MANAV RACHNA UNIVERSITY

FACULTY: FACULTY OF APPLIED SCIENCES

DEPARTMENT: MATHEMATICS

PROGRAM: M.Sc. MATHEMATICS

PROGRAM CODE: MAP01

SYLLABUS: SCHEME (2017-18)

M.Sc. (MATHEMATICS) – Semester I

COURSE CODE	COURSE NAME	Course Type	Course Nature	PERIODS			CREDITS
		Core(Departmental/Allied)/ Elective (Departmental/ Open) / University Compulsory	Hard/Soft/ Workshop/ NTCC	L	P	O	
MAH501-T	ABSTRACT ALGEBRA	Core (Departmental)	Hard	4	0	0	4
MAH502-T	TOPOLOGY-I	Core (Departmental)	Hard	4	0	0	4
MAH503-T	DIFFERENTIAL EQUATION	Core (Departmental)	Hard	4	0	0	4
MAH504-T	GRAPH THEORY	ELECTIVE (Departmental) (Any one)	Hard	4	0	0	4
MAH505-T	OPERATIONS RESEARCH		Hard	4	0	0	
MAH506-T	MATHEMATICAL MODELING AND SIMULATION		Hard	4	0	0	
MAH507-p	MATHS LAB	Core (Departmental)	Hard	0	4	0	2
MAW508 MAW509 MAW231 MAW225 MAW119 CSW102	BASKET OF WORKSHOP ELECTIVES (ANY ONE)	Core (Departmental & Allied)	WORKSHOP	0	3	0	2
	RESEARCH METHODOLOGY	Core	SOFT	1	2	0	2

BASKET OF WORKSHOP ELECTIVES (ANY ONE):

1) SCILAB —MAW508
2) STATISTICS USING EXCEL —MAW119
3) MATHEMATICA--MAW509
4) SPSS —MAW231
5) LATEX—MAW225
6) HTML5 & CSS-CSW102

DETAILED SYLLABUS
SEMESTER I

Course Title/ Code	**ABSTRACT ALGEBRA- MAH501-T**
Course Type	Core (Departmental)
Course Nature	Hard
L-P-O Structure	(4-0-0)
Objective	To familiarize students with the concept of group, ring and fields.
Outcomes	The student would be able to conceptualize and apply the concepts of Modern Algebraic Structures.
Prerequisites	Students should have a basic knowledge of Modern Algebra

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	100%

Section A

Introduction of Group, subgroup and Quotient group, Sylow's P-subgroups, Sylow's Theorems, Simple groups, Solvable groups, Nilpotent groups, Simplicity of Alternating Groups, Normal and Subnormal series, Composition series, Jordan-Holder Theorem. Direct product of groups, Structure theorem for finitely generated Abelian Groups.

Section B

Rings, Ring extensions; Polynomial rings, Formal power series rings, Matrix rings, Group rings, Ideals; Prime and Maximal ideals, Rings of fractions, Chinese Remainder Theorem for pairwise comaximal ideals.

Section C

Euclidean Domains, Principal Ideal Domains and Unique Factorizations Domains. Poly-nomial rings over UFD's.

Section D

Fields, Characteristic and prime subfields, Field extensions, Finite, Algebraic and finitely generated field extensions, Classical ruler and compass constructions, Splitting fields, Finite fields, Cyclotomic fields, Separable and Inseparable extensions.

Recommended
Books:

1. I.N. Herstein, Topics in Algebra
2. M. Artin, Algebra, Prentice Hall of India, 1994.
3. D.S. Dummit and R. M. Foote, Abstract Algebra, 2nd Ed., John Wiley, 2002.

4. I.B.S. Passi, Group Theory
5. I.B.S. Passi, Ring Theory
6. J.A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa, 1999.
7. N. Jacobson, Basic Algebra I, 2nd Ed., Hindustan Publishing Co., 1984, W.H. Freeman, 1985.

Course Title/ Code	**TOPOLOGY-I-** **MAH502-T**
Course Type:	Core (Departmental)
Course Nature:	Hard
L-P-O Structure	(4-0-0)
Objective	To familiarize students with Sets, metric spaces, topological spaces, continuous mappings, connectedness, compactness.
Outcomes	The student would be able to conceptualize and apply the concepts of Topological Spaces.
Prerequisites	B.Sc. with Mathematics as one of the Subject.

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	100%

Section A

Metric spaces , Topological spaces, Closed set, Closure, Dense subset, Neighborhoods, Interior, Exterior and Boundary, Accumulation point and Derived sets, Bases Sub–bases, Sub space and Relative topology.

Section B

Characterization of topology in terms of base and subbase axioms, Topology generated by a family of subsets, Alternate methods of defining a topology in term of Kuratowski closure Operator and Neihbourhood System,

Continuous functions and Homomorphism.

Section C

First and Second Countable spaces, Lendelof's theorem, Separable spaces, Second count ability and Separability, Separation axioms T0,T1,T2,T3-1\2,T4, Their Characterizations and basic Properties, Urysohn's lemma, Teitze extension theorem.

Section D

Compactness, Continuous functions and Compact sets, Basic properties of Compactness, Compactness and finite intersection property, Sequentially and countably compact sets, Connected spaces, Connectedness on the real line, Components, Locally connected space.

Recommended Books:

1. James R. Munkres, Topology (2ndEdition) Pearson Education Pve. Ltd., Delhi-2002
2. George F.Sinmons, Introduction to Topology and Modern Analysis, McGraw Hill Book Co., 1963
3. J. Dugundji , Topology , Prentice Hall of India, New Delhi, 1975.
4. K. D. Joshi : Introduction to General Topology (Wiley Eastern Limited).
5. S. Kumaresan: Topology of Metric Spaces, alpha science.

Course Title/ Code	**DIFFERENTIAL EQUATIONS-MAH503-T**
Course Type:	CORE (Departmental)
Course Nature:	Hard
L-P-O Structure	(4-0-0)
Objective	Exposure to Ordinary Differential equations(Existence and Uniqueness), Partial Differential equations, system of differential equations, Applications
Outcome	The student would be able to apply the concepts of Differential Equations in various physical problems.
Prerequisites	B.Sc. with Mathematics as one of the Subject.

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	100%

SECTION-A

Existence and Uniqueness of Ordinary Differential equations, Picard's method, Sturm comparison and separation
theorems, System of first order non homogeneous equations, Homogeneous Linear system, Non-homogeneous Linear system, Linear system with constant coefficient, Two point boundary value problems, Green functions, Strum- Lioville System, Eigen value and Eigen functions.

SECTION-B

Stability of autonomous system of differential equation, Types of critical points, Critical points and Stability of linear
systems, stability by Liapunov's Direct method, Simple critical points of nonlinear systems, Nonlinear mechanics, Periodic solutions, The Poincare – Bendixson Theorem.

SECTION-C

Solution of Cauchy's problem of First order Partial Differential equations, Solution of Non-homogeneous PDE by
Jacobi's method, PDE of the Second order (Homogeneous and Non-Homogeneous), Monge's Method, Method of separation of variables, Method of Integral transform.

SECTION-D

Laplace Equation in two dimension, Green function for Laplace Equation, Drichlet and Newman problem for Half
plane, Drichlet and Newman problem for circle, Drichlet and Newman problem for sphere and semi-infinite space, Wave Equation, Diffusion equation.

Recommended Books:

1. G. F. Simmons: Differential equation with Application and Historical Notes, McGraw-Hill
2. Ian Sneddon: Elements of Partial Differential Equations, McGraw-Hill.
3. S. L. Ross: Differential Equations, Wily India.
4. M. D. Raisinghania : Advance Differential equation, S.Chand India.

Course Title/ Code	**GRAPH THEORY- MAH504-T**
Course Type:	ELECTIVE (Departmental)
Course Nature:	Hard
L-P-O Structure	(4-0-0)
Objective	To familiarize students with the main concepts of graph theory, graph representations and the basic classes of graphs.
Outcomes	The objective of the course is to introduce students with the fundamental concepts in graph Theory, with a sense of some its modern applications.
Prerequisites	B.Sc. with Mathematics as one of the Subject.

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	100%

Section A

Graphs: Basic concepts in graph theory, walks, paths and circuits in a graph, connected graphs and components, degrees, operations on graphs, special graphs, isomorphic graphs, blocks, cut-points, bridges and blocks, block graphs and cut-point graphs.

Section B

Trees: Elementary properties of trees, minimally connected graph, distance , centers and centroids in a tree , radius and diameter, spanning trees ,rank and nullity, block-cut point trees, independent cycles and co-cycles.

Section C

Connectivity and Traversability: Connectivity and line connectivity, Menger's theorems, Eulerian graph, Hamiltonian graphs, travelling salesman problem, shortest path.

Section D

Planarity and Coloring: Planar graphs, outer planar graphs, Euler’s formula,, Kuratowski's theorem, dual graphs, self dual graphs, chromatic number, five color theorem, chromatic polynomial.

Recommended Books:

[1] R. Balakrishnan and K. Ranganathan, A Text Book of Graph Theory, Springer, 2000.

[2] B. Bollobas, Modem Graph Theory, Springer, 2002.

[3] G. Chartrand and L. Lesniak, Graphs and Digraphs, 4th Edit., Chapman & Hall (CRC), 2005.

[4] F. Harary, Graph Theory, Narosa Publishing House, New Delhi, 2001.

[5] *R.I.* Wilson, Introduction to Graph Theory, 4th Edit., Addison Wesley, 1996.

Course Title/ Code	**OPERATIONS RESEARCH- MAH505-T**
Course Type:	Elective (Departmental)
Course Nature:	Hard
L-P-O Structure	(4-0-0)
Objective	To familiarize students to use quantitative methods and techniques for effective decisions–making; model formulation and applications that are used in solving business decision problems.
Outcome	The student would be able to apply the concepts of Operations Research in various real time problems.
Prerequisites	B.Sc. with Mathematics as one of the Subject.

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	100%

Section A

Convex set theory: Linear independence and dependence of vectors, Convex sets, Extreme points, Hyper planes and Halfspaces, Directions of a convex set, Convex cones, Polyhedral sets and cones.

Section B

Introduction to Linear Programming: Linear Programming Problem Formulation, Graphical solution, Simplex Algorithm, Artificial variables techniques: Two–phase method & Big-M method , Duality theory, Dual-simplex method.

Section C

Transportation problem & Assignment problems: Formulation of Transportation problem,Optimal solution, Unbalanced transportation problem, Degeneracy, Formulation of Assignment problem, Optimal solution, Variants of Assignment Problem- Traveling Salesman problem.

Section D

Game Theory: Introduction, Two person zero sum game, Pure strategies, Maximin & miimax principle,Game with saddle points, Mixed strategies, Game without saddle points, Dominance rule.

Recommended Books:

1. H. A. Taha, Operations Research an introduction, pearson India
2. J. K. Sharma, Operations Research theory & applications:
3. Gupta & Hira, Operations Research.

Course Title/ Code	**MATHEMATICAL MODELING & SIMULATIONS- MAH506-T**
Course Type:	ELECTIVE (Departmental)
Course Nature:	Hard
L-P-O Structure	(4-0-0)
Objective	To familiarize the students with mathematical modeling and simulation with an explanation of basic concepts and ideas, which includes definitions of terms such as system, model, simulation, mathematical model, reflections.
Outcomes	The student would be able to apply the concepts of Mathematical Modeling and Simulations in various physical problems.
Prerequisites	B.Sc. with Mathematics as one of the Subject.

Section A

Mathematical Model, Types of Mathematical models and properties, Procedure of modeling, Graphical method: Barterning model, Basic optimization.

Section B

Basic probability: Monte-Carlo simulation, Approaches to differential equation: Heun method, Local stability theory: Bernoulli Trials, Classical and continuous models, Case studies in problems of engineering and biological sciences.

Section C

General techniques for simulating continuous random variables, Simulation from Normal and Gamma distributions.

Section D

Simulation from discrete probability distributions, Simulating a non– Homogeneous Poisson Process and Queuing system.

Recommended Books:

1. Edward A. Bender.. An Introduction to Mathematical Modeling.
2. A. C. Fowler.. Mathematical Models in Applied Sciences, Cambridge University Press.
3. J. N. Kapoor.. Mathematical Modeling, Wiley eastern Limited.
4. S.M. Ross ..Simulation, India Elsevier Publication.
5. A.M.Law and W.D.Kelton.. Simulation Modeling and Analysis, T.M.H. Edition.

Course Title/ Code	**MATHS LAB- MAW507-P**
Course Type:	Core (Departmental)
Course Nature:	Hard
L-P-O Structure	(0-4-0)
Objective	To familiarize students with MATLAb - Installation ,practical application in maths and in real world
Outcome	The student would be able to apply the tools of Matlab software for solving mathematical problems.
Prerequisites	B.Sc. with Mathematics as one of the Subject.

LAB EXERCISE:

1. Introduction to MATLAB and use of some simple MATLAB commands.
2. Introduction to some of the fundamentals of MATLAB: Variables, operators, expressions and Arrays(including vectors and matrices)
3. Introduction to graphics: Basic Two-Dimensional Graphs, Labels, Multiple plots on the same axes, Line styles, Markers and color, Axis limits and Subplots.
4. Introduction to graphics: Three-Dimensional Graphs, Labels, Multiple plots on the same axes, Line styles, Markers and color, Axis limits and Subplots.
5. To find the Rank of a matrix, Inverse of a Square matrix and to reduce a matrix into Normal Form.
6. To solve the system of simultaneous linear equations. To find the Eigen values and Eigen vectors of a square matrix.
7. To find derivatives, partial derivatives & directional derivatives of functions.
8. To find limit, continuity & differentiability of function of single variable.
9. To find limit, continuity & differentiability of function of several variables.
10. To find maxima & minima of function of single & several variables.
11. Evaluation of Single, Double integral and Triple Integration.
12. To find the Surface area and volume of solids of revolution by single & double integration.
13. To solve ODE & LDE & plot the graph of the solution of LDE. Also, solve the linear differential equations with variable coefficients(Cauchy & Legendre Differential equations).

14. To solve & plot solutions the system of two & three ordinary differential equations.

15. To find gradient of a scalar field (through graph also). Also, find directional derivatives, divergence & curl (through graph also).

Course Title/ Code	**SCILAB-MAW508**
Course Type:	Core (Departmental)
Course Nature:	Worksho p
L-P-O Structure	(0-3-0)
Objective	To familiarize student with Scilab Basics, their use in mathematics and statistics.
Objective	The student would be able to apply the tools of Scilab for solving various Mathematical Problems.
Prerequisites	B.Sc. with Mathematics as one of the Subject.

LAB EXERCISE:

1. Introduction to Scilab.
2. Scilab environment
3. Scilab as an interactive calculator
4. Scilab workspace and working directory
5. Creating matrices and some simple matrix operations
6. Sub-matrices
7. Statistics
8. Working with polynomials
9. Plotting graphs-2D & 3D.
10. Scilab programming language
11. Script files and function files
12. Writing Scilab functions
13. File operations

Course Title/ Code	**MATHEMATICA- MAW509**
Course Type:	Core (Departmental)
Course Nature:	Worksho p
L-P-O Structure	(0-3-0)
Objective	To familiarize the students with the mathematica-installation , use of software and their applications in real world.
Outcome	The student would be able to apply the tools of Mathematica for solving various Mathematical Problems.
Prerequisites	Basic software Knowledge

LAB EXERCISE:

1. Introduction to MATHEMATICA and use of some simple MATHEMATICA commands.
2. Introduction to some of the fundamentals of MATHEMATICA: Symbols & Variables, Dynamic Data typing, Assignments & Equality Checks, Logical operators, loops and four types of brackets in MATHEMATICA.
3. To study the working with lists in MATHEMATICA.
4. To study rules, patterns and functions.
5. To study functions on lists and functional programming.
6. Writing efficient programs: some techniques and applications.

Course Title/ Code	SPSS WORKSHOP-MAW231
Course Type:	Core (Departmental)
Course Nature:	Worksho p
L-P-O Structure	(0-3-0)
Objectives	To familiarize the students with SPSS software, and further use the statistical tools for data analysis using SPSS
Outcome	The students will be able to perform data analysis with SPSS that finds extreme usage as data analyists in MNC's
Prerequisites	Basic knowledge of working on Excel

LAB EXERCISE;

1. Introduction SPSS software, open and save an SPSS data file, define codes for categorical variables in SPSS, print a copy of an SPSS data file.
2. Categorize a quantitative variable, create a bar chart, create a pie chart.
3. Create a modified box plot of one quantitative variable, create modified box plots of one quantitative variable to compare groups, create modified box plots to compare quantitative variables.
4. Enter a contingency table into an SPSS data file, create a pie chart from a contingency table, create a stacked bar chart from a contingency table.
5. Create a contingency table from raw data entered into an SPSS data file, create a stacked bar chart from a contingency table.
6. Obtain the equation of the least squares line for predicting one quantitative variable from another quantitative variable create a graph of the least squares line on a scatter plot create a modified box plot of the residuals.
7. Enter data into an SPSS data file perform two sample t tests and create appropriate graphical displays.
8. Perform a one sample paired t test and create an appropriate graphical display.
9. Enter data into an SPSS data file, perform a one-way analysis of variance and create and an appropriate graphical display.
10. Perform a chi-square goodness-of-fit test and create and appropriate graphical display create a stacked bar chart from a contingency table.

Course Title/ Code	**LaTeX - MAW225**
Course Type:	Core (Departmental)
Course Nature:	Workshop
L-P-O Structure	(0-3-0)
Objective	The students would be able to apply the concepts of LaTeX to create a document of Scientific Writing.
Outcome	The students would be able to successfully install LaTeX and its related components on a home/personal computer, use LaTeX and various templates acquired from the course to compose Mathematical documents, presentation`ns, reports and access various resources, such as http://ctan.org, to obtain additional LaTeX packages.
Prerequisites	NIL

LAB EXERCISE:

1. Introduction and basics of LaTeX.
2. Document structure and text formatting in LaTeX.
3. Mechanics of error and warning, lengths, Counters and Boxes.
4. Fundamentals for creating Technical Texts.
5. To Create Special Pages: Indexing ,Glossary, Bibliography
6. To Create Special Documents: Letters, Presentations, Curriculum Vitae.
7. Creating Graphics in LaTeX.
8. Programming: Macros, Plain text, Creating Packages, Themes.
9. Miscellaneous: Modular Documents, Collaborative Writing of LaTeX Documents, Export to other Formats.
10. Math – Type in Microsoft Word.

Course Title/ Code	**STATISTICAL METHODS USING EXCEL- MAW119**
Course Type:	Core (Departmental)
Course Nature:	Workshop
L-P-O Structure	(0-3-0)
Objective	The student would be able to apply the concepts of statistics for solving mathematical problems using Excel.
Outcome	The students would be able to utilise the data to obtain the best information and analyse using statistical methods on Excel which finds scope in primary, secondary as well as tertiary sector.
Prerequisites	Basic knowledge of working on Excel

LAB EXERCISE

1. To present the data by tables and by diagrams. To study the frequency distributions by histogram and frequency polygon.

2. To find mean, median, mode, quartiles, deciles and percentiles for the data.

3. To find mean deviation, standard deviation, coefficient of mean deviation and coefficient of variation.
   Comparison of various measures of dispersion.

4. To find moments, coefficient of skewness and measures of kurtosis.

5. Bivariate data scatter diagram, principle of least squares and fitting of polynomials and exponential curves.

6. To find coefficient of correlation and rank correlation. Multiple correlation analysis.

7. To find regression coefficients and lines of regression.

8. To construct the index numbers by different methods. Time reversal, factor reversal and circular tests.

9. Analysis of time series by using different methods (graphical method, method of semi averages, method of fitting curves).

10. To study Sampling distributions. Tests of significance based on t and F distributions.

11. Test of significance based on Chi- square distribution.

M.Sc. (MATHEMATICS)- Semester II

COURSE CODE	COURSE NAME	Course Type	Course Nature	PERIODS			CREDITS
		Core(Departmental/Allied)/ Elective (Departmental/ Open) / University Compulsory	Hard/Soft/ Workshop/ NTCC	L	P	O	
MAH510- T	LINEAR ALGEBRA	Core (Departmental)	Hard	4	0	0	4
MAH511- T	COMPLEX ANALYSIS	Core (Departmental)	Hard	4	0	0	4
MAH512- T	MEASURE THEORY	Core (Departmental)	Hard	4	0	0	4
MAH513- T	FUZZY SETS & FUZZY LOGIC	ELECTIVE (Departmental) (Any one)	Hard	4	0	0	4
MAH514- T	MATHEMATICAL STATISTICS		Hard	4	0	0	
MAH515- T	TOPOLOGY-II		Hard	4	0	0	
MAH516- P	MATHS LAB	Core (Departmental)	Hard	0	4	0	2
MAW508 MAW509 MAW231 MAW225 MAW119 CSW102	BASKET OF WORKSHOP ELECTIVES(ANY ONE)	ELECTIVE(Departmental)	WORKSHOP	0	3	0	2
	PEDAGOGICAL SKILLS	Core	SOFT	1	2	0	2

BASKET OF WORKSHOP ELECTIVES (ANY ONE): 1) SCILAB —MAW508
2) STATISTICS USING EXCEL —MAW119
3) MATHEMATICA--MAW509
4) SPSS —MAW231
5) LATEX—MAW225
6) HTML5 & CSS-CSW102

** MAW517---SUMMER TRAINING

DETAILED SYLLABUS
SEMESTER II

Course Title/ Code	**LINEAR ALGEBRA- MAH510-T**
Course Type	Core (Departmental)
Course Nature	Hard
L-P-O Structure	(4-0-0)
Objective	The student would be able to conceptualize and apply the concepts of Advanced Liner Algebra.

	Sections	**Weightage**
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	**100%**

Section A

Vector Spaces, Subspaces, Basis and dimension, Linear Transformations, Rank and nullity of a linear transformation, Sylvester's Law of nullity, Quotient spaces, direct sum, The matrix of a linear transformation, Duality.

Section B

Minimal polynomial, Invariant Subspaces, Eigen values and eigenvectors, Similarity of linear transformations, Diagonalizable operator, Cyclic subspaces and Annihilators, Canonical Forms, The Rational Form, The Jordan Form.

Section C

Definition of inner product spaces, Euclidean space, Unitary space, norm or length of a vector, Cauchy-Schwarz inequality, Orthogonal and Orthonormal set, Orthogonal complement, Gram-Schmidt orthogonalization theorem, Linear functionals and Adjoints, Self-adjoint (Hermitian), Unitary operators, Normal operators , Operators on inner product spaces ,Forms on inner product spaces, Positive form, Spectral theorem.

Section D

Blinear form, Non-degenerate bilinear form, Symmetric bilinear form and Skew-symmetric bilinear form, Group preserving bilinear forms. Quadratic forms, Real quadratic forms, Orthogonal matrices, Reduction of real quadratic forms, Nilpotent forms, Classification of real quadratic forms.

Recommended Books:

1. K. Hoffman and R. Kunze, Linear Algebra, Pearson Education (India), 2003. Prentice-Hall of India,1991.
2. S. Lang, Linear Algebra, Undergraduate Texts in Mathematics, Springer-Verlag, New York, 1989.
3. I. N. Herstein, Topic in Abstract Algebra, Wiley Eastern Limtd.
4. A.G. Hamilton, Linear Algebra, Cambridge University Press (1989)

Course Title/ Code	**COMPLEX ANALYSIS-MAH511-T**
Course Type:	Core (Departmental)
Course Nature:	Hard
L-P-O Structure	(4-0-0)
Objective	The objective of this course is to introduce the fundamental ideas of developing a clear understanding of the fundamental concepts of Complex Analysis such as analytic functions, complex integrals and conformal mapping.
Outcome	The student would be able to evaluate questions on complex integration, integral formula, Taylor's and Laurent's series, analytical continuation, conformal mapping.
Prerequisites	B.Sc. with Mathematics as one of the Subject.

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	100%

Section A

Complex Integration, Cauchy-Goursat Theorem, Cauchy's Integral Theorem, Cauchy's Integral Formula, Cauchy's Integral Formula for Higher order derivatives, Morera's Theorem, Cauchy's Inequality and Liouville's theorem, The Fundamental theorem of algebra.

Section B

Taylor & Laurent's Series Expansion, Isolated Singularities, Casporati-Weierstress theorem, Meromorphic functions, The argument principle, Rouche's theorem, Inverse function theorem. Residues, Cauchy's residue theorem, Evaluation of integrals, Branches of many valued functions with special reference to arg Z, Log Z, and Z^a.

Section C

Analytic continuation, Uniqueness of direct analytic continuation, Uniqueness of analytic continuation along a curve, Power series method of analytic continuation, Schwarz reflection principle, Monodromy theorem and its consequences.

Section D

Conformal Mapping, general linear transformations, Analytic- continuation, Principle of reflection, Principle of maximum modulus, Sewarz's lemma, Vitali's convergence theorem, Hadamard's three circle theorem functions.

Recommended Books:

1. Prof R.Y. Dennis, Complex- Variable & integral transform.
2. S. Ponnusamy, Complex Analysis.
3. E. T. Copson, Complex Variables, Oxford University Press.
4. J. B. Conway, Functions of one complex variable, Narosa Publication House.

Course Title/ Code	**MEASURE THEORY- MAH512-T**
Course Type:	Core (Departmental)
Course Nature:	Hard
L-P-O Structure	(4-0-0)
Objective	To gain understanding of the abstract measure theory and definition and main properties of the integral. To construct Lebesgue's measure on the real line..
Outcome	The student would be able to conceptualize measure and integral with respect to a measure and apply the concepts of measure theory for further studies in Analysis, probability and dynamical systems etc.
Prerequisites	Set Theory, Real Analysis

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	100%

Section A

Boolean algebra, Borel field, Counting measure, Outer measure, Measurable sets, Lebesgue measure, non-measurable sets, Measurable functions, Littlewood's Three principles.

Section B

Riemann Integral, Lebesgue Integral of a Bounded functions over a set of Finite Measure, Fatou's Lemma, Monotone Convergence Theorem, Lebesgue Convergence Theorem and Convergence in Measure.

Section C

Vitali's Lemma Functions of Bounded variation, Absolute continuity, Converse functions, Jensen Inequality, Measure spaces, -finite measure, Semifinite measure, General convergence Theorems, Signed Measures, Hahn Decomposition Theorem, Jordan decomposition, Radon-Nikodym Theorem, Lebesgue decomposition, Product measure, Fubini's Theorem.

Section D

The L^p spaces where $1 \leq p < \infty$, Holder and Minkowski inequalities, Completeness of L_p spaces.

Recommended
Books:

1. Real Analysis : H. L. Royden
2. Mathematical Analysis : T. M. Apostol
3. Real Analysis : Walter Rudin
4. Real and Abstract Analysis : E. Hewitt and K. Stromberg

Course Title/ Code	**FUZZY SETS & FUZZY LOGIC- MAH 513-T**
Course Type:	Elective(Departmental)
Course Nature:	Hard
L-P-O Structure	(4-0-0)
Objective	The student would be able to conceptualize basic knowledge of fuzzy sets and fuzzy logic and apply these concepts for basic fuzzy system modeling methods & PID control systems.
Outcome	The student would be able to understand the basic mathematical elements of the theory of fuzzy sets,emphasis on the differences and similarities between fuzzy sets and classical sets theories.
Prerequisites	Mathematical set theory, linear algebra and concepts related to functions, relations, etc. Knowledge in classical logic.

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	100%

Section A

Fuzzy Sets: Basics Classical sets vs Fuzzy Sets , Need for fuzzy sets , Definition and Mathematical representations , Level Sets, Fuzzy functions , Zadeh's Extension Principle.

Section B

Operations on Fuzzy Sets: Operations on [0,1] – Fuzzy negation, Triangular norms, T-conorms, Fuzzy implications, Aggregation Operations, Fuzzy Functional Equations

Section C

Fuzzy Relations: Fuzzy Binary and n-ary relations, composition of fuzzy relations , Fuzzy Equivalence Relations, Fuzzy Compatibility Relations, Fuzzy Relational Equations.

Section D

Fuzzy Logic: Basic concepts of Fuzzy logic, Linguistic variables, Membership functions, , Fuzzy if-then rules, Variables inference techniques, Defuzzification techniques, Basic Fuzzy interference algorithm, Applications of fuzzy logic.

Recommended Books:

1. H.J. Zimmermann, Fuzzy Set Theory and its Applications, Allied Publishers, New Delhi, 1991
2. Timothy J. Ross, “Fuzzy Logic with Engineering Applications,” McGraw Hill, 1995.
3. Kevin M Passino and Stephen Yurkovich, Fuzzy Control, Addison Wesley Longman, 1998.
4. Michal Baczynski and Balasubramaniam Jayaram, Fuzzy Implications, Springer Verlag, Heidelberg, 2008.

Course Title/ Code	**MATHEMATICAL STATISTICS-MAH514-T**
Course Type:	Elective(Departmental)
Course Nature:	Hard
L-P-O Structure	(4-0-0)
Objective	The student will be introduced to the various statistical tools for computing mathematical problems involving data.
Outcome	The student would be able to apply the concepts of statistics for solving mathematical problems and its applications in data analysis for industrial and agricultural sectors
Prerequisites	B.Sc. with Mathematics as one of the Subject.

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	100%

Section A

Probability and Baye's Theorem, Random Variables, Probability Density Functions, Multivariate Distributions, Marginal Distributions, Conditional Distributions, Mathematical Expectation, Moments, Moment Generating Functions, Product Moments, The Binomial Distribution, The Poisson Distribution, The Normal Distribution, Correlation and Regression.

Section B

Special Probability Distributions: The Discrete Uniform Distribution, The Negative Binomial and Geometric Distributions, The Hypergeometric Distribution, The Multinomial Distribution, The Multivariate Hypergeometric Distribution, Special Probability Densities: The Uniform Distribution, The Gamma, Exponential and Chi-Square Distributions, The Beta Distribution, The Normal approximation to the Binomial Distribution, The Bivariate Normal Distribution.

Section C

Sampling Distributions & Decision Theory: Point Estimation, Interval Estimation, The Distribution of the mean – finite Populations, Hypothesis Testing, Tests of Hypothesis involving Mean, Variance and Proportions, The Chi- Square Distribution, The t – Distribution, The F – Distribution, Order Statistics.

Section D

The Theory of Games, Statistical Games, the Minimax Criterion.Design and Analysis of Experiments: Introduction, One – Way Designs, Randomized – Block Designs, Factorial Experiments, Multiple Comparisons and Other Experimental Designs. Non- Parametric Tests: The Sign Test, The Signed – Rank Test, and Rank Sum Tests: The U Test and H Test, Tests Based on Runs.

Recommended Books:

1. Mood, A.M., Graybill, F.A. and Boes, D.C., Mc Graw Hill Book Company.
2. Freund, J.E., Mathematical Statistics, Prentice Hall of India.
3. Gupta S.C. and Kapoor V.K., Fundamentals of Mathematical Statistics, S.Chand Pub., New Delhi.

Course Title/ Code	**TOPOLOGY-II- MAH515-T**
Course Type:	Elective(Departmental)
Course Nature:	Hard
L-P-O Structure	(4-0-0)
Objective	To familiarize students with concepts of topological spaces , separation Axioms, nets and filters
Outcome	The student would be able to conceptualize and apply the concepts of Topological Spaces,
Pre-requisites	Topology-I

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	100%

Section A

Tychonoff product topology in term of standard sub-base and its characterizations, Projection maps, Separation axioms and product spaces, Connectedness and product spaces, Compactness and product spaces, Countability and product spaces .

Section B

Nets and filters, Topology and convergence of nets, Housdorffness and nets , Compactness, Nets Filter and their Convergence.

Section C

Canonical way of converting nets to filters and vice-versa, ultra filters and compactness. Stone-Cech compactification. Application of Urysohn's Lemma, The Stone–Cech Compactification, The Stone–Weierstrass Theorems.

Section D

Homotopy of paths, Fundamental group, Covering spaces, The fundamental group of the circle and fundamental theorem of algebra. Covering of a space, local finiteness, paracompact spaces, Mchaell theorem on characterisation of paracompactness in regular space, Paracompactness as normal, Nagata-Smirnov Metrization theorem.

Recommended Books:

1. James R. Munkres, Topology (2ndEdition) Pearson Education Pve. Ltd., Delhi-2002
2. J. Dugundji , Topology , Prentice Hall of India, New Delhi, 1975.
3. George F.Sinmons, Introduction to Topology and Modern Analysis, McGraw Hill Book Co., 1963
4. K. D. Joshi : Introduction to General Topology (Wiley Eastern Limited).

Course Title/ Code	MATHS LAB- MAH516-P
Course Type:	Core (Departmental)
Course Nature:	Hard
L-P-O Structure	(0-4-0)
Objective	To familiarize students with programming, study of linear algebra in MATLAB
Outcome	The student would be able to apply the tools of Matlab software for solving the Mathematical problems.
Prerequisites	Basics of MATLAB

LAB EXERCISE:

1. Introduction to programming.
2. Creating script file or m-files
3. Introduction to Conditional statements –if and else using MATLAB.
4. Introduction to Conditional statements –if and else using MATLAB (Continued).
5. Introduction to Loops- for using MATLAB.
6. Introduction to Loops- while using MATLAB.
7. Introduction to switch and break using MATLAB
8. Introduction to functions and function filesusing MATLAB.
9. Introduction to functions and function filesusing MATLAB (continued).
10. Study Linear Algebra using MATLAB.
11. Study Linear Algebra using MATLAB(Continued)

.

M.Sc. (MATHEMATICS)- Semester-III

COURSE CODE	COURSE NAME	Course Type	Course Nature	PERIODS			CREDITS
		Core(Departmental/Allied) / Elective (Departmental/ Open) / University Compulsory	Hard/Soft/ Workshop/ NTCC	L	P	O	
MAH618 - T	FUNCTIONAL ANALYSIS	Core (Departmental)	Hard	4	0	0	4
MAH619- T	DIFFERENTIAL GEOMETRY	Core (Departmental)	Hard	4	0	0	4
MAH620 - T	DYNAMICS OF RIGID BODY	Core (Departmental)	Hard	4	0	0	4
MAH621 - T	CODING THEORY	ELECTIVE (Departmental) (Any one)	Hard	4	0	0	4
MAH622 - T	GENERAL THEORY OF RELATIVITY		Hard	4	0	0	
MAH623 - T	ADVANCED OPERATIONS RESEARCH		Hard	4	0	0	
MAH624 - T	FOURIER ANALYSIS		Hard	4	0	0	
MAH625- P	MATHS LAB	Core (Departmental)	WORKSHOP	0	4	0	2
	BASKET OF COURSES BY MANEGMENT DEPARTMENT	Elective (Allied)	SOFT	1	2	0	2
MAN626	SEMINAR	Core (Departmental)	NTCC	0	3	0	2

DETAILED SYLLABUS
SEMESTER III

Course Title/ Code	FUNCTIONAL ANALYSIS- MAH618-T
Course Type:	Core (Departmental)
Course Nature:	Hard
L-P-O Structure	(4-0-0)
Objective	To provide the student with the concept and the understanding in Banach spaces, Hilbert space and Banach Algebras.
Outcome	The student would be able to conceptualize basics of Functional Analysis and apply these concepts in harmonic analysis and stochastic calculus.
Prerequisites	B.Sc. with Mathematics as one of the Subject.

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	100%

Section A

Vector space, Normed linear space, Quotient space, Banach spaces, Bounded linear transformation, B(X,Y) as a normed linear space, Isometric isomorphism, Uniform boundedness principle and its consequences.

Section B

Hahn-Banach Theorem, Application of Hahn-Banach theorem, Conjugate and second conjugate space of normed linear space, Weak topology, Strong topology, Open-mapping theorem, Closed graph theorem, Uniform Boundedness theorem.

Section C

Inner Product Spaces, Hilbert spaces, Orthonormal sets, Bessel's Inequality, Complete orthonormal sets and Parseval's identity, Orthonormal bases, Structure of Hilbert space, Projection theorem, Riesz representation theorem, Riesz-Fischer theorem.

Section D

Adjoint of an operator on a Hilbert Space, Strong and weak convergence, Operator theory, Spectral theorem, Polar decomposition, Compact Operator, Fredholm Operators, Closed operators, Symmetric and self-adjoint operators.

Recommended Books:

1. V.S. Sunder, Functional Analysis spectral theory.
2. Walter Rudin, Functional Analysis.
3. S. Ponnusamy, Foundation of Functional Analysis.

Course Title/ Code	DIFFERENTIAL GEOMETRY- MAH619-T
Course Type:	Core (Departmental)
Course Nature:	Hard
L-P-O Structure	(4-0-0)
Objective	To familiarize students with space curves, geodesics, intrinsic and non-intrinsic properties of a surface.
Outcome	The student would be able to apply the concepts of space curves, geodesics, intrinsic and non- intrinsic properties of a surface.
Prerequisites	Linear Algebra , Analysis.

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	100%

Section A

Co-ordinate transformation, Covariant, Contravariant and Mixed tensors, Tensors of higher rank, Symmetric and Skew-symmetric tensors, Tensor algebra, Contraction, Inner product, Riemannian metric tensor, Christoffel symbols, Covariant derivatives of tensors.

Section B

Differentible curves in R3 and their parametric representations, Vector fields, Tangent vector, Principal normal, Binormal, Curvature and torsion, Serret-Frenet formula, Frame fields, Covariant differentiation, Connection forms, The structural equations.

Section C

Surfaces, Differentiable functions on surfaces, Differential of a differentiable map, Differential forms, Normal vector fields, First fundamental form, Shape operator, Normal curvature, Principal curvatures, Gaussian curvature, Mean curvature, Second fundamental form.

Section D

Gauss equations, Weingarten equation, Codazzi-Mainardi equations, Totally umbilical surfaces, Minimal surfaces,Variations, First and second variations of arc length, Geodesic, Exponential map, Jacobi vector field, Index form of a geodesic.

Recommended Books:

1. Barett O' Neill, Elementary Differential Geometry, Academic Press, 2006.
2. Manfredo P. Do' Carmo, Differential Geometry of Curves and Surfaces, , Prentice Hall Inc.
3. S. Montiel and A. Ros, Curves and Surfaces , American Mathematical Society, 2005.
4. Somasundaram, Differential Geometry, A first course , Narosa Publication.
5. Zafar Ahsan, Tensor Calculus, Anamaya Publications, New Delhi. 19 / 27
6. U. C. De, Tensor Calculus, Narosa Publications, New Delhi.

Course Title/ Code	**DYNAMICS OF RIGID BODY- MAH620-T**
Course Type:	Core (Departmental)
Course Nature:	Hard
L-P-O Structure	(4-0-0)
Objective	To familiarize students with the kinematics and dynamics of rigid bodies in general planar motion, which is typically encountered in analysis of mechanical systems. .
Outcome	To study mechanical systems under generalized coordinate systems, energy and momentum to study mechanics developed by Jacobian, Euler, Legendre, with Extremals and Functionals.
Prerequisites	B.Sc. with Mathematics as one of the Subject.

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	100%

Section A

Moments and products of inertia, The momental ellipsoid , Equimomental systems Principal axes, D'Alembert's principle, The general equation of motion of a rigid body, Motion of Centre of inertia and motion relative to the centre of inertia.

Section B

Motion about the fixed axis, The compound pendulum, Centre of Percussion, Motion of rigid body in two dimensions under finite and impulsive forces.

Section C

Conservation of Momentum and Energy, Initial motions, Lagrange's equation Euler's equations of motion, Hamiltons's principle, Hamilton's equation of motion, Euler's equation for functional containing first order derivative and one independent variable, Extremals.

Section D

Functionals dependent on higher order derivatives Functional s dependent on more than one independent variable, Variational problems in parametric form, Invariance of Euler's equation under coordinate transformation, Jacobian and Legendre conditions, Second variation, Variational principle of least action.

Recommended Books:

1. D. Greenwood, Classical Dynamics, Prentice Hall of India, New Delhi, 1985.

2. H. Goldstein, Classical Mechanics, (2ndEdition) Narosa Publishing House, New Delhi.

3. A.S Gupta, Calculus of variations with –Applications ,Prentice Hall of india,1997

4. S.L. Loney , An elementary Treatise on the dynamics of particle and rigid bodies ,Cambridge University Press.

Course Title/ Code	CODING THEORY- MAH 621-T
Course Type:	Elective (Departmental)
Course Nature:	Hard
L-P-O Structure	(4-0-0)
Objective	The students would be able to apply the concepts of coding theory.
Outcome	The students would be able to distinguish between different types error correcting codes based on probability of error, understand various methods of generating and detecting different types of error correcting codes, formulate the basic equations of linear block codes.
Prerequisites	Algebra,basics of logic, set theory, number theory, matrices, and probability.

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	100%

Section A

The communication channel, The coding problem, Types of codes, Block codes, Error-detecting and error-correcting codes, Linear codes, The Hamming metric, Description of linear block codes by matrices, Dual codes, Standard array, Syndrome.

Section B

Step-by-step decoding, Modular representation, Error-correction capabilities of linear codes, Bounds on minimum distance for block codes, Plotkin bound, Hamming sphere packing bound, Varshamov-Gilbert-Sacks bound.

Section C

Bounds for burst-error detecting and correcting codes, Important linear block codes, Hamming codes.

Section D

Golay codes, Perfect codes, Quasi-perfect codes, Reed-Muller codes, Codes derived from Hadamard matrices, Product codes, Concatenated codes.

Recommended Books:

1. W.W. Peterson and E.J. Weldon, Jr., Error-Correcting Codes. M.I.T. Press, Cambridge, Massachusetts, 1972.
2. Raymond Hill, A First Course in Coding Theory, Oxford University Press, 1990.
3. Man Young Rhee, Error Correcting Coding Theory, McGraw Hill Inc., 1989.
4. F.J. Macwilliams and N.J. A. Sloane, The Theory of Error Correcting Codes, North- Holland, 2006.

Course Title/ Code	GENERAL THEORY OF RELATIVITY- MAH622-T
Course Type:	Elective (Departmental)
Course Nature:	Hard
L-P-O Structure	(4-0-0)
Objective	To familiarize students with the concept of general theory of relativity.
Outcome	The students would be able to understand the fundamental principles of the general theory of relativity
Prerequisites	

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	100%

Section A

Uniform vector field. Flat space-time, Review of the special theory of relativity and the Newtonian mechainics. The law of gravitation, Principle of equivalence and general covariance, Geodesic principle, Newtonian approximation relativistic equations of motion, Emstein's field equations and its Newtonian approximation, Schwarzschild external solution and its isotopic form.

Section B

Planetary orbits and analogues of Kepler's laws in general relativity, Advance of perihelion of a planet,

Bending of light rays in a gravitational field, Gravitational reds hift of spectral lines, Rader Echo delay, Schwarzschild internal solution, Energy momentum tensor of a perfect fluid.

Section C

Static Cosmological Model s: Mach's principle, Einstein modified field equations with Cosmological term, Static cosmological models, Properties of Einstein model, Properties of De-sitter model, Difference between Einstein and De-sitter universe, Comparison of Einstein and De-sitter universes with actual universe.

Section D

Non-Static Cosmological Models: Weyl's postulate, Cosmological principles, Hubble's law, Derivation of Robertson-Walker metric, Geometrical feature of RW metric, Redshift versus distance relation, Angular size versus redshift relation and source counts in Robertson-Walker space-time, Friedmann models, Particle horizon, Event horizon, Einstein's equation and dynamics of the universe.

Recommended Books:

1. J. N. Islam, A Introduction to Mathematical Cosmology, Cambridge University Press.
2. J.V. Narlikar, General Relativity and Cosmology, The Macmillan Company of India Limited, 1978.
3. S.R Roy & Raj Bali, Theory of Relativity
4. A.S. Eddington, The Mathematical Theory of Relativity, Cambridge University Press, 1965.
5. P.G. Bergmann, Introduction to the Theory of Relativity

Course Title/ Code	**ADVANCED OPERATIONS RESEARCH- MAH623-T**
Course Type:	Elective (Departmental)
Course Nature:	Hard
L-P-O Structure	(4-0-0)
Objective	The student would be able to apply the concepts of Operations Research in various real time problems.
Outcome	Applications of the different methods and techniques of Operations Research in practice. A collection of real-life cases will be discussed during the course, and a range of solution approaches will be highlighted.
Prerequisites	Operation Research.

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	100%

Section A

Project management-PERT & CPM: Significance, Phases of project management, PERT /CPM network components and precedence relationship, Critical path analysis, Forward and backward pass methods, Slack of an activity and event, Project scheduling with uncertain activity times, Estimation of project completion time, Project time –cost trade off, Updating of the project progress.

Section B

Replacement: Introduction, Replacement of items that deteriorate with time – when money value is not counted and counted – Replacement of items that fail completely, Group replacement, Staffing problem, Equipment renewal problem.

Section C

Queuing Theory: Introduction, Single Channel, Poisson arrivals, Exponential service times – with infinite population and finite population models, Multichannel, Poisson arrivals, exponential service times with infinite population single channel Poisson arrivals.

Section D

Quadratic Programming: Wolfe's method, Complementary pivot algorithm, Duality in quadratic programming.

Recommended Books:

1. H. A. Taha, Operations Research an introduction, pearson India
2. J. K. Sharma, Operations Research theory & applications:
3. Gupta & Hira, Operations Research,

Course Title/ Code	**FOURIER ANALYSIS- MAH624-T**
Course Type:	Elective (Departmental)
Course Nature:	Hard
L-P-O Structure	(4-0-0)
Objective	To familiarize students with Fourier series, orthogonality, completeness, Fourier Transform, tempered distributions.
Outcome	The student would be able to apply the concepts of discrete Fourier series, integral Fourier and Inverse - Fourier transforms for solving mathematical problems.
Prerequisites	Calculus-Integral and differential.

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	100%

Section A

Basic Properties of Fourier Series: Uniqueness of Fourier Series, Convolutions, Cesaro and Abel Summability, Fejer's
theorem, Poisson Kernel and Dirichlet problem in the unit disc, Mean square Convergence, Example of Continuous functions with divergent Fourier series.

Section B

L2-theory: Orthogonality, Completeness, ON systems, Applications to partial differential equations, Separation of variables, Something about Sturm-Liouville theory and Eigen function expansions.

Section C

Distributions and Fourier Transforms: Calculus of Distributions, Schwartz class of rapidly decreasing functions, Fourier transforms of rapidly decreasing functions, Riemann Lebesgue lemma, Fourier Inversion Theorem, Fourier transforms of Gaussians.

Section D

Tempered Distributions: Fourier transforms of tempered distributions, Convolutions, Applications to PDEs (Laplace, Heat and Wave Equations), Schrodinger-Equation and Uncertainty principle. Paley-Wienner Theorems, Poisson Summation Formula: Radial Fourier transforms and Bessel's functions, Hermite functions.

Recommended Books:

1. R. Strichartz, A Guide to Distributions and Fourier Transforms, CRC Press.
2. E.M. Stein and R. Shakarchi, Fourier Analysis: An Introduction, Princeton University Press, Princeton 2003.

Course Title/ Code	MATHS LAB- MAH 625-P
Course Type:	Core (Departmental)
Course Nature:	Hard
L-P-O Structure	(0-4-0)
Objective	Exposure of students to Maple-Installation, graphs , solution of Mathematical problems.
Outcome	The student would be able to apply the tools of Matlab software for solving the concepts of Mathematical problems.
Prerequisites	Basic Knowledge of Computers

LAB EXERCISE:

1. Introduction to Maple and Methods of entering expressions.

2. An introduction to the point-and-click features in Maple and An introduction to the commands of the

   Maple Language.

3. Entering and evaluating mathematical expressions in Document mode.

4. Worksheet mode – input prompt and commands.

5. Pallets

6. Introduction to graphs, graphs of Tabular and continuous functions.

7. Graphs of composed functions.

8. To solve standard mathematical problems.

9. To construct and compute with expressions that have units, scientific constants or uncertainty.

10. To evaluate plane curves in rectangular coordinates using Maple.

11. To evaluate curve in polar coordinates using Maple.

12. To calculate asymptotes of curves using Maple.

13. To calculate tangent lines to curve, singular points on curves using Maple.

14. To calculate curvature and torsion of curves using Maple.

M.Sc. (MATHEMATICS)- Semester-IV

COURSE CODE	COURSE NAME	Course Type	Course Nature	PERIODS			CREDITS
		Core(Departmental/Allied) / Elective (Departmental/ Open) / University Compulsory	Hard/Soft/ Workshop/ NTCC	L	P	O	
MAH627 - T	WAVELET ANALYSIS	Core (Departmental)	Hard	4	0	0	4
MAH628 - T	FLUID MECHAINICS	Core (Departmental)	Hard	4	0	0	4
MAH629 - T	ALGEBRAIC TOPOLOGY	ELECTIVE (Departmental) (Any one)	Hard	4	0	0	4
MAH630 - T	CRYPTOGRAPHY		Hard	4	0	0	
MAH631 - T	STRUCTURES ON DIFFERENTIABLE MANIFOLDS						
MAH632 - T	THEORY OF ELASTICITY & FRACTURE MECHANICS		Hard	4	0	0	
MAH633 - P	MATHS LAB	Core (Departmental)	Hard	0	4	0	2
MAW508 MAW509 MAW231 MAW225 MAW119 CSW102	BASKET OF WORKSHOP ELECTIVES(ANY ONE)	Core (Departmental)	WORKSHOP	0	3	0	2
MAN634	PROJECT	Core (Departmental)	NTCC	0	0	6	6

BASKET OF WORKSHOP ELECTIVES (ANY ONE): 1) SCILAB —MAW508
2) STATISTICS USING EXCEL —MAW119
3) MATHEMATICA--MAW509
4) SPSS —MAW231
5) LATEX—MAW225
6) HTML5 & CSS-CSW102

DETAILED SYLLABUS
FOURTH SEMESTER

Course Title/ Code	**WAVELET ANALYSIS- MAH627-T**
Course Type:	Elective (Departmental)
Course Nature:	Hard
L-P-O Structure	(4-0-0)
Objective	The student would be able to apply the concepts of theory of wavelets for solving problems in mathematics and signal processing.
Outcome	The student would be able to understand the fundamental concepts which has applications in the development of tools and techniques which may be used in signal theory, communication techniques, graphical algorithms and numerical analysis.
Prerequisites	Fourier Series, Fourier Transforms

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	100%

Section A

Study of Spaces $\boldsymbol{l^2(z_N), l^2(z), l^2[0, 2\pi), L^1(R)}$& $\boldsymbol{L^2(R)}$**,** Discrete Fourier Transform, Properties of DFT, Inverse Discrete Fourier Transform, Convolution, The Fast Fourier Transform.

Section B

Construction of Wavelets on Z_N**:** The first stage wavelets on $\boldsymbol{Z_N}$, Up-sampling operator, Down-sampling operator, The iteration step wavelets on $\boldsymbol{Z_N}$, P^{th} stage wavelet basis, Examples & applications.
Wavelets on Z : $\boldsymbol{l^2(Z)}$**,** Complete orthonormal sets in Hilbert Space, Fourier Series, The Fourier transform and convolution on $l^2(Z)$, The first stage wavelets on $\boldsymbol{Z}$, The iteration steps for Wavelets on Z, Examples.

Section C

Wavelets on R : $\boldsymbol{L^1(R)}$ & $\boldsymbol{L^2(R)}$**,** Fourier & Inverse Fourier Transform on R, Properties of Fourier transform, Orthonormal Wavelets, Characterization of Orthonormal Wavelets, Some standard Wavelets (Haar Wavelets, Shannon Wavelets, Journe's Wavelets, Meyer Wavelets, Daubechies' family of wavelets in detail), Multiresolution Analysis, Father Wavelets & Mother Wavelets, Construction of Wavelets through MRA, Scaling function.

Section D

Characterization of Scaling function, Low-pass filter & High Pass filter, Characterizations of Low & High pass filter, Band limited Wavelets, Compactly Supported Wavelets, Minimally-Supported Frequency (MSF) Wavelets, Wavelet Sets, Characterization of MSF wavelets & Wavelet Sets, Dimension Functions, Characterization of MRA Wavelets, Wavelet Transform.

Recommended Books:

1. Michael W. Frazier, An Introduction to Wavelets through Linear Algebra, Springer
2. Hernandez & Weiss, A First Course of Wavelets, CRC Press
3. Charles K. Chui, An Introduction to Wavelets :
4. George Bachman, Lawrence Narici, Edward Beckenstein , Fourier and Wavelet Analysis,

Course Title/ Code	FLUID MECHANICS- MAH628-T
Course Type	Core (Departmental)
Course Nature	Hard
L-P-O Structure	4-0-0
Objective	To familiarize students with basic concepts of fluid dynamics,
Outcome	The student would be able to apply the concepts of fluid mechanics for solving problems related to fluids.
Prerequisites	Mechanics at Graduate Level

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	100%

Section A

Physical Properties of fluids, Concept of fluids, Continuum Hypothesis, Density, Specific weight, Specific volume. Kinematics: Lagrangian and Eulerian methods, Steady and Unsteady flows, Uniform and Non uniform flows, Stream lines, Path lines and streak lines, Equation of continuity (Cartesian, polar & cylindrical coordinates), Equivalence of the two forms of Equation of continuity, velocity potential, Irrotational & Rotational flows, Boundary Surface, Conservation of Momentum: Euler's equation, Equation of motion of inviscid fluids, Bernoullie's equation, Lagrange's equation.

Section B

Viscous fluid flow: Stress analysis, Symmetry of stress tensor, stress in a fluid at rest and in motion, Transformation of stress components, Principal stresses and principal directions, Strain analysis, Rate of strain quadric, Navier stokes equation of motion of viscous fluid, Equation of energy, Dissipation of energy, Vorticity and circulations & viscous fluids, Diffusion of vorticity, the equations of state, Reynolds number.

Section C

Conservation Laws : Equation of conservation of mass, equation of conservation of momentum, Navier Stokes equation, Equation of moments of momentum, Equation of energy, Basic equations in different co-ordinate systems, Boundary conditions.

Section D

Irrotational Motion:- General motion of a fluid element, Vorticity, Flow and Circulation, Stoke's theory, Kelvin's circulation theory Motion in two dimensions:- Stream function & its physical interpretation complex potential and complex velocity, Motion in two dimensions; Stream function, Complex potential,

Source, Sink, Doublet, Complex potential and images with respect to straight line and circle, Milne-Circle theorem, Blausius theorem.

Recommended Books:

1. S.W.Yuan, Foundation to Fluid Mechanics.
2. F. Chorltron, Text book of Fluid Dynamics.
3. Bansi Lal, Theoretical Hydro-Dynamics.
4. M. Ray and Sharma, A text book of Fluid –Dynamics.
5. R. K. Gupta, Fluid Dyanamics

Course Title/ Code	**ALGEBRAIC TOPOLOGY- MAH629-T**
Course Type:	Elective (Departmental)
Course Nature:	Hard
L-P-O Structure	(4-0-0)
Objective	To familiarize students with topological groups, Homotopies, Deck transform etc.
Outcome	The student would be able to conceptualize and apply the concepts of Algebraic topology
Prerequisites	Topology, Algebra

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	100%

Section A

Introduction, Topological groups, Paths, Homotopies and the fundamental group, Categories and functors, Functorial properties of the fundamental group, Brouwer's theorem and its applications.

Section B

Homotopies of maps, Deformation retracts, Fundamental group of the circle, Covering projections, Lifting of paths and homotopies, Action of $\Pi 1(X, x0)$ on the fibers $p^{-1}(x0)$, The lifting criterion.

Section C

Deck transformations, Orbit spaces, Fundamental groups of SO(3, R) and SO(4, R), Coproducts and push-outs, Adjunction spaces, The Seifert Van Kampen theorem.

Section D

Homology theory, Singular complex of a topological space, The homology groups and there functoriality, Homotopy invariance of homology, Small simplicies, The Mayer Vietoris sequence, Abelianization of the fundamental group, The Mayer Vietoris sequence, Maps of spheres, Relative homology, Excision theorem, Inductive limits, Jordan Brouwer separation theorem.

Recommended
Books:

1. Allen Hatcher, Algebraic Topology. Cambridge, UK: Cambridge University Press
2. William S. Massey, A Basic Course in Algebraic Topology. New York, NY: Springer-Verlag
3. Glen Bredon, Topology and Geometry
4. James R. Munkres, Topology (2ndEdition) Pearson Education Pve. Ltd., Delhi-2002.

Course Title/ Code	CRYPTOGRAPHY- MAH630-T
Course Type:	Elective (Departmental)
Course Nature:	Hard
L-P-O Structure	(4-0-0)
Objective	The student would be able to conceptualize and apply the concepts of Cryptography.
Outcome	The student would be able to analyse basic cryptographic protocols, -have a solid understanding of the use of fundamental cryptoprimitives in security in computing, especially in networking (including the capability to analyse existing solutions).
Prerequisites	Basic probability, algebra / elementary number theory ,Discrete Mathematics

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	100%

Section A

Secure communications, Shift ciphers, Affine ciphers, Vigenere cipher key, Symmetric key, Public key, Block ciphers, One-time pads, Secure random bit generator, Linear feedback shift register sequences.

Section B

Differential cryptanalysis, Modes of DES, Attack on DES, Advanced encryption standard.

Section C

RSA, Attacks on RSA, Diffie-Hellman key exchange, ElGamal public key cryptosystem, cryptographic hash function

Section D

RSA signatures, ElGamal signature, Hashing and signing, Digital signature algorithm.

Recommended Books:

1. Johannes A. Buchmann, Introduction to Cryptography, Springer 2000.
2. Douglas Robert Stinson, Cryptography - Theory and Practice, Chapman Hall / CRC 2006.
3. Wade Trappe and Lawrence C. Washington, Introduction to Cryptography with Coding Theory, Pearson Prentice Hall, 2006.

Course Title/ Code	STRUCTURES ON A DIFFERENTIABLE MANIFOLD – MAH631-T
Course Type:	Core (Departmental)
Course Nature:	Hard
L-P-O Structure	(4-0-0)
Objective	To familiarize students with the concept of manifold theory
Outcome	The student would be able to conceptualize and apply the concepts of Differential manifold.
Prerequisites	Differential Geometry

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	100%

Section A

Almost Complex Manifolds : Elementary notions, Nijenhuis tensor Eigen values of F, Integrability conditions, Contravariant and covariant analytic vectors, F-connection, Quaternion Structure

Section B

Almost Hermitian Manifolds: Definition, Almost analytic vector fields, Curvature tensor, Linear connections, Almost quaternion Metric structure.

Section C

Kaehler Manifolds: Definition. Curvature tensor, Affine connection, Properties of projective, Conformal, Concircular and conharmonic curvature tensors, Contravariant almost analytic vector, Quaternion Kaehler manifold.

Section D

Nearly Kaehler Manifolds: Introduction, Curvature identities, Almost analytic vectors.

Recommended Books:

1. R.S. Mishra: Structure on differentiable manifold and their application, ChandramaPrakashan, Allahabad, 1984.
2. K. Yano and M. Kon: Structures of Manifolds, World Scientific Publishing Co. Pvt. Ltd., 1984.

Course Title/ Code	THEORY OF ELASTICITY & FRACTURE MECHANICS- MAH632-T
Course Type:	Elective (Departmental)
Course Nature:	Hard
L-P-O Structure	(4-0-0)
Objective	To familiarize students with theory of Elasticity and Fracture Mechanics.
Outcome	The student would be able to apply the concepts of fracture mechanics to avoid fracture in a body.
Prerequisites	Classical Mechanics

	Sections	Weightage
Syllabus	A	25%
	B	25%
	C	25%
	D	25%
	TOTAL	100%

Section A

Analysis of stress and strain, Equilibrium equations , Compatibility equations, stress strain relationship, Generalized Hooke's law, Stress, Strain &Elasticity, Stiffness, Strength and Toughness, Types of mechanical behavior, Relevance, Measurement, Data, Macroscopic, Continuum behavior, Physical mechanisms controlling behavior, Introduction, Stress, Strain, Compliance and stiffness tensors, Physical origin of elastic modulii, Generalized Hooke's law and its application to crystals, Designing for modulus and Composites.

Section B

Plane stress and plane strain, Simple two dimensional problems in Cartesian and polar co-ordinates.

Section C

Importance of Fracture Mechanics, Griffith Fracture Theory, Crack Driving Force & Energy Release Rate, Modes of fracture, Stress intensity factors, Similitude, Role of Crack-tip Plasticity-Plastic Zone Size & Shape, K-dominance, Fracture Toughness-Microstructural issues. Significance of fracture mechanics, Griffith energy balance approach, Irwin's modification to the Griffith theory, Stress intensity approach, Crack tip plasticity, Fracture toughness, sub- critical crack growth, Influence of material behaviour, I, II & III modes, Mixed mode problems.

Section D

Fatigue Crack Growth: Description of fatigue crack growth using stress intensity factor, Effects of stress ratio and crack tip plasticity – crack closure, Prediction of fatigue crack growth under constant amplitude and variable amplitude loading, Fatigue crack growth from notches – the short crack problem. Practical Problems:- Through cracks emanating from holes, Corner cracks at holes, Cracks approaching holes, fracture toughness of weldments, Service failure analysis, applications in pressure vessels, pipelines and stiffened sheet structures.

Recommended Books:

1. Ewalds, H.L. & Wanhill, R.J.H., Fracture Mechanics – Edward Arnold Edition
2. Timoshenko, S. and Goodier J.N."Theory of Elasticity", McGraw Hill Book Co., Newyork, 1988.
3. Broek, D. Elementary Engineering Fracture Mechanics, Sijthoff & Noordhoff Int. Pub., 1988.
4. Broek, D. The Practical Use of Fracture Mechanics, Kluwer Academic Pub., 1990.
5. Hellan, D. Introduction to Fracture Mechanics, McGraw Hill Book Company, 1985.
6. Kumar, P. Elements of Fracture Mechanics, Wheeler Publishing, 1998.

Course Title/ Code	MATHS LAB- MAH633-P
Course Type:	Core (Departmental)
Course Nature:	Hard
L-P-O Structure	(0-4-0)
Objective	To familiarize student with Discrete Fourier transform using MATLAB
Outcome	The student would be able to apply the tools of Matlab software for solving the problems of Fourier & Wavelet Analysis.
Prerequisites	MATLAB at Undergraduate Level

LAB EXERCISE:

1. To evaluate discrete Fourier transform (DFT) of functions or signals using MATLAB.
2. To evaluate inverse discrete Fourier transform (IDFT) of functions or signals using MATLAB.
3. To evaluate Fast Fourier transform (FFT) of functions or signals using MATLAB.
4. To evaluate Inverse Fourier transform (IFFT) of functions or signals using MATLAB.
5. Evaluation of Fourier basis using MATLAB.
6. To plot discrete and continuous signals.
7. To evaluate translation of a given signals and plot the translated signals.
8. To plot discrete Fourier transform () of a given signal(z) and also plot real & imaginary part of (), phase(angle) and magnitude of ().
9. To find convolution of a given signals using MATLAB.
10. To evaluate first stage Shannon basis using MATLAB and plot the same.
11. To evaluate first stage real Shannon basis using MATLAB and plot the same.
12. To evaluate first-stage Haar basis using MATLAB and plot the same.