITS: 4

		SESSIONAL:	40
L	P	THEORY EXAM:	60
4	0	TOTAL:	100

NOTE: Question paper has two parts. Part-1 has 10 questions each of 2 marks. It covers the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OBJECTIVES

This course is aimed at various Mathematical Transforms. In addition to being an important tool of mathematics in its own right, MAM is now an essential tool in solving various differential and Integral Equations.

UNIT-I

Curvilinear Co-ordinates: Co-ordinate transformation, Orthogonal Co-ordinates, Change of Co-ordinates, Cartesian, Cylindrical and spherical coordinates, expressions for velocity and acceleration ds, dv and ds^2 in orthogonal coordinates, Areas ,volumes and Surface area in Cartesian , Cylindrical and spherical coordinates in few simple cases, Grad, div, Curl, Laplacian in orthogonal Co-ordinates, Contravariant and Co-variant components of a vector, Metric coefficients and the volume element.

UNIT-II

Laplace Transform: Review and its application to solve ordinary differential equation and integral equation.
Fourier Transform: Definition and properties, fourier transform of some elementary functions, convolution theorem, application of fourier transform to solve ordinary and partial differential equation.

UNIT-III

Mellin Tranform: Definition, Elementry properties, Mellin transform of derivatives, Integrals, Inverse Mellin transform, Convolution theorem , Inverse Mellin transform of two functions.
Hankel Tranform: Definition, Elementry properties, Hankel transform of derivatives, Exponential functions, Inversion formula for Hankel transformation, Parsevals theorem , Relation between Hankel and Laplace transform.

UNIT-IV

Modified Bessel function, ber and bei function, Kelvin function, spherical Bessel function , modified spherical Bessel function.

UNIT-V

Legender's associated functions and differential equation, integral expression for associated legender polynomial, recurrence relation for associated legender polynomial.

COURSE OUTCOMES

After successful completion of this course , students should achieve mastry in

- Co-ordinate Transformation, expressions for velocity and acceleration ds, dv and ds^2 in orthogonal coordinates, Areas ,Grad, div, Curl, Laplacian in orthogonal Co-ordinates, Contravariant and Co-variant components of a vector, Metric coefficients and the volume element.
- Application of Laplace Transformation to solve ordinary differential equation and integral equations.
- Fourier Transform of some elementary functions, convolution theorem, application of fourier transform to solve ordinary and partial differential equation.
- Elementry properties of Mellin Tranform:, Mellin transform of derivatives, Integrals, Inverse Mellin transform
- Elementry properties of Hankel Tranform, Hankel transform of derivatives, Exponential functions, Inversion formula for Hankel transformation.
- Modified Bessel function, Legender's associated functions and differential equation

REFERENCE BOOKS

1. Sneddon, I. N., The Use of integral Transforms.
2. Schaum's Series, Vector Analysis.
3. Gupta, S.C. and Kapoor, V.K., Fundamentals of Mathematical Statistics.
4. Goyal S.P. and Goyal A.K., Integral Transforms.

M.SC MATHEMATICS SEMESTER II

CODE: MTH 508

SUBJECT NAME: NUMERICAL ANALYSIS

NO. OF CREDITS: 4

		SESSIONAL:	40
L	P	THEORY EXAM:	60
4	0	TOTAL:	100

NOTE: Question paper has two parts. Part-1 has 10 questions each of 2 marks. It covers the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OBJECTIVES

The main objective of this course is to give the solutions of applied problems and it helps students to have an in-depth knowledge of various advanced methods in numerical analysis.

UNIT-I

Various difference operators and relation between them .Newton‘s forward and backward interpolation formulae . Central difference interpolation formula. Gauss forward and backward interpolation formulae. Langrages interpolation formula and Newton‘s divided difference formulae.

UNIT-II

Solution of algebraic and transcendental equations: Bisection method, method of false position,secant method, iteration method, Newton's Raphson method, Generalised Newton-Raphson method

UNIT-III

Solution of simultaneous algebraic equations: Jacobi's method, Gauss-Seidal method, Relaxation method.

Numerical differentiation and integration: Formula for derivatives Trapezoidal rule, Simpson's 1/3rd and 3/8th rules, Boole's rule and Weddle's rule, Romberg's Integration.

UNIT-IV

Numerical solution of O.D.E.: Taylor series,Picard‘s method, Eule , Modified Euler method, Runge-Kutta second and fourth order methods, predictor collector methods(Adams-Bashforth and Milne's method only). Finite element method for finding approximate solution to boundary value problems for differential equation.

UNIT- V

Numerical solution of P.D.E.: Finite difference approximations of partial derivatives, solution of Laplace equation (Standard 5-point formula only), one-dimensional heat equation (Schmidt method, Crank-Nicolson method, Dufort and Frankel method) and wave equation.

COURSE OUTCOMES

After completing this course satisfactorily, a student will be able to:

- Demonstrate understanding of common Numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.
- Apply various mathematical operations and tasks, such as interpolation, differentiation, integration, the solutions of linear equations and the solutions of differential equations and partial differential equations.
- Examine approximate solutions to mathematical problems.

REFERENCES BOOKS

1. K.Atkinson and W. Han, Elementary Numerical Analysis, John Wiley,2006.
2. Numerical Methods in Engg. &Science : B.S. Grewal;khanna.
3. Numerical Methods for Scientific and Engg. Computations : M.K. Jain, S.R.K. Iyenger and R.K. Jain-Wiley Eastern Ltd

4. Taneja, H.C. "Advanced Engineering Mathematics", IK International, New Delhi.

M.SC MATHEMATICS SEMESTER II

CODE: MTH 510

SUBJECT NAME: PROGRAMMING IN C++

NO OF CREDITS: 4

			SESSIONAL:	40
L	P		THEORY EXAM:	60
4	0		TOTAL:	100

NOTE: Question paper has two parts. Part-1 has 10 questions each of 2 marks. It covers the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OBJECTIVES

The main objective of this course is to introduce students to the basic concepts of a C++ language and the ability to write programs of computational techniques . It also introduce different techniques pertaining problem solving skills.

UNIT-I

Introduction to C++, structure of C++ program, Basic concepts of object oriented programming (OOP), Advantages and Applications of OOP- Object Oriented Languages. Creating a source files, Compiling and Linking. C++ Programming Basics.

UNIT-II

Data types, Operators, Expressions, Control Structures, Library functions, Functions in C++, Passing Arguments to and returning values from Function, inline function, default arguments, function overloading .

UNIT –III

Classes and objects, Specifying and using class and object, array within a class, Arrays of object as a function argument, friendly functions, pointer to members, constructors and deconstructors. Operator overloading and type conversion.

UNIT –IV

Inheritance, derived class and their constructs, overriding member function, class hierarchies, Public and Private inheritance levels, Polymorphism, pointer to objects, this pointer, Pointer to derived classes, Virtual functions, Strums and streams classes, unformatted I/O operations. Formatted console.

UNIT-V

I/O operations, managing output with manipulators, classes for file stream operations, opening and closing a file. File pointers and their manipulations, Random Access, Error handling during file operations, Command–line argument, Exceptional handling.

COURSE OUTCOMES

After completing this course satisfactorily, a student will be able to:

- Explain the need and importance of OOP using C++.
- Distinguish basic data types, custom input/output operators and illustrate class definition using member functions.
- Apply concept of overloading, type conversion and virtual functions.
- Demonstrate templates, use and handle exceptions.
- Describe inheritance, polymorphism and concepts related to files.
- Discuss the concept of pointers, make use of constructors and destructors themselves and manage a class' resources using dynamic memory allocation and de-allocation.

REFERENCES BOOKS

1. I.S. Robert Lafore, Object Oriented Programming using C++, Waite's Group Galgotia Pub.

2. E. Balagrusamy, Object Oriented Programming with C++, 2nd Edition, Tata Mc Graw Hill Pub.Co.

3. Byron, S. Gottfried, Object Oriented Programming using C++, Schaum's Outline Series, Tata McGraw Hill Pub.Co.

4. J.N. Barakaki, Object Oriented Programming using C++, Prentice Hall of India, 1996.

5. Deitel and Deitel, C++: How to program, Prentice Hall of India

M.SC MATHEMATICS SEMESTER II

CODE: MTH 552

SUBJECT NAME: PROGRAMMING IN C++(LAB)

NO. OF CREDITS: 4

		INTERNAL	40
L	P	EXTERNAL:	60
0	8	TOTAL:	100

COURSE OBJECTIVES

This courses introduces a higher level language C++ and numerical methods for hands-on experience on computers. Stress is also given on the error analysis.

LIST OF EXPERIMENTS

1. Write a class to represent a vector (a series of float values). Include member functions to perform the following tasks: To create the vector, To modify the value of a given element, To multiply by a scalar value, To display the vector in the form (10, 20, 30,…). Write a program to test your class.

2. Create a class FLOAT that contains one float data member. Overload all the four arithmetic operators so that they operate on the objects of FLOAT.

3. Write a program which shows the days from the start of year to date specified. Hold the number of days for each month in an array. Allow the user to enter the month and the day of the year. Then the program should display the total days till the day.

4. Write a program to include all possible binary operator overloading using friend function.

5. Write a program to read an array of integer numbers and sort it in descending order. Use readdata, putdata, and arraymax as member functions in a class.

6. Write a program to read two character strings and use the overloaded '+' operator to append the second string to the first.

7. Develop a program Railway Reservation System using Hybrid Inheritance and Virtual Function.

8. Using overloaded constructor in a class write a program to add two complex numbers.

9. Create a class MAT of size(m,n). Define all possible matrix operations for MAT type objects.

10. Write a program that determines whether a given number is a prime number or not and then prints the result using polymorphism.

11. Write a program to illustrate the dynamic initialization of constructors.

12. Write a program to illustrate the use of pointers to objects.

13. Write a program to illustrate how to construct a matrix of size m x n .

14. Write a program to arrange the given data in ascending / descending order using various sorting algorithms.

15. Write a program to find the biggest /smallest number in the given data using various search algorithms.

COURSE OUTCOMES

- Demonstrate familiarity with major algorithms and data structures.
- Analyze performance of algorithms.
- Choose the appropriate data structure and algorithm design method for a specified application.
- Determine which algorithm or data structure to use in different scenarios.
- Be familiar with writing recursive methods.
- Implementation of two dimensional array operations.
- Implementation of stack and queue using array.
- Stack operations to perform the following: Converting infix expression into postfix expression, Evaluating the postfix expression

REFERENCES BOOKS

1. I.S. Robert Lafore, Object Oriented Programming using C++, Waite's Group Galgotia Pub.
2. E. Balagrusamy, Object Oriented Programming with C++, 2nd Edition, Tata Mc Graw Hill Pub.Co.
3. Byron, S. Gottfried, Object Oriented Programming using C++, Schaum's Outline Series, Tata McGraw Hill Pub.Co.
4. J.N. Barakaki, Object Oriented Programming using C++, Prentice Hall of India, 1996.
5. Deitel and Deitel, C++: How to program, Prentice Hall of India

M.SC MATHEMATICS SEMESTER III

CODE: MTH 511

SUBJECT NAME: TOPOLOGY

NO. OF CREDITS: 4

		SESSIONAL:	40
L	P	THEORY EXAM:	60
4	0	TOTAL:	100

NOTE: Question paper has two parts. Part-1 has 10 questions each of 2 marks. It covers the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OBJECTIVES

The course will introduce the students to various type of topologies like discrete, indiscrete. Understand the concepts of distance between two sets;connectedness, compactness and separation axioms. They will have the ability to determine that a given point in a topological space is either a limitpoint or not for a given subset of a topological space.The course will enable them to use correct language while talking about topological concepts.

UNIT - I

Definition and examples of topological spaces; basis and sub basis; order relations,

Limit points , adherent points , Derived sets , Kuratowski's closure axioms, Dense subsets,

closure, interior, exterior and boundary pts. of a set, subspace , relative topology.

UNIT - II

Continuity and related concepts; product topology; quotient topology; countability axioms;

Lindelof spaces and separable spaces, First and second countable spaces,Lindelof theorem

Second countability and seperability

UNIT - III

Separated sets, connected sets; component, path component; localconnectedness, Disconnected sets, Totally Disconnected sets.,locally connected spaces,connectedness on real line

UNIT - IV

Compact spaces; limit point compact and sequentially compact spaces,local compactness and one point compactification; Finite intersection property; finite product of compact spaces, statement of Stone cech theorem and Tychonoff's theorem. Heine Borel theorem

UNIT -V

Separation axioms (T_0,T_1,T_2,T_3spaces, Regular space, Completely regular spaces,Normal spaces);their characterizations and basic properties.Urysohn's lemma; Tietze's extension theorem; statement of Urysohn'smetrization theorem.

COURSE OUTCOMES

The students after completion of course will be able to:

- Determine whether a collection of subsets define a topology.
- Recognize whether or not a subset of a topological space is compact and

  be familiar with the basic properties of compact subsetsand their proofs.
- Recognize whether a topological space is Hausdroff and be familiar with the basic properties of Hausdroff spaces and their proofs.
- Ability to understand continuity and related concepts like product and quotient topology,first and second countable spaces.
- Able to understand the concepts of connectedness and total connectedness.

REFERENCE BOOKS

1. Topology, a first course – J. R. Munkres, Prentice-Hall of India Ltd., New Delhi,2000.
2. General Topology – J. L. Kelley, Springer Verlag, New York, 1990.
3. An introduction to general topology (2nd edition) – K. D. Joshi, Wiley Eastern Ltd., New Delhi, 2002.

M.SC MATHEMATICS SEMESTER III

CODE: MTH -513

SUBJECT NAME: MECHANICS

NO. OF CREDITS: 4

		SESSIONAL:	40
L	P	THEORY EXAM:	60
4	0	TOTAL:	100

NOTE: Question paper has two parts. Part-1 has 10 questions each of 2 marks. It covers the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OBJECTIVES:

To understand the basic concept of Generalised Coordinates, Holonomic and non –Holonomic Systems, Hamilton canonical equations, Cyclic coordinates., Poisson's Bracket,Poisson's Identity.,Hamilton's Principle,Principle of least action. Gravitation: Attraction and potential of rod, Laplace and Poisson equations.

UNIT I

Moments and products of Inertia, Theorems of parallel and perpendicular axes, principal axes, The momental ellipsoid, Equimomental systems, Coplanar distributions.

UNIT II

Generalized coordinates. Holonomic and Non-holonomic systems. Scleronomic and Rheonomic systems. Lagrange's equations for a holonomic system., Lagrange's equations for a conservative and impulsive forces. Kinetic energy as quadratic function of velocities. Generalized potential, Energy equation for conservative fields. Hamilton's variables.

UNIT III

Hamilton canonical equations. Cyclic coordinates. Routh's equations. Poisson's Bracket. Poisson's Identity. Jacobi-Poisson Theorem. Hamilton's Principle. Principle of least action.

UNIT IV

Poincare Cartan Integral invariant. Whittaker's equations. Jacobi's equations. Statement of Lee Hwa Chung's theorem. Hamilton-Jacobi equation. Jacobi theorem. Method of separation of variables. Lagrange Brackets. Condition of canonical character of a transformation in terms of Lagrange brackets and Poisson brackets. Invariance of Lagrange brackets and Poisson brackets under canonical transformations.

UNIT V

Gravitation: Attraction and potential of rod, disc, spherical shells and sphere. Laplace and Poisson equations. Work done by self-attracting systems. Distributions for a given potential. Equipotential surfaces. Surface and solid harmonics. Surface density in terms of surface harmonics.

COURSE OUTCOMES

After Successful completion of this programe Students will achieve mastery in

- Moments and products of Inertia, Equimomental systems.
- Generalized coordinates, Scleronomic and Rheonomic systems. Lagrange's equations for various systems , Generalized potential, Hamilton's variables.
- Hamilton canonical equations.,Cyclic coordinates, Poisson's Bracket,Hamilton's Principle. Principle of least action.
- Poincare Cartan Integral invariant, Hamilton-Jacobi equation.,Method of separation of variable,. Cannonical Transformations ,Lagrange brackets and Poisson brackets.

- Gravitation: Attraction and potential of rod, disc, spherical shells and sphere. Laplace and Poisson equations. Work done by self-attracting systems. Distributions for a given potential. Equipotential surfaces. Surface and solid harmonics. Surface density in terms of surface harmonics.
- Gravitatio,. Distributions for a given potential, Equipotential surfaces, Surface and solid harmonics, Surface density in terms of surface harmonics.

REFERENCE BOOKS

1. F.Chorlton, A Text Book of Dynamics, CBS Publishers & Dist., New Delhi.
2. F.Gantmacher, Lectures in Analytic Mechanics, MIR Publishers, Moscow.
3. A.S. Ramsey, Newtonian Gravitation, The English Language Book Society and the Cambridge University Press.
4. Louis N. Hand and Janet D. Finch, Analytical Mechanics, Cambridge University Press.

M.SC MATHEMATICS SEMESTER III

CODE: MTH -515

SUBJECT NAME: PARTIAL DIFFERENTIAL EQUATION

NO. OF CREDITS: 4

		SESSIONAL:	40
L	P	THEORY EXAM:	60
4	0	TOTAL:	100

NOTE: Question paper has two parts. Part-1 has 10 questions each of 2 marks. It covers the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OBJECTIVES

This course aims to bring a comprehensive treatment of the theory of partial differential equations (pde) from an applied mathematics perspective. Equilibrium, propagation, diffusion, and other phenomena. Initial and boundary value problems. Transform methods, eigenvalue and eigenfunction expansions, Green's functions. Theory of characteristics and shocks. Boundary layers and other singular perturbation phenomena. Elementary concepts for the numerical solution of pde's. Illustrative examples from fluid dynamics, nonlinear waves, geometrical optics, and other applications.

UNIT-I

PDE OF Kth order : Definition, examples and classifications, Initial value problems. Transport equations homogeneous and non-homogeneous, Radial solution of Laplace’s Equation, Fundamental solutions, harmonic functions and their properties, Mean value Formulas, Poission’s equation and its solution, strong maximum principle, uniqueness.

UNIT-II

Green’s function and its derivation, representation formula using Green’s function, symmetry of Green’s function, Green’s function for a half space and for a ball. Energy methods : uniqueness, Dirichlet’s principle.

UNIT-III

Heat Euqations : Physical interpretation, fundamental solution. Integral of fundamental solution, solution of initial value problem, Duhamel’s principle, non-homogeneous heat equation, Mean value formula for heat equation, strong maximum principle and uniqueness.Energy methods.

UNIT-IV

Wave equation – Physical interpretation, Solution for one dimentional wave equation, d’Alemberts formula and its applications, reflection method, Solution by spherical means Euler-

Poisson_Darboux equation, Kirchhoff's and Poisson's formulas (for n=2,3 only), Solution of non-homogeneous wave equation for n=1, 3. Energy method.Uniqueness of solution.

UNIT-V

Non-linear first order PDE-complete integrals, envelopes. Characteristics of (i) linear (ii) quasilinera (iii) fully non-linear first order partial differential equations. Hamilton Jacobi equations (calculus of variations Hamilton's ODE, Legendre Transform, Hopf-Lax formula, weak solutions, Uniqueness.

COURSE OUTCOMES

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

- classify partial differential equations and transform into canonical form
- Solve linear partial differential equations of both first and second order.

REFERENCE BOOKS'

1) L.C. Evans, Partial Differential Euqations, Graduate Studies in 2 books with the above title by I.N. Snedden, F.John, P Prasad and R Ravindran, Amarnath etc.
2) Differential Equations By Shepley Ross

M.SC MATHEMATICS SEMESTER III

CODE: MTH 517

SUBJECT NAME: OPERATIONS RESEARCH

NO OF CREDITS: 4

		SESSIONAL:	40
L	P	THEORY EXAM:	60
4	0	TOTAL:	100

NOTE: Question paper has two parts. Part-1 has 10 questions each of 2 marks. It covers the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OBJECTIVES

Being able to solve the real life problems and obtaining the right solution requires understanding and modelling the problem correctly and applying appropriate optimization tools and skills to solve the mathematical model. The goal of this course is to teach you to formulate, analyze, and solve mathematical models that represent real-world problems.

UNIT-I

The origin of OR, Definition and scope of Operation Research, Types, methodology and typical applications of OR, Classification of OR models, Phases of an O.R. study, Impact of OR, Formulation of Linear-programming model, Graphical solution. Converting the linear programming problem to standard form, Simplex method.

UNIT-II

Big-M method, Two-phase method, Degeneracy, Alternate optima, unbounded and infeasible solution.

Definition of the dual problem, prima-dual relationship, Dual Simplex method.

UNIT-III

Assignment problem and its mathematical formulation, solution of assignment problem (Hyngarian method), Transportation problem and its mathematical formulation. Initial basic feasible solution of transportation problem by North-West corner rule. Lowest-Cost Entry method and Vogel's Approximation method, Optimal solution of transportation problem.

UNIT-IV

Game theory: Two person zero games, Minimax and maximum principle, Game with saddle point, Rule of dominance, Algebraic and graphical method. Decision theory: Types of decisions, Components of decision making,

UNIT-V

General inventory Model, Static Economic Order Quantity (EOQ) Models.

COURSE OUTCOMES

After completing this course satisfactorily, a student will be able to:

- Solve linear programming problems using simplex methods and its modified types
- Design solution for solving transportation problem and assignment problem.
- Implement of games theory, which is mathematical theory for decision making.
- Solve problem related to inventory using appropriate inventory models.

REFERENCES:

1. Taha, H.A., Operation Research-An introduction, Tata McGraw Hill, New Delhi.

2. Dipak Chatterjee, Linear programming and Game Theory, Prentice-Hall India.

3. Gupta, P.K. and Hira, D.S., Operations Research, S. Chand & Co.

4. Sharma, S.D., Operation Research, Kedar Nath Ram Nath Publications.

5. Sharma, J.K., Mathematical Model in Operation Research, Tata McGraw Hill.

M.SC MATHEMATICS SEMESTER III

CODE: MTH 553

SUBJECT NAME: MATLAB

NO OF CREDITS: 4

		INTERNAL	40
L	P	EXTERNAL	60
0	8	TOTAL:	100

COURSE OBJECTIVES

The course is designed to introduce students to the software MATLAB for numerical computations and familiarizing them with the Matlab desktop. They are trained to use it for various computations and do file management using MATLAB. Students will learn to make one and two dimensional graphical representations.

LIST OF EXPERIMENTS

1. Study of Introduction to MATLAB

2. Study of basic matrix operations

3. To solve linear equation

4. Solution of Linear equations for Underdetermined and Overdetermined cases.

5. Determination of Eigen values and Eigen vectors of a Square matrix.

6. Solution of Difference Equations.

7. Solution of Difference Equations using Euler Method.

8. Solution of differential equation using 4th order Runge- Kutta method.

9. Determination of roots of a polynomial.

10.Determination of polynomial using method of Least Square Curve Fitting.

11.Determination of polynomial fit, analyzing residuals, exponential fit and error bounds from the given data.

12.Solution of ordinary differential equation using Taylor's Series method.

13.Solution of simultaneous equations using Jacobi's Method

14. Solution of simultaneous equations using Gauss Elimination Method

COURSE OUTCOMES

After completion of course, students will

- Become familiar with fundamental operations in MATLAB.
- Be able to apply MATLAB for solution of various numerical computations.
- Perform data interpolation by MATLAB and solve differential equations using MATLAB.
- Be able to generate plots and export this for use in reports.
- Become able to manage files in MATLAB.

REFERENCE BOOKS

1.MATLAB :An Introduction with application,Wiley

2.Applied Numerical Methods using MATLAB,Wiley

M.Sc. MATHEMATICS SEMESTER IV

CODE: MTH 512

SUBJECT NAME: FUNCTIONAL ANALYSIS

NO OF CREDITS: 4

		SESSIONAL:	40
L	P	THEORY EXAM:	60
4	0	TOTAL:	100

NOTE: Question paper has two parts. Part-1 has 10 questions each of 2 marks. It covers the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OBJECTIVES

Functional analysis is the branch of mathematics concerned with the study of spaces of functions. This course is intended to introduce the student to the basic concepts and theorems of functional analysis and its applications.

UNIT-I

Normed linear spaces, Banach Spaces and examples, subspace of a Banach space, completion of a normed space. Quotient space of a normed linear space and its completeness, product of normed spaces, finite dimensional normed spaces and subspaces, equivalent norms, compactness and finite dimension F. Riesz'z lemma.

UNIT-II

Bounded and continuous linear operators, differentiation operator, integral operator, bounded linear extension, linear functionals, bounded linear functionals, continuity and boundedness, definite integral, canonical mapping, linear operators and functionals on finite dimensional spaces, normed spaces of operators, dual spaces with examples.

UNIT-III

Hahn-Banach theorem for real linear spaces, complex linear spaces and normed linear spaces, application to bounded linear functional on C[a,b], Riesz-representatiion theorem for bounded linear functionals on C[a,b], adjoint operator, norm of the adjoint operator. Reflexive spaces, uniform boundedness theorem and some of its applications to the space of polynomials and fourier series.

UNIT-IV

Strong and weak convergence, weak convergence in lp, convergence of sequences of operators, uniform operator convergence, strong operator convergence, weak operator convergence, strong and weak* convergence of a sequence of functionals. Open mapping theorem, bounded inverse theorem, closed linear operators, closed graph theorem, differential operator, relation between closedness and boundedness of a liear operator. Inner product spaces, Hilbert spaces and their examples, Pythagorean theorem, Apolloniu's identity, Schwarz inequality, continuity of innerproduct, completion of an inner product space, subspace of a Hilbert space, orthogonal complements and direct sums, projection theorem.

UNIT-V

Orthonormal sets and sequences, Bessel's inequality, series related to orthonormal sequences and sets, total (complete) orthonormal sets and sequences, Parseval's identity, seperable Hilbert spaces. Representation of functionals on Hilbert spaces, Riesz representation theorem for bounded linear functionals on a Hilbert space, sesquilinear form, Riesz representation theorem for bounded sesquilinear forms on a Hilbert space Hilbert adjoint operator, its existence and uniqueness, properties of Hilbert adjoint operators, self adjoint, unitary, normal, positive and projection operators.

COURSE OUTCOMES

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

- describe properties of normed linear spaces and construct examples of such spaces
- extend basic notions from calculus to metric spaces and normed vector spaces
- state and prove theorems about finite dimensionality in normed vector spaces
- state and prove the Cauchy-Swartz Inequality and apply it to the derivation of other inequalities
- distinguish pointwise and uniform convergence
- prove that a given space is a Hilbert spaces or a Banach Spaces
- describe the dual of a normed linear space
- apply orthonormality to Fourier series expansions of functions
- state and prove the Hahn-Banach theorem.

REFERENCES BOOKS

1. G.F. Simmons : Introduction to Topology and Modern Analysis, Mcgraw Hill Book Co., New York, 1963.
2. C. Goffman and G.Pedrick : First Course in Functional Analysis, Prentice Hall of India, New Delhi, 1987.
3. G. Bachman and L.Narici, Functional Analysis, Academic Press, 1966.
4. L.A. Lustenik and V.J. Sobolev, Elements of Functional Analysis, Hindustan Publishing Corporation, New Delhi, 1971.
5. J.B. Conway : A Course in Functional Analysis, Springer-Verlag, 1990.
6. P.K. Jain, O.P. Ahuja and Khalil Ahmad : Functional Analysis, New Age International (P) Ltd. And Wiley Eastern Ltd., New Delhi, 1987.
7. E.Kreyszig : Introductory Functional Analysis with Applications, John Wiley and Sons, New York, 1978.

M.SC MATHEMATICS SEMESTER IV

CODE: MTH -514

SUBJECT NAME: **DIFFERENTIAL GEOMETRY**

NO. OF CREDITS: 4

		SESSIONAL:	40
L	P	THEORY EXAM:	60
4	0	TOTAL:	100

NOTE: Question paper has two parts. Part-1 has 10 questions each of 2 marks. It covers the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OBJECTIVES

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,

UNIT-I

Curves with Torsion :Tangent, Principal normal, Curvature, Binormal. Torsion. Serret-Frenet formulae, Locus of centre of curvature, Spherical curvature, Locus of centre of spherical curvature., Involutes, Evolutes.

UNIT II

ENVELOPES. DEVELOPABLE SURFACES: One-parameter family of surfaces, Envelope. Characteristics, Edge of regression, Developable surfaces. Developables associated with a curve, Osculating developable, Polar developable, Rectifying developable, two-parameter family of surfaces: Envelope. Characteristic points ,Envelopes, Edge of regression, Ruled surface, Developable surface, Monge's theorem, conjugate directions.

UNIT III

CURVILINEAR COORDINATES ON A SURFACE. FUNDAMENTAL MAGNITUDES

Curvilinear coordinates,First order magnitudes,Directions on a surface,The normalSecond order magnitudes,Derivatives of n ,Curvature of normal section. Meunier's theorem.

UNIT IV

Principal directions and curvatures, First and second curvatures, Euler'stheorem, Dupin'sindicatrix, The surface z = f(x,y) ,Surface of revolution.

UNIT- V

Conjugate system: Conjugate directions, Conjugate system Asymptotic lines, asymptotic lines,Curvature and torsion, Isometric lines: Isometric parameters. Null lines, or minimal curves. Geodesic Property, Equations of geodesics, Surface of revolution, Torsion of a geodesic.

COURSE OUTCOMES

Upon completion of the programme, student will be able

- to explain and apply the concepts and techniques of differential geometry of curves and surfaces
- to analyze and solve problems (using concepts and techniques from differential geometry).
- to parametrize a plane and a space curve and to calculate its curvatures and Frenet-Serret apparatus and arc-length

REFERENCE BOOKS

1. Introduction to Differential Geometry: Abraham Goetz; Addison Wesley Pub. Company.

2. Differential Geometry: Nirmala Prakash; McGraw-Hill

3. Elementary Differential Geometry: B.O. Neill; Academic Press.

4. A course in tensors with Application to Riemannian Geometry: R.S. Mishra

5. An introduction to Differential Geometry: T.J. Willmore

6. Introduction to Riemannian Geometry and Tensor Calculus: Weatherburn

M.SC MATHEMATICS SEMESTER IV

CODE: MTH -516

SUBJECT NAME: FLUID DYNAMICS

NO. OF CREDITS: 4

		SESSIONAL:	40
L	P	THEORY EXAM:	60
4	0	TOTAL:	100

NOTE: Question paper has two parts. Part-1 has 10 questions each of 2 marks. It covers the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OBJECTIVES

Develop an understanding of fluid dynamics. Understand and use differential equations to determine pressure and velocity variations in internal and external flows.Understand the concept of viscosity and where viscosity is important in real flows.

UNIT I

Concept of fluid and its physical properties, Continuum hypothesis, Kinematics of fluids-Methods of describing fluid motion, Langrangian and Eulerian description,Translation, Rotation and deformation of fluid elements, Stream Lines, Path lines and Streak lines, concepts of Vorticity.

UNIT II

General theory of stress and rate of strain in a real fluid –Symmetry of stress tensor, Principal axes and Principle values of stress tensor, Constitutive equation for Newtonian fluid. Conservation laws- Conservation of mass, Conservation of momentum, Conservation of energy.

UNIT III

One and two dimensional inviscid incompressible flow-Equation of continuity and motion using stream tube, , Circulation, Velocity potential, Irrotational flow, Some theorems about rotational and irrotational flows – Stoke's theorem, Kelvin's minimum energy theorem, Gauss theorem, Kelvin's circulation theorem.

UNIT IV

Vortex motion and its elementary properties, Integration of equations of motion - Bernoulli's equation, Stream function in two dimensional motion, Complex potential functions, Velocity potential, flow past a circular cylinder, Blasius theorem, Milne's circle theorem, Sources, Sinks and Doublets. Dynamical similarity, Buckingham's pie theorem, Non-dimensional numbers and their physical significance

UNIT V

Incompressible viscous fluid flows- Plane couette flow, Plane poiseuille flow, Generalized plane couette flow, Steady flow of two immiscible fluids between two rigid parallel plates, Steady flow through tube of uniform circular cross section, Steady flow through concentric circular cylinders under constant pressure gradient.

COURSE OUTCOMES

Students successfully completing this course will demonstrate the following outcomes by homework and exams:

- An understanding of fluid mechanics fundamentals, including concepts of mass and momentum conservation.
- An ability to apply the General theory of stress and rate of strain in a real fluid.
- An ability to apply One and two dimensional inviscid incompressible flow,Equation of continuity.

REFERENCE BOOKS

1. S. W. Yuan, FOUNDATIONS OF FLUID MECHANICS Prentice Hall of India Private Limited, New-Delhi,1976.

2. R. K. Rathy, AN INTRODUCTION OF FLUID DYNAMI

M.SC MATHEMATICS SEMESTER IV

CODE: MTH 518

SUBJECT NAME: ADVANCED DISCRETE MATHEMATICS

NO. OF CREDITS: 4

		SESSIONAL:	40
L	P	THEORY EXAM:	60
4	0	TOTAL:	100

NOTE: Question paper has two parts. Part-1 has 10 questions each of 2 marks. It covers the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OBJECTIVES

To understand the basics of discrete mathematics like formal logic representations, symbolic representations and tautologies.They will understand the concept of lattices and Boolean algebra.They will learn to apply Boolean algebra to switching theory.They will understand the concept of graph theory like paths,circuits,cycles and subgraphs.

UNIT-I

Sets, Algebra of sets, Representation of relations on finite sets, mappings, Countability of sets, Partially ordered sets, Hasse diagram, Isomorphism, ordered sets, Principle of Mathematical induction, Formal logic statements, Symbolic representations and Tautologies, Quantifiers, proposition logic.

UNIT-II

Lattices- Lattices as partially ordered sets, their properties, Lattices as algebraic systems, some special lattices e.g. complete, complemented and distributive lattices

UNIT-III

Boolean Algebra – Boolean Algebra as lattices, various Boolean identities, the switching algebra e.g. Toin-Irreducible elements, Atoms and Minterms, Boolean forms and their equivalence, Mintern Boolean forms, Sum of products canonical forms, minimization of boolean functions. Application of Boolean algebra to switching theory (using AND, OR and NOT gates)

UNIT-IV

Graph Theory- Definition of Graphs, Paths, Circuits, cycles and subgraphs, induced subgraphs, degree of a vertex connectivity, Planar graphs and their properties, Trees, Euler‘s formula for connected planar graph, Complete and complete bipartite graphs, Spanning trees, Minimal spanning trees, Matrix representation of graphs, Euler‘s theorem on existence of Eulerian paths andcircuits, Directed graphs, Indegree and Outdegree of a vertex, weighted undirected graphs, Strong connectivity and Warshall‘s algorithm, Directed trees, Search trees, Tree traversals.

UNIT-V

Numeric function, Operation on numeric functions, Convolution of two numeric functions, Generating functions, recurrence relations, Explicit formula for a sequence, solution of recurrence relations, homogenous recurrence relations with constant coefficients, particular solution of difference equation, recursive functions solution of a recurrence relations by the method of generating function.

COURSE OUTCOMES

- Students will be able to comprehend the various symbolic representations in the basics of discrete mathematics.
- They will be able to use Boolean algebra and know everything about lattices.
- They will be able to use the knowledge acquired in switching theory.
- They will be able to use the concept of graph theory and will demonstrate
- the ability to analyze the modeling problems from social sciences with graphs and to provide answers in a clear, convincing manner.

REFERENCE BOOKS

1. Babu Ram, Discrete Mathematics, Vinayak Publishers and Distributors, Delhi, 2004.

2. J.P. Tremblay & R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co., 1997.

3. J.L. Gersting, Mathematical Structures for Computer

M.SC MATHEMATICSSEMESTER IV

CODE: MTH 520D

SUBJECT NAME: ADVANCED OPERATIONS RESEARCH

NO. OF CREDITS: 4

		SESSIONAL:	40
L	P	THEORY EXAM:	60
4	0	TOTAL:	100

NOTE: Question paper has two parts. Part-1 has 10 questions each of 2 marks. It covers the entire syllabus. Attempt any four questions out of six from Part-2.

COURSE OBJECTIVES

To enable the students to use quantitative methods and techniques for effective decisions–making; model formulation and applications that are used in solving business decision problems.

UNIT I

Sensitivity Analysis & Integer Linear Programming: Introduction of Sensitivity Analysis, Change in Objective function coefficient, Change in availability of resources, Addition of new variable and new constraint.

Introduction to Integer Linear Programming, Gomory's all integer cutting plane method, Gomory's mixed-integer cutting plane method, Branch and bound method, Application of Zero-One integer Programming.

UNIT II

Dynamic Programming:Bellman's Principle of optimality of Dynamic Programming, Multistage decision problem and its solution by Dynamic Programming with finite number of stages, Solution of linear programming problems as a Dynamic Programming problem

UNIT III

CPM and PERT: Common errors in network drawing, Rules for network construction, Fulkerson's Rule, Float and Network diagram, PERT computation, Critical Path Analysis, Estimation of Project Completion Time, Project crashing.

UNIT IV

Decision Theory & Decision Trees: Decision making Environments, Decision making under uncertainty, decision making under conditions of risk, expected value criterion for continuously distributed random variables, Decision Trees: Steps, displaying alternatives, Bayesian approach in decision making, advantages and limitations of decision tree approach.

UNIT V

Queuing Models :Introduction of Basic Concepts in Stochastic Processes. Markov Chain and Markov Processes. Queuing Systems. Probability Distribution of Arrival and Service Times. Markovian Queuing Systems: M/M/1, M/M/C, Finite Source queues. Erlangian Queueing Systems: M/Ek/l and Ek/M/1. Bulk Queuing Systems. Basic Idea of Priority Systems. Imbedded Markov Chain Models: M/G/1, G/M/1, M/D/C.

COURSE OUTCOMES

After completing this course satisfactorily, a student will be able to:

- Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
- Understand the applications of, basic methods for, and challenges in integer programming
- Design new simple models, like: CPM, PERT to improve decision –making and develop critical thinking and objective analysis of decision problems.
- Solve operational problems like budgeting using dynamic programming
- Model a dynamic system as a queuing model and compute important performance measures.

REFERENCE BOOKS

1. Hamdy A. Taha, Operations Research, An Introduction (8th edition), Prentice-Hall India, 2006.
2. F. S. Hillier and G. J. Lieberman, Introduction to Operations Research (8^{th} Edition), Tata McGraw Hill, Singapore, 2004.
3. A. Ravindran, D. T. Phillips and James J. Solberg: Operations Research- Principles and Practice, John Wiley & Sons, 2005.
4. P K. Gupta and D.S. Hira, Operations Research. S. Chand & Co, New Delhi.
5. T. L. Satty: Elements of Queueing Theory with Applications, Dover, NY, 1983.
6. R.B. Cooper: Introduction to Queueing Theory, 2nd Edition, North Holland, 1981.
7. G. Hadley: Nonlinear and Dynamic Programming, Addison-Wesley, 1964
8. Antoniou, Wu-Sheng Lu: Practical Optimization-Algorithms and Engineering Applications, Springer, 2007.
9. Sharma, S.D., Operation Research, Kedar Nath Ram Nath Publications.
10. Sharma, J.K., Mathematical Model in Operation Research, Tata McGraw Hill.