DEPARTMENT OF

HUMANITIES AND SCIENCES

M.Sc. (Mathematics)

ACADEMIC SESSION 2017-2018

YMCA UNIVERSITY OF SCIENCE AND TECHNOLOGY

YMCA UNIVERSITY OF SCIENCE AND TECHNOLOGY

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

HUMANITIES AND SCIENCES 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.

M.Sc. Mathematics

PROGRAM EDUCATIONAL 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.

PROGRAM 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.

YMCA UNIVERSITY OF SCIENCE AND TECHNOLOGY, FARIDABAD
DEPARTMENT OF HUMANITIES AND SCIENCES

SCHEME OF M.Sc. MATHEMATICS

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

Lab: 03

Project:01

SEMESTER I

S. No.	Subject Code	Title	L	T	P	Sessional Marks	Final Exam Marks	Total	Credits	Category code
1	MATH17-101	Real Analysis	4	0	0	25	75	100	4	DCC
2	MATH17-102	Abstract Algebra	4	0	0	25	75	100	4	DCC
3	MATH17-103	Ordinary Differential Equations	4	0	0	25	75	100	4	DCC
4	MATH17-104	Complex Analysis	4	0	0	25	75	100	4	DCC
5	MATH17-105	Programming in C(theory)	4	0	0	25	75	100	4	DCC
6	MATH17-106	Programming in C lab	0	0	8	30	70	100	4	DCC
7	XXX	MOOC*								MOOC
		Total	**20**	**0**	**8**	**155**	**445**	**600**	**24**	

DCC – Discipline Core Course; FC – Foundation Course; MOOC – Massive Open Online Course
L – Lecture; T - Tutorial; P - Practical
*The students have to pass at least one mandatory MOOC course with 4-6 credits (12-16 weeks) from the list given on the Swayam portal or the list given by the department/ university from 1st semester to 3rd semester as notified by the university. (Instructions to students overleaf)

Instructions to the students regarding MOOC

1. Two types of courses will be circulated: branch specific and general courses from the website https://swayam.gov.in in the month of June and November every year for the forthcoming semester.
2. The department coordinators will be the course coordinators of their respective departments.
3. Every student has to pass a selected MOOC course within the duration ass specified below:

Programme	**Duration**
B. Tech.	Sem. I to Sem. VII
M.Sc./M.Tech./MA/MBA	Sem. I to Sem. III
B.Sc./MCA	Sem. I to Sem. V

The passing of a MOOC course is mandatory for the fulfilment of the award of the degree of concerned programme.

4. A student has to register for the course for which he is interested and eligible which is approved by the department with the help of course coordinator of the concerned department.
5. A student may register in the MOOC course of any programme. However, a UG student will register only in UG MOOC courses and a PG student will register in only PG MOOC courses.
6. The students must read all the instructions for the selected course on the website, get updated with all key dates of the concerned course and must inform his/her progress to their course coordinator.
7. The student has to pass the exam (online or pen-paper mode as the case may be) with at least 40% marks.
8. The students should note that there will be a weightage of Assessment/quiz etc. and final examination appropriately as mentioned in the instructions for a particular course.
9. A student must claim the credits earned in the MOOC course in his/her marksheet in the examination branch by forwarding his/her application through course coordinator and chairperson.

YMCA UNIVERSITY OF SCIENCE AND TECHNOLOGY, FARIDABAD
DEPARTMENT OF HUMANITIES AND SCIENCES

SCHEME OF M. SC. MATHEMATICS

SEMESTER II

S. No.	Subject Code	Title	L	T	P	Sessional Marks	Final Exam Marks	Total	Credits	Category code
1	MATH17-107	Mathematical Statistics	4	0	0	25	75	100	4	DCC
2	MATH17-108	Linear Algebra	4	0	0	25	75	100	4	DCC
3	MATH17-109	Mathematical Methods	4	0	0	25	75	100	4	DCC
4	MATH17-110	Numerical Methods	4	0	0	25	75	100	4	DCC
5	MATH17-111	Programming in C++(theory)	4	0	0	25	75	100	4	DCC
6	MATH17-112	Programming in C++ lab	0	0	8	30	70	100	4	DCC
7	XXX	Audit Course*	2	0	0	25	75	100	0	AUD
		Total	**22**	**0**	**8**	**180**	**520**	**700**	**24**	

DCC – Discipline Core Course; AUD-Audit Course
L – Lecture; T - Tutorial; P - Practical
*The students have to choose one Audit course from the list provided by the department/university. Only passing of the Audit course will be mandatory.

YMCA UNIVERSITY OF SCIENCE AND TECHNOLOGY, FARIDABAD
DEPARTMENT OF HUMANITIES AND SCIENCES
SCHEME OF M. SC. MATHEMATICS
SEMESTER III

S. No.	Subject Code	Title	L	T	P	Sessional Marks	Final Exam Marks	Total	Credits	Category code
1	MATH17-113	Topology	4	0	0	25	75	100	4	DCC
2	MATH17-114	Mechanics	4	0	0	25	75	100	4	DCC
3	MATH17-115	Partial Differential Equations	4	0	0	25	75	100	4	DEC
4	MATH17-116	Operations Research	4	0	0	25	75	100	4	DEC
5	MATH17-117	MATLAB	0	0	8	30	70	100	4	DCC
6	XXX	Open Elective**	3	0	0	25	75	100	3	OEC
		Total	**19**	**0**	**8**	**155**	**445**	**600**	**23**	

DCC – Discipline Core Course; DEC – Discipline Elective Course; OEC – Open Elective Course
L – Lecture; T - Tutorial; P - Practical

* The students have to choose one Open elective course related to other branch of Science/Engg./other discipline required for enhancing professional performance as provided by the department/university.

**Discipline Elective Courses can be offered subject to availability of requisite resources/ faculty in the university/department.

YMCA UNIVERSITY OF SCIENCE AND TECHNOLOGY, FARIDABAD
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SCHEME OF M. SC. MATHEMATICS

SEMESTER IV

S. No.	Subject Code	Title	L	T	P	Sessional Marks	Final Exam Marks	Total	Credits	Category code
1	MATH17-118	Functional Analysis	4	0	0	25	75	100	4	DCC
2	MATH17-119	Differential Geometry	4	0	0	25	75	100	4	DEC
3	MATH17-120	Fluid Dynamics	4	0	0	25	75	100	4	DCC
4	MATH17-121	Integral Equations	4	0	0	25	75	100	4	DCC
5	MATH17-122	*Discipline Elective	4	0	0	25	75	100	4	DEC
4	MATH17-P121	Project Work	0	0	8	30	70	100	4	DCC
		Total	**20**	**0**	**8**	**155**	**445**	**600**	**24**	
*Discipline Elective Course (Elective III): Select any one course from the following:										
2	MATH17-122A	Advanced Discrete Mathematics	4	0	0	25	75	100	4	DEC
	MATH17-122B	Wavelets and its Applications	4	0	0	25	75	100	4	DEC
	MATH17-122C	Advanced Operation Research	4	0	0	25	75	100	4	DEC
	MATH17-122D	Information Theory	4	0	0	25	75	100	4	DEC
	MATH17-122E	Mechanics of Solids	4	0	0	25	75	100	4	DEC

DCC – Discipline Core Course; DEC – Discipline Elective Course
L – Lecture; T - Tutorial; P - Practical l

*Discipline Elective Courses can be offered subject to availability of requisite resources/ faculty in the department.

YMCA UNIVERSITY OF SCIENCE AND TECHNOLOGY, FARIDABAD
DEPARTMENT OF HUMANITIES AND SCIENCES

The Audit course and Open elective courses offered by PG Department in Mathematics:

Course	Subject	Subject Code
Audit Course	1. Elementary Number theory	AC-201B
Open Elective Course	1. Basics of Statistics	OMATH-203A
	2. Graph theory	OMATH-204A

1. The students have to choose one Audit course (0 credit) from the list provided by the department/university. Only passing of the Audit course will be mandatory.

2. The students have to choose one Open elective course (03 credits) related to other branch of Science/Engg./other discipline required for enhancing professional performance as provided by the department/university.

Grading Scheme

*Percentage	Grade	Grade Points	Category
90-100	O	10	Outstanding
80-90	A+	9	Excellent
70-80	A	8	Very Good
60-70	B+	7	Good
50-60	B	6	Above Average
45-50	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: MATH17-101

SUBJECT NAME: **REAL ANALYSIS**

NO OF CREDITS: 4

		SESSIONAL:	25
L	P	THEORY EXAM:	75
4	0	TOTAL:	100

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 R-S integrals, and sequences of functions. The course will develop specialized techniques in problem solving of power series and functions of several variables. The course will also develop understanding of Lebesgue Integral and Measure theory.

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, uniqueness theorem for power series, properties of function expressed as power series, Abel's theorem.

Function of several variables, derivation of higher orders, change of variables, Taylor's theorem, Jacobian, Inverse function theorem, Implicit function theorem, Lagrange's multiplier method.

UNIT - IV

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, measurability and integrability, Fatou's lemma, Classical lebesgue dominated convergence theorem.

COURSE OUTCOMES

Students will be able to

- describe the concept of sequence and series of functions and related results
- describe the concept of R-S integral and related theorems.
- describe the concept of power serirs and functions of several variables.
- define Lebesgue Integral and prove theorems about Lebesgue Integral.

BOOKS RECOMMENDED

- W. Rudin, Principles of Mathematical Analysis (3rd edition) McGraw-Hill, Kogakusha,1976, International student edition.
- T.M.Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi,1985.
- P.K.Jain and V.P.Gupta, Lebesgue Measure and Integration, New Age International (P) Limited Published, New Delhi, 1986 (Reprint 2000).
- H.L.Royden, Real Analysis, Macmillan Pub. Co. Inc. 4th Edition, New York, 1993.
- S.C. Malik &SavitaArora, Mathematical Analysis, New Age International (P) Limited Published,2008.

M.SC. MATHEMATICS SEMESTER I

CODE: MATH 17-102

SUBJECT NAME : **ABSTRACT ALGEBRA**

NO OF CREDITS: 4

		SESSIONAL:	25
L	P	THEORY EXAM:	75
4	0	TOTAL:	100

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 & Composition series, Subnormal series, Refinement, Jordon Holder's Theorem,Solvable groups, Permutation groups, cyclic permutation, Transposition, Even and odd permutation,Alternating groups, Cayley's theorem, (Galois) Simplicity of An (n>=5).

UNIT-II

Conjugacy, Class equations, p-group,Sylow's theorems, Cauchy's theorem, 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, Field of quotients of an Integral domain, Euclidean domains, The ring of Gaussian integers, Principal ideal domains, Unique factorization Domain.

UNIT-IV

Gauss lemma, Eisenstein's irreduciblity criterion, Primitive polynomials, Cyclotomic polynomials, Unique factorization in R[x] where R is a Unique factorization Domain. Field extensions, Algebraic and transcendental extensions, Splitting Fields, Normal extensions, Finite fields, Construction 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
- Ring Theory
- Field extensions, Algebraic and transcendental extensions.
- Normal extensions,Finite fields, Construction of finite fields.

BOOKS RECOMMENDED

- P. B. Bhattacharya, S.K. Nagpaul, Basic Abstract Algebra (2nd Edition)Cambridge University Press, Indian Edition, 1997.
- Contemporary abstract algebra, Joseph A. Gallian .
- I. N. Herstein, Topics in Algebra, New Age International (P) Limited,New Delhi
- Abstract Algerbra , David S. Dummit and Richard M. Foote ,Wiley

M.SC MATHEMATICSSEMESTER I

CODE: MATH17-103

SUBJECT NAME: ORDINARY DIFFERENTIAL EQUATIONS

NO. OF CREDITS: 4

		SESSIONAL:	25
L	P	THEORY EXAM:	75
4	0	TOTAL:	100

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 initial value problems ,system of equations. They will develop ability to solve differential equations by power series solution,frobenius. They will learn to apply concepts of Sturmian theory, Non linear differential equations.

UNIT - I

Initial-value problem and the equivalent integral equation, e-approximate solution, Cauchy-Euler construction of an e-approximate solution, Equicontinuous family of functions, Ascoli-Arzela theorem, Cauchy-Peano existence theorem. Uniqueness of solutions, Lipschitz condition, Picard-Lindelof theorem for local existence and uniqueness of solutions, solution of initial-value problems by Picard method.

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.

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 – III

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

UNIT-IV

System of Linear Differential Equations: 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.

COURSE OUTCOMES

Upon completion of course, students will be able to:

- Solve initial value problems, use knowledge about some basic theorems related to the topic.
- Use power series and Frobenius method for solving differential equations, use Sturmian theory for solving problems.
- Use the basic terms and Liapunov method for non- linear differential equations.
- 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.

BOOKS RECOMMENDED:

- E.A. Coddington and N. Levinson,Theory of Ordinary Differential Equations,McGraw Hill, NY, 1955.
- G. Birkhoff and G.C. Rota, Ordinary Differential Equations, John Wiley and Sons Inc..NY, 1978.
- S.L. Ross, Differential Equations, John Wiley and Sons Inc., NY, 1984.
- W.E. Boyce and R.C. Diprima, Elementary Differential Eqluations and Boundary Value Problems, John Wiley and sons Inc., NY, 1986.
- Philip Hartman, Ordinary Differential Equations, John Wiley & Sons, NY
- 1964. 6. Sharma and Gupta, Differential Equations, Krish.
- M.D.Raisinghania, Ordinary Differential Equations by S.Chand.

M.SC. MATHEMATICS SEMESTER I

CODE: MATH17-104

SUBJECT NAME: COMPLEX ANALYSIS

NO OF CREDITS: 4

		SESSIONAL:	25
L	P	THEORY EXAM:	75
4	0	TOTAL:	100

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

Analytic functions and their properties, Cauchy-Riemann equations in Cartesian and polar coordinates. Power series, Radius of convergence, 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 -II

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 - III

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.

UNIT - IV

Bilinear transformations, their properties and classifications. Definitions and examples of conformal mappings.

COURSE OUTCOMES

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

- Demonstrate the ability to integrate knowledge and ideas of Analytic function and Cauchy-Riemann equations in Cartesian and polar coordinates .
- 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.

BOOKS RECOMMENDED

- H.A. Priestly, Introduction to Complex Analysis, Clarendon Press, Oxford, 1990.
- J.B. Conway, Functions of one Complex variable, Springer-Verlag, International student-Edition, Narosa Publishing House, 1980.
- S. Lang, Complex Analysis, Addison Wesley, 1977.
- Mark J. Ablowitz and A.S. Fokas, Complex Variables : Introduction and Applications, Cambridge University Press, South Asian Edition, 1998.
- S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House,1997.
- Ruel V. Churchill and James Ward Brown, Complex Variables and Applications, McGraw-Hill Publishing Company.
- Rudin, Real and Complex Analysis .
- B. Choudhary, The Elements of Complex Analysis. New Age International.

M.SC. MATHEMATICS SEMESTER I

CODE: MATH17-105

SUBJECT NAME: PROGRAMMING IN C

NO. OF CREDITS: 4

		SESSIONAL:	25
L	P	THEORY EXAM:	75
4	0	TOTAL:	100

COURSE OBJECTIVE

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

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.

UNIT-II

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

UNIT-III

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 outputfunctions. Control flow- Conditional Branching, The switch statement. Looping, Nested Loops. The break and continue statement. The gotostatement , infinite loop.

UNIT-IV

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

- 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.

BOOKS RECOMMENDED

- Kenneth, A. : C problem solving and programming, Prentice Hall.
- Gottfried, B. : Theory and problems of Programming in C, Schaum Series.
- Kerninghan&Ritchie : The Programming Language, PHI.
- E. Horowitz and S. Sahani, "Fundamentals of Data Structures", GalgotiaBooksourcePvt. Ltd, 2003
- R.S.Salaria, "Data Structure & Algorithms", Khanna Book Publishing Co. (P) Ltd.,2002.
- P. S. Deshpande and O.G. Kakde, "C & Data Structure", Wiley Dreamtech, 1stEdition, 2003.
- Schaum's outline series, "Data Structure", TMH, 2002
- E Balagurusamy, Programing in C, McGraw Hill Education,6th edition.

M.SC MATHEMATICSSEMESTER I

CODE: MATH17-106

SUBJECT NAME: PROGRAMMING IN C LAB)

NO. OF CREDITS: 4

		INTERNAL:	30
L	P	EXTERNAL:	70
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.

BOOKS RECOMMENDED

- Kenneth, A. : C problem solving and programming, Prentice Hall.
- Gottfried, B. : Theory and problems of Programming in C, Schaum Series.
- Kerninghan&Ritchie : The Programming Language, PHI.
- E. Horowitz and S. Sahani, “Fundamentals of Data Structures”, GalgotiaBooksourcePvt. Ltd, 2003
- R. S. Salaria, “Data Structure & Algorithms”, Khanna Book Publishing Co. (P) Ltd.,2002.
- P. S. Deshpande and O.G. Kakde, “C & Data Structure”, Wiley Dreamtech, 1stEdition, 2003.
- Schaum’s outline series, “Data Structure”, TMH, 2002

M.SC. MATHEMATICS SEMESTER II

CODE: MATH17- 107

SUBJECT NAME: MATHEMATICAL STATISTICS

NO. OF CREDITS: 4

		SESSIONAL:	25
L	P	THEORY EXAM:	75
4	0	TOTAL:	100

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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 the basic statistical terms, use of various distributions, Discrete distributions and application of various tests of hypothesis.

UNIT - I

Random variable and probability functions: definition and properties, Discrete and continuous random variables, probability mass and density function, Two dimensional random variable ,joint ,marginal and conditional distribution.

Mathematical expectation: definition and its properties, Moment generating function: definition and their properties.

UNIT - II

Discrete Distributions: Uniform and Bernouli distribution (definition only), Binomial Distribution: definition and their properties, Poisson Distribution: definition and their properties.

Continuous Distribution: Normal Distribution: definition , Properties of Normal Distribution, Area under Normal Probability Curve. Importance of normal distribution.

UNIT -III

Testing of Hypothesis: Parameter and Statistic, null and alternate hypothesis ,Simple and Composite hypothesis, Critical region, Level of Significance, One tailed and two tailed test, two types of error .

Test of Significance: Large sample test for single mean, single proportion, difference between two means and two proportion.

UNIT - IV

Continuous distribution: Gamma distribution and their properties, Exponential distribution and their properties.

Sampling distribution: chi –square test, t- test, F-test.

Weak law of large number, Central limit theorem

COURSE OUTCOMES

After completion of course, students will be able to:

- Formulate and analyze discrete and continuous random variable, concept of joint , marginal and conditional distributions, concept of mathematical expectations.
- Learn about various types of distributions (discrete and continuous) and their properties.
- Learn about testing of hypothesis, types of error and test of significance for large sample.
- Learn about Gamma and Exponential distribution, Sampliong distribution, central limit theorem.

BOOKS RECOMMENDED

- Baisnab and Jas, M., Element of Probability and statistics, Tata McGraw Hill.
- Freund,J.E., Mathematical Statistics, Prentice Hall of India.
- Hogg, R.V. and Craig, A.T., Introduction to Mathematical Statistics, Pearson Education Limited-2014.
- Gupta,S.C., Mathematical Statistics, Himalayan Publications.
- Gupta,S.C and Kapoor V.K., Fundamentals of Mathematical Statistics, S. Chand Pub., New Delhi.
- Speigel, M., Probability and Statistics, Schaum Outline Series.
- A.M. Mood, F.A. Graybill, and D.C. Boes, Introduction to the theory of Statistics, McGraw Hill Book Company

M.SC. MATHEMATICS SEMESTER II

CODE: MATH17-108

SUBJECT NAME: LINEAR ALGEBRA

NO. OF CREDITS: 4

		SESSIONAL:	25
L	P	THEORY EXAM:	75
4	0	TOTAL:	100

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.

Quotient spaces, Basis, Subspaces, Linear transformation, Rank and nullity of a linear transformation, Sylvester‟s law of nullity, Algebra of linear transformations, Orthogonal and supplementary linear transformations

UNIT –II

Linear functional, Dual space, Dual basis, Bidual, Cannonical isomorphism, Matrix of a linear transformation, Change of basis, Equivalent and similar matrices, Invertible linear transformations.

UNIT III.

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

UNIT -IV

Review of Inner product spaces,Adjoint operator , Self adjoint operator,Hermitianoperator, Unitary and Normal operators.

COURSE OUTCOMES

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

- Locate and use information to solve problems of linear transformations and vector
- spaces;
- Explain the dimension of a vector space, and rank of a matrix;
  Concept of Linear functional, Dual space, Dual basis.
- Reduce a matrix to a given form using Gauss-Jordan reduction;
- Find eigenvalues and eigenvectors, and diagonalizing matrices.

Books recommended

1. I.N. Herstein, Topics in Algebra
2. Linear algabra ,Schaum's Outline, McGraw Hill Education (India) Private Limited
3. P.R. Halmos, Linear Algebra with Problems
4. Hoffman & Kunze, Linear Algebra

REFERENCES:

- S. Andrilli and D. Hecker, Elementary Linear Algebra, Academic Press, 4/e (2012)
- B. Kolman and D.R. Hill, Introductory Linear Algebra with Applications, Pearson Education, 7/e (2003)
- Linear algabra ,Schaum's Outline, McGraw Hill Education (India) Private Limited

M.Sc. MATHEMATICS SEMESTER II

CODE: MATH17-109

SUBJECT NAME: **MATHEMATICAL METHODS**

NO. OF CREDITS: 4

SESSIONAL: 25

L P THEORY EXAM: 75

COURSE OBJECTIVES

This course is aimed at various Mathematical Transforms. In addition to being an important tool of mathematics in its own right, Mathematical Methods 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

Fourier Series: Periodic Functions , Euler's formulae for fourier series, fourier series for discontinuous functions, half range series, Parseval's Idendity, Fourier Integral Theorem .
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

MellinTranform: Definition, Elementary properties, Mellin transform of derivatives, Integrals, Inverse Mellin transform, Convolution theorem , Inverse Mellin transform of two functions.
Hankel Tranform: Definition, Elementary properties, Hankel transform of derivatives, Exponential functions, Inversion formula for Hankel transformation, Parseval'stheorem , Relation between Hankel and Laplace transform.

UNIT-IV

Bessel's functions, Bessel function of second kind of order n, Trignometric expansion involving Bessel Functions, Bessel Integral , Fourier-Bessel Expansion, ber and bei function.

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.
- Fourier Transform of some elementary functions, convolution theorem, application of fourier transform to solve ordinary and partial differential equation.
- Elementry properties of MellinTranform:, Mellin transform of derivatives, Integrals, Inverse Mellin transform
- Elementry properties of Hankel Tranform, Hankel transform of derivatives, Exponential functions, Inversion formula for Hankel transformation.
- Bessel function, Legender's associated functions and differential equation

BOOKS RECOMMENDED:

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

M.SC MATHEMATICS SEMESTER II

CODE: MATH17-110

SUBJECT NAME: NUMERICAL METHODS

NO. OF CREDITS: 4

		SESSIONAL:	25
L	P	THEORY EXAM:	75
4	0	TOTAL:	100

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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

Newton‘s forward and backward interpolation formulae. Central difference interpolation formula, Gauss forward and backward interpolation formulae, Langrage’s interpolation formula and Newton‘s divided difference formulae.

Solution of algebraic and transcendental equations: Bisection method, method of false position, secant method, iteration method, Newton's Rap son method.

UNIT-II

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-III

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

UNIT- IV

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:

- Apply various mathematical operations and tasks, such as interpolation and solutions of algebraic and transcendental equations.
- Ability to find Solution of simultaneous algebraic equations and to solve the problems based on Numerical differentiation and integration.
- Ability to find Numerical solution of Ordinary differential equations.
- Ability to find Numerical solution of partial differential equations.

BOOKS RECOMMENDED:-

- K.Atkinson and W. Han, Elementary Numerical Analysis, John Wiley,2006.
- Numerical Methods in Engg. & Science : B.S. Grewal :khanna publications.
- Numerical Methods for Scientific and Engg. Computations : M.K. Jain, S.R.K. Iyengerand R.K. Jain-Wiley Eastern Ltd
- Taneja, H.C. "Advanced Engineering Mathematics", IK International, New Delhi.
- Introductory Methods of Numerical Analysis: S.S. Shastri, PHI learning pvt limited.

M.SC MATHEMATICS SEMESTER II

CODE: MATH17- 111

SUBJECT NAME: **PROGRAMMING IN C++**

NO OF CREDITS: 4

		SESSIONAL:	25
L	P	THEORY EXAM:	75
4	0	TOTAL:	100

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, opening and closing a file. File pointers and their manipulations, Random Access, Error handling during file operations, Command–line argument,.

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.
- 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.

BOOKS RECOMMENDED

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

M.SC MATHEMATICSSEMESTER II

CODE: MATH17- 112

SUBJECT NAME: **PROGRAMMING IN C++ (LAB)**

NO. OF CREDITS: 4

		INTERNAL	30
L	P	EXTERNAL:	70
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

BOOKS RECOMMENDED

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

M.SC. MATHEMATICS SEMESTER III

CODE: MATH 17-113

SUBJECT NAME: TOPOLOGY

NO. OF CREDITS: 4

		SESSIONAL:	30
L	P	THEORY EXAM:	70
4	0	TOTAL:	100

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 limit point 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

Topological spaces, basis and sub basis,ordered topology ,quotient topology, product topology,Limit points , adherent points , Derived sets , Closure, interior, exterior and boundary pts. of a set, subspace, relative topology.

UNIT - II

Continuity ,Homeomorphism, countability axioms, First and second countable spaces,Seperablespace. Separated sets, connected sets; component, path component; localconnectedness, Disconnected sets, Totally Disconnected sets.,locally connected spaces,connectedness on real line

UNIT - III

Compact spaces; limit point compact and sequentially compact spaces,local compactness and one point compactification; finite product of compact spaces, Stone czech theorem and Tychonoff's theorem(without proof)

UNIT -IV

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(all types).
- Recognize whether or not a subset of a topological space is compact and be familiar with the basic properties of compact subsetsand their proofs.
- Ability to understand continuity and related concepts like product and quotient topology,first and second countable spaces,separation axioms.
- Able to understand the concepts of connectedness and total connectedness.

BOOKS RECOMMENDED:

- **Topology**, a first course – **J. R. Munkres,** Prentice-Hall of India Ltd., New Delhi,2000.
- **Introduction to topology and modern analysis,G.F.Simmons,Tata McGraw Hill 1963.**
- General Topology – J. L. Kelley, Springer Verlag, New York, 1990.
- An introduction to general topology (2nd edition) – K. D. Joshi, Wiley Eastern Ltd., New Delhi, 2002.
- Topology by T.B.Singh published by CRC Press.

M.Sc. MATHEMATICS SEMESTER III

CODE: MATH17-114

SUBJECT NAME: **MECHANICS**

NO. OF CREDITS: 4

		SESSIONAL:	25
L	P	THEORY EXAM:	75
4	0	TOTAL:	100

COURSE OBJECTIVES:

To understand the basic concept of Calculus of variation and its applications, 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.

UNIT I

Calculus of Variations: Functional and their properties, Motivating problemsof calculus of variations,Shortest Distance,minimum surface of revolution, Brachistocrome problem,isoperimetric problems,Geodesics,Fundamental lemma of Calculus of Variations(only statement),Euler's equation for one dependent function and its generalisation to i) n dependent functions ii) higher order derivatives

Moments and products of Inertia, Theorems of parallel and perpendicular axes, principal axes, Themomental 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.

UNIT III

Hamilton's variables ,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, 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.

COURSE OUTCOMES

After Successful completion of this programe Students will achieve mastery in

- Calculus of variations, 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,. CannonicalTransformations ,Lagrange brackets and Poisson brackets.

BOOKS RECOMMENDED

- F.Chorlton, A Text Book of Dynamics, CBS Publishers & Dist., New Delhi.
- F.Gantmacher, Lectures in Analytic Mechanics, MIR Publishers, Moscow.
- H.Goldstein, C. Poole and J. Safko: Classical Mechanics ,3rd Edition, Addition Wesley (2002).
- L . E. Elsgolc: The Calculus of Variations, Pergamon Press Inc , London,1962

M.Sc. MATHEMATICS SEMESTER III

CODE: MATH 17-115

SUBJECT NAME: PARTIAL DIFFERENTIAL EQUATION

NO. OF CREDITS: 4

		SESSIONAL: 25
L	P	THEORY EXAM: 75
4	0	TOTAL: 100

COURSE OBJECTIVES

This course aims to bring a comprehensive treatment of the theory of partial differential equations (P.D.E) from an applied mathematics perspective. Initial and boundary value problems. Method of separation of variables, Transform methods, Green's functions, Transport Equation, homogeneous and non-homogeneous transport equation, detailed knowledge of Laplace equation ,Heat equation and wave equation(one ,two, three dimensional).

UNIT-I

Method of separation of variables to solve B.V.P. associated with one dimensional heat equation, heat equation in semi-infinite and infinite regions.

Solution of three dimensional Laplace equation in Cartesian, Cylindrical and Spherical coordinates.

Solution of Wave equation in two dimensional, Solution of wave equation in three dimensional (Cartesian , Cylindrical, Spherical)

UNIT-II

PDE OF k^{th} Order : Definition, examples and classifications, Initial value problems, Transport equations: definition, solution of homogeneous and non-homogeneous transport equations, Laplace Equation, Fundamental solution of Laplace equation, Harmonic function , Mean Value formula for Harmonic function .

UNIT-III

Green's formula, Corrector function (definition only),Green's function and its derivation, Representation formula using Green's function, Symmetry of Green's function, Energy methods : uniqueness, Dirichlet Principle.

Heat Equations : Fundamental solution of Heat equation, Uniqueness of Heat equation :Energy methods.

UNIT-IV

Wave equation – Physical interpretation, Solution for one dimensional wave equation, Reflection method, derivation of 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.

COURSE OUTCOMES

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

- classify partial differential equations and find the solution of Laplace ,Heat, Wave equation(cartesian , cylindrical ,spherical) using separation of variables.
- learn about transport equation, homogeneous and non-homogeneous equation, fundamental solution of Laplace equation
- learn about Green's formula , Green's Function, Heat equation, Uniqueness of Heat equation.
- learn about one ,two and three dimensional wave equation, Kirchhoff's and Poisson formula and uniqueness of wave equation.

BOOKS RECOMMENDED

- L.C. Evans, Partial Differential Equations: Second edition(Graduate Studies in Mathematics)
- I.N. Snedden ,Elements of Partial Differential Equation, McGraw Hill, New York.
- Peter V. O'Neil, Advanced Engineering Mathematics ,ITP
- H. F.Weinberger, AFirst Course in Partial Differential Equation , John Wiley &Sons,1965
- M.D. Raisinghania, Advanced Differential Equation, S.Chand &Co.
- Differential Equations By Shepley L.Ross

M.SC. MATHEMATICS SEMESTER III

CODE: MATH17-116

SUBJECT NAME: **OPERATIONS RESEARCH**

NO OF CREDITS: 4

		SESSIONAL:	25
L	P	THEORY EXAM:	75
4	0	TOTAL:	100

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.
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-II

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-III

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-IV

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.

BOOKS RECOMMENDED:

- Taha, H.A., Operation Research-An introduction, Tata McGraw Hill, New Delhi.
- Dipak Chatterjee, Linear programming and Game Theory, Prentice-Hall India.
- Gupta, P.K. and Hira, D.S., Operations Research, S. Chand & Co.
- Sharma, S.D., Operation Research, Kedar Nath Ram Nath Publications.
- Sharma, J.K., Mathematical Model in Operation Research, Tata McGraw Hill.

M.SC MATHEMATICS SEMESTER III

CODE: MATH17-117

SUBJECT NAME: MATLAB

NO OF CREDITS: 4

		INTERNAL	30
L	P	EXTERNAL	70
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. WAP to add two numbers.
2. WAP to check whether a number is even or odd
3. WAP to make simple calculator
4. WAP to find greatest among ten numbers
5. WAP to find %age and grade of students
6. WAP to check whether a character is vowel or consonant
7. WAP to calculate simple interest
8. WAP to draw graph of ellipse
9. WAP to draw Sinusoidal wave form
10. WAP to find root of an equation using Bisection Method
11. WAP to find root of an equation using Regula Falsi Method
12. WAP to find root of an equation using Secant Method
13. WAP to find root of an equation using Newton Raphson Method
14. WAP to solve system of equations using Gauss Jacobi Method
15. WAP to evaluate integral using Trapezoidal rule.
16. WAP to evaluate integral using Simpson's 1/3 Rule
17. WAP to evaluate integral using Simpson's 3/8 Rule
18. WAP to evaluate integral using Boolle's rule
19. WAP to evaluate integral using Weddle's Rule
20. WAP for Lagrange's Interpolation formula
21. WAP to solve differential equation using Euler's Method
22. WAP to solve differential equation using Runge Kutta 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.

BOOKS RECOMMENDED

- MATLAB :An Introduction with application ,Wiley
- Applied Numerical Methods using MATLAB ,Wiley

M.Sc. MATHEMATICS SEMESTER IV

CODE: MATH17-118

SUBJECT NAME: FUNCTIONAL ANALYSIS

NO OF CREDITS: 4

		SESSIONAL:	25
L	P	THEORY EXAM:	75
4	0	TOTAL:	100

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.

UNIT-II

Compactness and finite dimension F. Riesz'z lemma, Bounded and continuous linear operators, linear functional , bounded linear functional, Hahn-Banachtheorem for real linear spaces and complex linear spaces, Riesz-representatiion theorem for bounded linear functionals on C[a,b], adjoint operator, norm of the adjoint operator. Reflexive spaces, uniform boundedness theorem.

UNIT-III

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.

UNIT-IV

Inner product spaces, Hilbert spaces and their examples, Pythagorean theorem, Apolloniu's identity, Schwarz inequality, continuity of innerproduct space, completion of an inner product space, subspace of a Hilbert space, orthogonal complements and direct sums, projection theorem, Orthonormal sets and sequences, Bessel's inequality, total (complete) orthonormal sets and

sequences, Parseval's identity, separable Hilbert spaces, Riesz representation theorem for bounded linear functionals on a Hilbert space.

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
- describe the concept of linear functional and prove the Hahn-Banach theorems.
- describe the concept of strong and weak convergence.
- describe the concept of inner product space & Hilbert space and related theorems.

BOOKS RECOMMENDED

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: MATH17-119

SUBJECT NAME: **DIFFERENTIAL GEOMETRY**

NO. OF CREDITS: 4

		SESSIONAL:	25
L	P	THEORY EXAM:	75
4	0	TOTAL:	100

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 normal Second 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.

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

BOOKS RECOMMENDED

- Introduction to Differential Geometry: Abraham Goetz; Addison Wesley Pub. Company
- Differential Geometry of 3- Dimentions: C E Wetherburn, Cambridge, University Press.
- Differential Geometry an Integrated Approach: Nirmala Prakash , McGraw-Hill
- Elementary Differential Geometry: B.O. Neill; Academic Press.
- An introduction to Differential Geometry: T.J. Willmore

M.SC MATHEMATICS SEMESTER IV

CODE: MATH 17- 120

SUBJECT NAME: FLUID DYNAMICS

NO. OF CREDITS: 4

		SESSIONAL:	25
L	P	THEORY EXAM:	75
4	0	TOTAL:	100

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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

Kinematics- Velocity at a point of a fluid, Eulerian and Lagrangian methods.
Real fluids and ideal fluids, velocity of fluid at a point, streamlines, pathlines, streaklines, velocity potential, vorticity vector, local and particle rate of change, equation of continuity, irrotational and rotational motion, acceleration of fluid, conditions at rigid boundary.

UNIT II

Euler's equation of motion, Equations of motion in cylindrical and spherical polar co-ordinates, Bernoulli's equation, their applications, Potential theorems ,axially symmetric flows, impulsive motion, Kelvin's Theorem of circulation, equation of vorticity.

UNIT III

Some three dimensional flows: sources, sinks and doublets, Images of sources, sinks and doublets in rigid impermeable infinite plane and in impermeable spherical surface, images in rigid planes, images in solid sphere.

UNIT IV

Two dimensional flows:Stoke's stream function, complex velocity potential, Milne Thomson Circle Theorem andapplications, Two-dimensional sources, sinks, doublets and their images, Theorem of Blasius, vortex rows, Karman vortex street.

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 conservation.
- An ability to apply One and two dimensional inviscid incompressible flow,Equation of continuity.
- An understanding the concept of sources, sinks and doublets.
- Milne Thomson Circle Theorem and applications

BOOKS RECOMMENDED

- W.H. Besaint and A.S. Ramsey, A Treatise on Hydromechanics, Part II, CBS Publishers, Delhi, 1988.
- F. Chorlton, Textbook of Fluid Dynamics, C.B.S. Publishers, Delhi, 1985.
- S.W. Yuan, Foundations of Fluid Mechanics, Prentice Hall of India Private Limited, New Delhi, 1976.
- M.E.O'Neil and F.Choriton, Ideal and Incompressible Fluid Dynamics, John Wiley & Sons.

M.Sc. MATHEMATICS SEMESTER IV

CODE: MATH17-121

SUBJECT NAME: **INTEGRAL EQUATIONS**

NO. OF CREDITS: 4

		SESSIONAL:	25
L	P	THEORY EXAM:	75
4	0	TOTAL:	100

COURSE OBJECTIVES

This course concerns the analysis and applications of integral equations. Applications include areas such as classical mechanics and differential equations.

SYLLABUS

Unit-1

Definition of integral equation and their classification .Conversion of ordinary differential equation into integral equation. Eigen values and Eigen function, convolution integral Fredholm integral equation of the second time with separable kernels and their reduction to a system of algebraic equation, Fredholm alternative, Fredholm theorem,Fredholm alternative theorem and approximate method .

Unit II

Method of succesive approximation . Iterative scheme for Fredholm integration of second kind Neumann series iterative kernals ,resolvent kernels iterative scheme for voltera integral equation of the second kind . Condition of uniform convergence and uniqueness of series solution

Unit-III

Classical Fredholm theory . Fredholm's first, second and third theorems. Application of integral equation to ordinary differential equation . Integral value problem transformed to Volterra integral equation ,boundary value problem convertion to Fredholm integral equation. Schmidt's solution, Non homogeneous Fredholm integral equation of the second type,solution of the Fredholm integral equation of their first kind with symmetric kernel. Integral transform method, dirac delta function.

Unit IV

Construction of Green's Function for a B.V.P associated with homogeneous with a non homogeneous ordinary differential equation of second order with homogeneous boundary condition by using the method of variation of parameters. Basic four properties of the Green's function alternative procedure for construction of a Green's function by using its basic four properties . Green's function approach for are IVP for second order equation Green's function for higher order differential equation modified Green's function .

COURSE OUTCOMES:

Students will be

- Able to use methods of successive approximations.
- Able to solve Voterra integral equations and Fredholm integral equations,reduce the differential equations to integral equations.
- Able to use and apply concepts of classical fredholm theory.
- Able to integral equation & classification, approximate method.

SUGGESTED BOOKS:

- R.P. Kanwal, Linear Integral Equations: Theory and Techniques, New York: Birkhäuser, 2013.
- C. Corduneanu, Integral Equations and Applications, Cambridge: Cambridge University Press, 2008.
- A.J.Jerry, Introduction to Integral Equations with Applications, 2nd ed.,New York, John Wiley & Sons, 1999.
- B.Dacorogna, Introduction to the Calculus of Variations, London: Imperial College Press, 2004.
- Integral Equation of Boundary Value Problem Publised by S-Chand

M.SC MATHEMATICS SEMESTER IV

CODE: MATH17-122A

SUBJECT NAME: ADVANCED DISCRETE MATHEMATICS

NO. OF CREDITS: 4

		SESSIONAL:	25
L	P	THEORY EXAM:	75
4	0	TOTAL:	100

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.

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.

UNIT-III

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-IV

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 graph theory and switching theory.
- They will be able to use the knowledge acquired in numeric function and recurrence relation.

BOOKS RECOMMENDED

- Babu Ram, Discrete Mathematics, Vinayak Publishers and Distributors, Delhi, 2004.
- J.P. Tremblay & R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co., 1997.
- J.L. Gersting, Mathematical Structures for Computer

M.SC. MATHEMATICS SEMESTER IV

CODE: MATH17-122C

SUBJECT NAME: **ADVANCED OPERATIONS RESEARCH**

NO. OF CREDITS: 4

		SESSIONAL:	25
L	P	THEORY EXAM:	75
4	0	TOTAL:	100

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

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 integer programming.
- Design new simple models, like: CPM and PERT.
- Solve operational problems like budgeting using dynamic programming.
- Model a dynamic system as a queuing model and compute important performance measures.

BOOKS RECOMMENDED

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

M.SC. MATHEMATICS SEMESTER IV

CODE: OMATH203A

SUBJECT NAME: BASICS OF STATISTICS

NO. OF CREDITS: 4

		SESSIONAL:	25
L	P	THEORY EXAM:	75
4	0	TOTAL:	100

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,concept of correlation and regression, use of various distributions.

UNIT – I

Measurement of Central Tendency and variation: Mean, Median and Mode, Mean Deviation , Standard Deviation, Variance, Coefficient of Variation.

UNIT-II

Corelation Analysis: meaning, significance ,types and methods,Regression Analysis: meaning equations and lines,Difference between correlation and regression.

UNIT - III

Probability: Definition and various approaches of probability, addition theorem, multiplication theorem and Conditional probability, Independent events, Mutual and pairwise independence of events, Baye's theorem and its applications.

UNIT - IV

Discrete Distributions: Uniform distribution, Bernoulli distribution, Binomial Distribution, and Poisson Distribution, with their properties.

Continuous Distributions: Normal Distribution,Area under Normal Probability Curve.Importance of normal distribution.

COURSE OUTCOMES

After completion of course, students will be able to:

- Formulate and analyze mathematical and statistical problems based on central tendency
- Use statistical methods to solve well-defined problems based on correlation and regression.
- Read, understand and construct correct data ,use the data-bases to locate information on mathematical problems.
- Learn about concept of probability and theorems based on it.
- Acquire mathematical and statistical knowledge of various distributions like binomial, poisson and normal.

REFERENCES BOOKS

2. Baisnab and Jas,M., Element of Probability and statistics, Tata McGraw Hill.
3. Freund,J.E., Mathematical Statistics, Prentice Hall of India.
4. Hogg,R.V. and Craig,A.T., Introduction to Mathematical Statistics, MawellMcmillian.
5. Gupta, S.C., Mathematical Statistics, Himalayan Publications.
6. Gupta S.C. and Kapoor V.K., Fundamentals of Mathematical Statistics, S. Chand Pub., New Delhi.
7. Speigel, M., Probability and Statistics, Schaum Outline Series.
8. S.P.Gupta, Statistical Methods S.Chand &Co., New Delhi

M.SC. MATHEMATICS SEMESTER IV

CODE: OMATH17-204A

SUBJECT NAME: Graph Theory

NO OF CREDITS: 3

		SESSIONAL:	25
L	P	THEORY EXAM:	75
4	0	TOTAL:	100

Course Objectives

The main objective of this course is to provide an introduction to graph theory and it helps students to solve the problems that can be modelled by graphs.

Unit -I

Introduction to Graphs: Definition and introductory concepts, Graphs as Models, Matrices and Isomorphism, Decomposition and Special Graphs, Connection in Graphs, Bipartite Graphs, Eulerian Circuits.

Unit- II

Vertex degrees and directed Graphs: Counting and Bijections, Extremal Problems, Graphic Sequences, Directed Graphs, Vertex Degrees, Eulerian Digraphs, Orientations and Tournaments.

Unit -III

Trees and Distance: Properties of Trees, Distance in Trees and Graphs, Enumeration of Trees, Spanning Trees in Graphs, Decomposition and Graceful Labellings, Minimum SpanningTree, Shortest Paths

Unit -IV

Connectivity and Paths: Connectivity, Edge-Connectivity, Blocks, 2-connected Graphs, Connectivity in Digraphs, k-connected and k-edge-connected Graphs, Maximum Network Flow, Integral Flows.

Course Outcomes

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

- Recall salient definitions in graph theory.
- Convert between various matrices and graphs.
- Calculate the spectrum of a graph.
- Determine the number of spanning trees in a graph algebraically.
- Understand basic concepts of planar graphs.

Text Books:

1. Kenneth H. Rosen, Discrete mathematics and its applications, McGraw-Hill, 2008.
2. R.P. Grimaldi, Discrete and combinatorial mathematics: An applied introduction, Pearson Education Inc., 2008.
3. F. Harary, Graph theory, Addison Wesley, 1969.
4. J.P. Tremblay and R.P. Manohar, Discrete mathematical structures with applications to computer science, McGraw-Hill, 1975.
5. C. L. Liu, Elements of discrete mathematics, Tata McGraw-Hill, 2000.
6. V.K. Balakrishnan, Combinatorics, Schaum's ouline series, 2001.
7. D.B. West, Introduction to graph theory, 2nd Ed., Pearson Education Asia, 2002.

M.SC MATHEMATICS

CODE: AC- 201 -B

SUBJECT NAME: ELEMENTARY NUMBER THEORY

NO. OF CREDITS: 4

		SESSIONAL:	25
L	P	THEORY EXAM:	75
4	0	TOTAL:	100

COURSE OBJECTIVES

This course will provide knowledge about the number theory concepts ,congruences, congruences of degree two, number theory from algebraic view point, quadratic residues, arithmetic functions, simultaneous linear equations, rational points on curves.

UNIT I Congruences, Solution of Congruence's, The Chinese Remainder Theorem, Techniques of Numerical Calculation, Public-Key Cryptography, Prime Power Moduli , Prime Modulus, Primitive Root and Power Residues, Congruences of Degree Two, Prime Modulus, Number Theory from an Algebraic Viewpoint, Group, Rings and Fields.

UNIT II Quadratic Residues, Quadratic Reciprocity, The Jacobi Symbol, Binary Quadratic Forms, Equivalence and Reduction of Binary Quadratic Forms, Sum of Two Squares, Positive Definite Binary Quadratic Forms

UNIT III Greatest Integer Function, Arithmetic Functions, The Mobius Inversion Formula, Recurrence Functions, Combinatorial Number Theory

UNIT IV The Equation ax+by=c, Simultaneous Linear Equations, Pythagorean Triangles, Assorted Examples, Ternary Quadratic Forms, Rational Point on Curves, Elliptic Curves, Factorization Using Elliptic Curves, Curves of Genus Greater Than 1

COURSE OUTCOMES:

Students will be able to understand and use the knowledge of:

- Congruences , Solution of Congruence's, The Chinese Remainder Theorem.
- Quadratic Residues, Quadratic Reciprocity, The Jacobi Symbol, Binary Quadratic Forms.
- Greatest Integer Function, Arithmetic Functions, The Mobius Inversion Formula.
- Simultaneous Linear Equations, Pythagorean Triangles, Assorted Examples, Ternary Quadratic Forms, Rational Point on Curves, Elliptic Curves.