Manav Rachna University

Faculty of Applied Sciences

Department of Mathematics

Scheme & Syllabus

M.Sc Mathematics (2018-20)

MANAV RACHNA UNIVERSITY
FACULTY OF APPLIED SCIENCES
DEPARTMENT OF MATHEMATICS
SYLLABUS & SCHEME
MAP01- Semester-I

SUBJECT CODES	SUBJECT NAME	**OFFERING DEPARTMENT	*COURSE NATURE (Hard/ Soft/ Workshop/ NTCC)	COURSE TYPE (Core/Elective / University Compulsory)	L	T	P	O	NO. OF CONTACT HOURS PER WEEK	NO. OF CREDITS
MAH501	ABSTRACT ALGEBRA	MA	HARD	CORE	4	0	0	0	4	4
MAH502	TOPOLOGY-I	MA	HARD	CORE	4	0	0	0	4	4
MAH503	DIFFERENTIAL EQUATIONS	MA	HARD	CORE	4	0	0	0	4	4
MAH504	GRAPH THEORY	MA	HARD	ELECTIVE	4	0	0	0	4	4
MAH505	OPERATIONS RESEARCH									
MAH513	FUZZY SETS & FUZZY LOGIC									
MAH507	MATHS LAB –I	MA	HARD	CORE	0	0	4	0	4	2
MAW508	SCILAB	MA	WORKSHOP	ELECTIVE	0	0	3	0	3	1.5
MAW509	MATHEMATICA	MA								
MAW231	SPSS	MA								
MAW225	LaTeX	MA								
MAW119	STATISTICS USING EXCEL	MA								
CSW102	HTML 5 & CSS	CS								
	RESEARCH METHODOLOGY		SOFT	CORE	1	0	2	0	3	2
TOTAL (L-T-P-O/ CONTACT HOURS/ CREDITS)					17	0	9	0	26	21.5

DETAILED SYLLABUS
MAP01 – FIRST SEMESTER

Course Title/ Code	ABSTRACT ALGEBRA- MAH501
Course Type	Core (Departmental)
Course Nature	Hard
L-P-O Structure	(4-0-0)
Objective	To familiarize students with the structure theory of groups, rings and fields.
Outcomes	The student would be able to conceptualize and apply the concepts of Modern Algebraic Structures.
Prerequisites	N.A

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

SECTION A

Structure Theory of Groups: Direct Products, External direct product, Internal direct product, Cauchy's theorem for Abelian groups, Sylow's P-subgroups, Double Cosets , Sylow's Theorems, Finite Abelian Groups, Fundamental Theorem of Finite Abelian Groups.

SECTION B

Solvable Groups & Jordan Holder Theorem: Generators of a subgroup and derived subgroups, Maximal Subgroups, Normal Series, Composition Series, Butterfly theorem, (Zassenhaus), Schreier's refinement theorem, Jordan Holder Theorem, Solvable groups.

SECTION C

Factorization Theory in Integral Domains: Divisibility, Euclidean Domains, Principal Ideal Domains and Unique Factorizations Domains, Polynomial rings over UFD's.

SECTION D

Fields: Fields, subfields, prime field, Extension of Fields, Finite, Algebraic and finitely generated field extensions, Factor Theorem, Splitting fields, Finite fields, Separable and Inseparable extensions.

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.
8. Surjeet Singh & Qazi Zameeruddin, Modern Algebra, 8th Edition, Vikas publishing house.

Course Title/ Code	TOPOLOGY-I- MAH502
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 TopologicalSpaces.
Prerequisites	N.A.

	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 Neighborhood 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
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	N.A.

	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 separationtheorems, 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 linearsystems, 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 byJacobi'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 Halfplane, 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, McGrawHill
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	MATHS LAB-I MAH507
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	N.A.

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 andArrays(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	RESEARCH METHODOLOGY PHH501
Course Type:	Core (Allied)
Course Nature:	SOFT
L-P-O Structure	(1-0-2-0)
Objective	Student shall be able to understand and apply the fundamentals of research methodology to a problem and make an informed decision.
Outcome	Student shall be able to – • write hypothesis; generate and choose alternatives; and test hypothesis. • select a sample ; generate data and present it • Calculate averages and dispersion • Calculate correlation and regression. • Statistical computation using Excel.
Prerequisites	N.A.

SECTION A

Basic Concepts of Research; Formulation & steps of Research : Decision-making: identifying the problem &Steps of decision-making process. Research : Its objectives and types. Formulation of Research Problem; its components and sources.Steps of research&Research ethics.Performance monitoring in research

Research Design: Requirements of Research Design; Types of Research Design; Factors Affecting Research Design; Hypothesis Formulation; Hypothesis Testing

SECTION B

Sampling Methods and Techniques: Sampling design; Scope of sampling method; Laws of sampling; Determination of sample size; Techniques of sampling**.**

Properties of Data Collection and Measurement: Basic Characteristics of data; Types of data and Scaling measurement. Methods of primary data collection; Editing Raw Data; Coding of Data; Tabulation of Data; Constructing Charts.

Presentation of Results:Report writing: Purpose of a Report; Essentials of a Good Report; Format of a Report; Types of Report Presentation.

SECTION C

Measures of Central Tendency: Types of Averages: The Arithmetic Mean; The Weighted Arithmetic Mean; The Median; The Mode; The Geometric Mean; The Harmonic Mean

Measures of Dispersion: Definition; Methods of Measuring Dispersion; The Range; The Inter-quartile Range; The Mean/Average Deviation ; The Standard Deviation; The Coefficient of Variation; The Gini Coefficient and the Lorenz Curve

Matrix Algebra : Matrix Multiplication; Matrix Addition; Matrix Substitution; Transpose of the Product of Two Matrices; Inverse of a Square Matrix; Matrix Notation in Case of Regression Analysis.

SECTION D

Multivariate Analysis; Correlation & Regression Analysis: Factor Analysis; Discriminant Analysis; Cluster Analysis; Dimensional Analysis; Meta Analysis; Conjoint Analysis. Introduction to Correlation Analysis; Rank Correlation; Linear Regression Analysis; Multiple Regression Analysis

Laboratory Work:

1. Identifying the hypothesis; alternatives and situations in given abstracts/reports.

2. Writing a research proposal as per research design fundamentals.
3. Coding, tabulating and drawing charts for a given data.
4. Calculating & plotting averages for the given data
5. Measuring dispersion for the given data.
6. Calculating correlation for the given data.
7. Calculating regression for a given data.

Mini Project: Identify a problem in given environment and apply the concepts of research methodology to conduct research and present the results.

MAP-01- Semester II

SUBJECT CODES	SUBJECT NAME	**OFFERING DEPARTMENT	*COURSE NATURE (Hard/ Soft/ Workshop/ NTCC)	COURSE TYPE (Core/Elective / University Compulsory)	L	T	P	O	NO. OF CONTACT HOURS PER WEEK	NO. OF CREDITS
MAH510	ADVANCED LINEAR ALGEBRA	MA	HARD	CORE	4	0	0	0	4	4
MAH511	COMPLEX ANALYSIS	MA	HARD	CORE	4	0	0	0	4	4
MAH512	MEASURE THEORY	MA	HARD	CORE	4	0	0	0	4	4
MAH504	GRAPH THEORY	MA	HARD	ELECTIVE	4	0	0	0	4	4
MAH505	OPERATIONS RESEARCH									
MAH513	FUZZY SETS & FUZZY LOGIC									
MAH515	TOPOLOGY-II									
MAH621	CODING THEORY									
MAH623	ADVANCED OPERATIONS RESEARCH									
MAH514	MATHEMATICAL STATISTICS									
MAH516	MATHS LAB –II	MA	HARD	CORE	0	0	4	0	4	2
MAW508	SCILAB	MA	WORKSHOP	ELECTIVE	0	0	3	0	3	1.5
MAW509	MATHEMATICA	MA								
MAW231	SPSS	MA								
MAW225	LaTeX	MA								
MAW119	STATISTICS USING EXCEL	MA								
CSW102	HTML 5 & CSS	CS								
EDS234	PEDAGOGICAL SKILLS		SOFT	CORE	1	0	2	0	3	2
TOTAL (L-T-P-O/ CONTACT HOURS/ CREDITS)					17	0	9	0	26	21.5

DETAILED SYLLABUS
MAP01 – SECOND SEMESTER

CourseTitle/Code	ADVANCED LINEAR ALGEBRA- MAH510
CourseType	Core (Departmental)
CourseNature	Hard
L-P-OStructure	(4-0-0)
Objective	The student would be able to conceptualize and apply the concepts of Advanced Linear Algebra.
Prerequisite	N.A

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

Section A

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

Section B

Invariant Subspaces-Definition & examples, Eigen values and Eigen vectors, Cayley Hamilton Theorem, Diagonalizable operator, diagonalisation; Minimal polynomial of linear operator, Cyclic subspaces and Annihilators, Canonical Forms, The Rational Form, The Jordan Form.

Section C

Definition: Inner product spaces, Euclidean space, Unitary space; Norm or length of a vector; Cauchy-Schwarz inequality, Triangular inequality; Orthogonal set; Orthonormal set; Gram-Schmidt orthogonalization theorem; Orthogonal complement; Linear functional; Adjoint; Self-adjoint (Hermitian); Unitary operators; Normal operators; Operators on inner product spaces; Forms on inner product spaces; Positive form; Spectral theorem.

Section D

Bilinear form, Bilinear forms as vectors, Matrix and rank of Bilinear form, Degenerate & Non-degenerate bilinear form, Symmetric bilinear form; 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.

RecommendedBooks:

1. K.HoffmanandR.Kunze,LinearAlgebra,PearsonEducation(India),2003.Prentice-HallofIndia,1991.

2. S.Lang, Linear Algebra ,UndergraduateTexts in Mathematics,Springer-Verlag,New York,1989.
3. I.N.Herstein,Topics in Abstract Algebra, Wiley EasternLimtd.
4. A.G.Hamilton,LinearAlgebra, CambridgeUniversityPress(1989)

Course Title/ Code	COMPLEX ANALYSIS-MAH511
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	NA

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

Section A

Analytic Functions (CR equations in Cartesian and Polar Coordinates),Limit, continuity and differentiability. Complex Integration, Cauchy's Integral Theorem, Cauchy-Goursat Theorem, Cauchy's Integral Formula, Cauchy's Integral Formula for Higher order derivatives, Maximum & Minimum modulus principle , Taylor & Laurent's Series Expansion.

Section B

Zeros and singularities, types of singularities, Casorati-Weierstress Theorem, Meromorphic Functions, The Argument Principle, Rouche's Theorem, The Fundamental Theorem of Algebra,Residues, Cauchy's Residue Theorem, Evaluation of Integrals, Inverse Function Theorem, Branches of many valued Functions with special reference to arg Z, Log Z, and Z^a

Section C

Introduction to Mapping (Transformations), Jacobian of Transformation, Complex Mapping functions. Some Elementary Transformation (Translation, Rotation, Magnification and Inversion).Linear Transformation, Bilinear or Fractional Transformation, The Schwarz – Christoffel Transformation. Transformation of Boundaries in Parametric Form.

Section D

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.

Recommended Books:

1. S. Ponnusamy, Complex Analysis.
2. E. T. Copson, Complex Variables, Oxford University Press.
3. J. B. Conway, Functions of one complex variable, Narosa Publication House.

4. H.S. Kasana, Complex- Variable Theory and Applications, PHI Learning Pvt.
5. J.N. Sharma, Complex variable, Krishna publication

Course Title/ Code	MEASURE THEORY- MAH512
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	N.A

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

Section A

Introduction of Measure Theory; Extension of Real Line, Semi algebra, Algebra, σ −algebra, Borel field, Set function, Length function and their properties, Counting measure, Extension of measure, Outer measure. Finite, Semi-finite and σ −finite measure, Measurable sets, Measureablespace, Completeness of measure spaces.

Section B

Lebesgue measure and its properties, Cantor's Theory, non-measurable sets, characterization of Lebesgue measurable sets, Measurable functions and its properties, Convergence of measurable function, Littlewood's Three principles.

Section C

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. Absolute continuity, Jensen Inequality Fundamental Theorem of Calculus for Lebesgue Integrals, Vitali's Lemma, Function of bounded variation.

Section D

Lebesgue Convergence Theorem and Convergence in Measure, Integration of complex valued function, Product measure, Fubini's Theorem, Signed Measures, Hahn Decomposition Theorem, Jordan decomposition, Radon-Nikodym Theorem, Lebesgue decomposition.

Recommended Books;

1. Real Analysis by H. L. Royden, PHI

2. An Introduction to Measure Theory by I. K. Rana. AMS and Narosa
3. Real Analysis By W. Rudin, TMH

Course Title/ Code	MATHS LAB-II MAH516
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	Maths Lab-I, MAH 507-P

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)

.

MAP01 -Semester-III

SUBJECT CODES	SUBJECT NAME	**OFFERING DEPARTMENT	*COURSE NATURE (Hard/ Soft/ Workshop/ NTCC)	COURSE TYPE (Core/Elective / University Compulsory)	L	T	P	O	NO. OF CONTACT HOURS PER WEEK	NO. OF CREDITS
MAH618	FUNCTIONAL ANALYSIS	MA	HARD	CORE	4	0	0	0	4	4
MAH619	DIFFERENTIAL GEOMETRY	MA	HARD	CORE	4	0	0	0	4	4
MAH620	DYNAMICS OF RIGID BODY	MA	HARD	CORE	4	0	0	0	4	4
MAH623	ADVANCED OPERATIONS RESEARCH	MA	ELECTIVE	CORE	4	0	0	0	4	4
MAH624	FOURIER ANALYSIS									
MAH621	CODING THEORY									
MAH514	MATHEMATICAL STATISTICS									
MAH630	CRYPTOGRAPHY									
MAH625	MATHS LAB –III	MA	HARD	CORE	0	0	4	0	4	2
MCS231	BASICS OF ECONOMICS	MC	SOFT	ELECTIVE ALLIED (BASKET OF COURSES BY MANAGEMENT DEPTT)	1	0	2	0	3	2
MCS232	INTRODUCTION TO FINANCE									
MAN626	SEMINAR	MA	NTCC	CORE	0	0	0	2	2	2
TOTAL (L-T-P-O/ CONTACT HOURS/ CREDITS)					17	0	6	2	25	21.5

DETAILED SYLLABUS
MAP01 - SEMESTER III

Course Title/ Code	FUNCTIONAL ANALYSIS- MAH618
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	N.A.

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

Section A

Normed linear spaces, Banach spaces, their examples including $R^n, \mathbb{C}^n, l_p(n), c_0, c, l_p, C[a,b]$. Subspaces, Quotient spaces of normed linear space and its completeness. Joint continuity of addition and scalar multiplication. Summable sequences and completeness,Continuous and bounded linear operators and their basic properties.

Section B

Normed linear space of bounded linear operators and its completeness. Isometric isomorphism, Topological isomorphism. Equivalent norms. Finite dimensional normed spaces and compactness. Riesz Theorem, Open mapping theorem and its simple consequences. Closed graph theorem. Uniform boundedness, Banach-Steinhaus theorem.

Section C

Bounded linear functionals Dual spaces. Form of dual spaces$R^{n*}, \mathbb{C}^{n*}, l_p(n), c_0^*, c^*, l_p^*, C^*[a,b]$., Hahn-Banach Theorem and its consequences, Embedding and Reflexivity of Normed spaces.

Section D

Adjoint of Bounded linear operators, Weak convergence and strong convergence. Hilbert spaces, orthogonal complements and direct sums, Bessel inequality, total orthonormal sets and sequences.

Recommended Books:

1. V.S. Sunder, Functional Analysis spectral theory.
2. Walter Rudin, Functional Analysis.
3. S. Ponnusamy, Foundation of Functional Analysis.
4. P. K. Jain and O P Ahuja, Functional Analysis

Course Title/ Code	DIFFERENTIAL GEOMETRY- MAH619
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	N.A

	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 andSkew-symmetric tensors, Tensor algebra, Contraction, Inner product, Riemannian metric tensor, Christoffel symbols, Covariant derivatives of tensors.

Section B

Differentible curves in R^3 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 vectorfields, 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
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	NA

	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 for finite as well as impulsive forces, Initial motions, Motion in three dimensions with reference to Euler's dynamics and geometrical equations .

SECTION D

Lagrange's equation, of motion, Energy equation for conservative field, Small oscillations, Hamiltons's principle, Hamilton's equation of motion, Variational principle of least action.

Recommended Books:

1. P. P. Gupta & G.S. Malik, Rigid Dynamics, Krishna's Publishers
2. S.L. Loney, An elementary Treatise on the dynamics of particle and rigid bodies, Cambridge University Press.
3. D. Greenwood, Classical Dynamics, Prentice Hall of India, New Delhi, 1985.
4. H. Goldstein, Classical Mechanics, (2ndEdition) Narosa Publishing House, New Delhi.
5. A.S Gupta, Calculus of variations with –Applications, Prentice Hall of india,1997
6. Synge, J.L., and Griffith, B.A., Principles of Mechanics, Tata McGraw Hill (1971).

Course Title/ Code	MATHS LAB-III MAH 625
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 MAPLE software for solving the Mathematical problems.
Prerequisites	

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 theMaple 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.

MAP01- Semester-IV

SUBJECT CODES	SUBJECT NAME	**OFFERING DEPARTMENT	*COURSE NATURE (Hard/ Soft/ Workshop/ NTCC)	COURSE TYPE (Core/Elective / University Compulsory)	L	T	P	O	NO. OF CONTACT HOURS PER WEEK	NO. OF CREDITS
MAH635	INTEGRAL EQUATIONS	MA	HARD	CORE	4	0	0	0	4	4
MAH628	FLUID MECHANICS	MA	HARD	CORE	4	0	0	0	4	4
MAH636	DIFFERENTIABLE MANIFOLDS	MA	ELECTIVE	CORE	4	0	0	0	4	4
MAH627	WAVELET ANALYSIS									
MAH506	MATHEMATICAL MODELING & SIMULATION									
MAH629	ALGEBRAIC TOPOLOGY									
MAH630	CRYPTOGRAPHY									
MAH632	THEORY OF ELASTICITY & FRACTURE MECHANICS									
MAH633	MATHS LAB –IV	MA	HARD	CORE	0	0	4	0	4	2
MAW508	SCILAB	MA	WORKSHOP	ELECTIVE	0	0	3	0	3	1.5
MAW509	MATHEMATICA	MA								
MAW231	SPSS	MA								
MAW225	LaTeX	MA								
MAW119	STATISTICS USING EXCEL	MA								
MAN634	PROJECT	MA	NTCC	CORE	0	0	0	6	6	6
TOTAL (L-T-P-O/ CONTACT HOURS/ CREDITS)					17	0	6	2	25	21.5

Course Title/ Code	FLUID MECHANICS- MAH628
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	NA

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

SECTION A

Concept of fluids, Physical Properties of fluids, Continuum Hypothesis, density, specific weight, specific volume, Kinematics of Fluids: Eulerian and Lagrangian methods of description of flows, Equivalence of Eulerian and Lagrangian method, General motion of fluid element, integrability and compatibility conditions, strain rate tensor, streamline, path line, streak lines, stream function¸ vortex lines, circulation.

SECTION B

Stresses in Fluids: Stress tensor, symmetry of stress tensor, transformation of stress components from one co-ordinate system to another, principle axes and principle values of stress tensor Conservation Laws: Equation of conservation of mass (continuity equation), equation of conservation of momentum, Navier Stokes equation, Euler's equation of motion, equation of moments of momentum, Equation of energy.

SECTION C

Irrotational and Rotational Flows: Bernoulli's equation, Bernoulli's equation for irrotational flows, Two dimensional irrotational incompressible flows, Circle theorem, sources and sinks, sources sinks and doublets in two dimensional flows, methods of images.

SECTION D

Approximate (analytical) solutions of Navier Stoke Equation, Order of magnitude analysis, Use of similarity variables in analytical solution techniques, Solutions of some benchmark problems like; Couette Flow, Axi-symmetric Flows, Creeping flows.

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	MATHS LAB- IV MAH633
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	N.A.

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.

Annexure-I
(Departmental Electives)

COURSE CODE	COURSE NAME	PERIODS			CREDITS
		L	P	O	
MAH504	GRAPH THEORY	4	0	0	4
MAH505	OPERATIONS RESEARCH				
MAH506	MATHEMATICAL MODELLING & SIMULATION				
MAH513	FUZZY SETS & FUZZY LOGIC				
MAH514	MATHEMATICAL STATISTICS				
MAH515	TOPOLOGY-II				
MAH621	CODING THEORY				
MAH623	ADVANCED OPERATIONS RESEARCH				
MAH624	FOURIER ANALYSIS				
MAH629	ALGEBRAIC TOPOLOGY				
MAH630	CRYPTOGRAPHY				
MAH627	WAVELET ANALYSIS				
MAH632	THEORY OF ELASTICITY & FRACTURE MECHANICS				
MAH636	DIFFERENTIABLE MANIFOLDS				

Course Title/ Code	GRAPH THEORY- MAH504
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	N.A.

	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.

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, matching.

Recommended Books:

[1] R. Balakrishnan and K. Ranganathan, A Text Book of Graph Theory, Springer, 2000.
[2] B.Bollobas,Modem GraphTheory,Springer,2002.
[3] G. Chartrand andL.Lesniak,GraphsandDigraphs,4th Edit., Chapman &Hall(CRC),2005.
[4] F.Iarary,GraphTheory,Narosa PublishingHouse,NewDelhi,200I.
[5] R.I.Wilson,Introduction to GraphTheory,4thEdit.,AddisonWesley,1996.

Course Title/ Code	OPERATIONS RESEARCH- MAH505
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	NA

	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 Half-spaces, 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

Sequencing: Sequencing problems: Introduction, assumptions, processing of n - jobs through 2 machines, Processing of n - jobs through 3 machines. Processing of n - jobs through m- machines.
Game Theory: Introduction, Two person zero sum game, Pure strategies, Maximin & minimax 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
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	N.A.

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	FUZZY SETS & FUZZY LOGIC- MAH 513
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 andclassical sets theories.
Prerequisites	N.A.

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

Section A

Fuzzy Sets - Basic definitions, α-level sets, Convex fuzzy sets, Basic operations on fuzzy sets, Types of fuzzy sets, Cartesian products, Algebraic products, Bounded sum and difference, t- norms , t - conorms.

The Extension Principle-The Zadeh's extension principle, Image and inverse image of fuzzy sets, Fuzzy numbers, Elements of fuzzy arithmetic.

Section B

Fuzzy Relations and Fuzzy Graphs - Fuzzy relations on fuzzy sets, Composition of fuzzy relations, Min-Max composition and its properties, Fuzzy equivalence relations, Fuzzy compatibility relations, Fuzzy relation equations, Fuzzy graphs. Similarity relation.

Possibility Theory - Fuzzy measures, Evidence theory, Necessity measure, Possibility measure, Possibility distribution, Possibility theory and fuzzy sets, Possibility theory versus probability theory.

Section C

Fuzzy Logic - An overview of classical logic, Multivalued logics, Fuzzy propositions, Fuzzy quantifiers, Linguistic variables and hedges, Inference from conditional fuzzy propositions, the compositional rule of inference.

Approximate Reasoning- An overview of fuzzy expert system, Fuzzy implications and their selection, Multiconditional approximate reasoning, The role of fuzzy relation equation.

Section D

An Introduction to Fuzzy Control - Fuzzy controllers, Fuzzy rule base, Fuzzy inference engine, Fuzzification, Defuzzification and the various defuzzification methods (the centre of area, the centre of maxima, and the mean of maxima methods).

Decision Making in Fuzzy Environment- Individual decision making, Multiperson decision making, Multicriteria decision making, Multistge decision making, Fuzzy ranking methods, Fuzzy linear programming.

Recommended Books:

1. H.J. Zimmermann, Fuzzy set theory and its Applications, Allied Publishers Ltd., New Delhi, 1991.
2. G.J. Klir and B. Yuan - Fuzzy sets and fuzzy logic, Prentice-Hall of India, New Delhi, 1995.

Course Title/ Code	MATHEMATICAL STATISTICS-MAH514
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	N.A.

	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
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 (MAH502)

	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, Compactness, Countability of 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	CODING THEORY- MAH 621
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	N.A.

	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	ADVANCED OPERATIONS RESEARCH- MAH623
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 timeproblems.
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	Operations Research(MAH505)

	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 networkcomponents 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 andcounted – 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 infinitepopulation 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
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 andInverse - Fourier transforms for solving mathematical problems.
Prerequisites	N.A.

	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'stheorem, 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.a

Course Title/ Code	ALGEBRAIC TOPOLOGY- MAH629
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	N.A.

	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
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	N.A.

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

Section A

Basic terminology, Secure communications, Types of cryptographic algorithm, Conventional Encryption model, Conventional Encryption Techniques (Ceaser Cipher, Monoalphabetic Cipher, Affine Cipher, Hill Cipher, Vigenere cipher, Block ciphers, One-time pads.

SECTION B

Differential cryptanalysis, Electronic code book(ECB), Cipher block chaining(CBC), Cipher feedback mode (CFB), Output feedback mode (OFB), Counter mode (CTR), Triple DES (TDES) encryption, International data encryption algorithm, Attack on DES,Advanced encryption standard.

SECTION C

Problems in classical cryptosystem, Public key cryptosystem, RSA cryptosystem, RSA cryptosystem, Diffie -Hellman's key exchange system, ElGamal cryptosystem, Messy-Omura cryptosystem, Key management in PKC, Elliptic curve over the field Zp, Elliptic curves over (2n), Elliptic curve cryptosystem, Seurity in ECC

SECTION D

Introduction to authentication with digital signature, Authentication Requirements, Authentication through message encryption, Authentication through message authentication code(MAC), Authentication Protocols, Authentication through Hash function, A classification of digital signature scheme,TheElGamal digital signature scheme, The digital signature algorithm (DSA), The Schnorr Signature scheme.

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, PearsonPrentice Hall, 2006.

Course Title/ Code	WAVELET ANALYSIS- MAH627
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 problemsin 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	N.A.

	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 onZ_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	THEORY OF ELASTICITY & FRACTURE MECHANICS- MAH632
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 abody.
Prerequisites	N.A.

	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	DIFFERENTIABLE MANIFOLD – MAH631
Course Type:	Elective (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(MAH619)

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

Section-A

Charts, Atlases, Manifolds, Differentiable manifolds, examples, smooth maps, tangent vector and tangent space at a point on a manifold, tangent bundle of manifold.

Section B

Vector fields, Lie bracket, Jacobian of a smooth map, Lie derivatives, integral curves on manifolds, one parameter group of transformation and flows, Involutive distribution.

Section-C

Cotangent space, differential forms, pullback of 1-form, tensor fields, exterior product and derivatives,Exterior algebra.

Section-D

Connections, parallelism,Geodesics, Covariant differentiations, Torsion, curvature, structure equations of Cartan, Bianchi identities

Recommended Books:

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

Annexure-II
(Workshop Electives)

COURSE CODE	COURSE NAME	OFFERING DEPARTMENT	PERIODS				CREDITS
			L	T	P	O	
MAW-508	SCI LAB	Mathematics	0	0	3	0	1.5
MAW-509	MATHEMATICA						
MAW-231	SPSS						
MAW-225	LaTeX						
MAW-119	STATISTICS USING EXCEL						

Course Title/ Code	SCILAB- MAW508
Course Type:	Core (Departmental)
Course Nature:	Workshop
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	N.A.

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:	Workshop
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:	Workshop
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	N.A.

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
1. 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	STATISTICS 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	N.A.

LAB EXERCISE

1. 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.

MANAV RACHNA UNIVERSITY
SUMMER TRAINING PROGRAM, JUNE 2018
DEPARTMENT OF MATHEMATICS

Post 2nd Semester M.Sc Summer Training Module

1. **Soft skills: 1 Credit**
2. **Applied Psychology: 1 credit**

Rationale:

- This module is well-structured academically, and also amalgamates classroom training and practical skills.
- Develop competencies regarding understanding self and social surrounding.
- Analyze the beauty of individual difference.
- Celebrate joyfully the different traits of personality.

Objectives:

The students will be able to:

-To define psychology and its application across various fields.
-To identify major attributes of Personality.
-To acknowledge Practical Intelligence.
-To conceptualize psychology in social settings.
-To understand and apply group dynamics.
-To apply intra personal and interpersonal management skills in managing stress.
-To develop deeper understanding of self.
-To understand the Conscious and Sub conscious functioning of Brain
-To understand the meaning of Self Regard/ Self Esteem
-To acknowledge the diversity of Intelligence types.

MODULE

Days	Topic to be covered	Transactional Modality	Resource Person
Day 1	**Introduction to Psychology, meaning, scope and importance.** **Thematic Apperception Test** - To understand the Conscious and Sub conscious functioning of Brain	**Test will be conducted on the students and Analysis shall be done.**	**Ms Shreyasi**
Day 2	**Self Concept** - To understand the meaning of Self Regard/ self Esteem	**Test will be conducted on the students. Techniques and tips for improving Self esteem shall be shared.**	**Ms Shreyasi**
Day 3	**Multi Variable Personality Test** - Will be able to explore different aspects of personality such as Empathy, Dominance, Dogmatism, etc	**Test will be conducted on the students and interpretation shall be shared.**	**Ms Shreyasi**
Day 4	**Raven's Progressive Matrice Test** **-**To apply the knowledge of Practical Intelligence	**Test will be conducted on the students**	**Ms Shreyasi**
Day 5	**Raven's Progressive Matrice Test** - To acknowledge the diversity of Intelligence types.	**Analysis shall be shared.**	**Ms Shreyasi**
Day 6	**Eyscenk's Test**	**Test shall be conducted and**	**Ms Ridhi Khanna**

	-To assess the degree of Introversion, Extroversion, Neurotism	**interpretation of different domains shall be discussed.**	
Day7	**Sentence Completion Test** - To develop deeper understanding of self.	**Test shall be administered and interpretation shall be shared.**	**Ms Ridhi Khanna**
Day 8	**Sociometery** -Will be able to assess the social intelligence and group dynamics.	**Students shall do hands on activity in groups and results shall be discussed.**	**Ms Ridhi Khanna**
Day 9	**Career Aspiration Test** - Will be able to assess different career aspiration of students	**Paper pencil test shall be conducted in assessing and sharing different career aspirations.**	**Ms Ridhi Khanna**
Day10	**Reflective Activities** - Will be able to skill fully apply the knowledge of Applied Psychology in understanding self.	**Hands on reflective activity shall be conducted and sharing of peer learning shall be encouraged.**	**Ms Ridhi Khanna**

3. **Mathematical Modelling: 1 Credit**

Modelling Skills and Creative Thinking : An Experimental Study

- Definition of Mathematical models
- Types of Mathematical Models
- Mathematical Modelling Skills
- Introduction to compartmental models, lake pollution model (with case study of Lake Burley Griffin), drug assimilation into the blood (case of a Griffin), drug assimilation into the blood (case of a study of alcohol in the bloodstream), exponential growth and decay problems.

Timings: 8:15 am-10:15am: Applied Psychology
10:15 am-10:45am: Break
10:45 am-12:45pm: Mathematical Modelling
12:45 pm-1:15pm: Break
1:15 pm-3:15pm: Soft Skill

Note: If attendance falls below 80% the evaluation of training will not be done.

SEMINAR

SECTION A

Research Paper:- Definition, Quality of a good Research Paper, Report Paper and Thesis Paper; Details of a Research Paper – Steps and Schedule.

Choosing a Topic:- Brainstorming, Consulting Experts, Considering Parameters, Narrowing the Research Topic.

Thesis:- Definition and function, Outline, Thesis Statement

SECTION B

Doing Research:- Finding Information, Sources of Information; Online Resources, Search Engines, Databases, Newsgroups, Internet Sites; Library – Books, Research Papers, Periodicals, Magazines and Journals,, Interviews, Surveys, Government Documents, Pamphlets, Special Collections; Evaluating Sources
Taking Notes:- Reading, Notes Taking Methods, Guidelines and Summarizing

SECTION C

Rough Draft :- Transforming Notes into Rough Draft Creating Outlines, Types of Outlines; Basics of Research Paper Style ; Words, Sentences, Punctuation ; Writing Introduction; Using Notes, Quotations, Graphics etc.

Revising Rough Drafts:- Principles, Revising Opening Paragraph, Sentences, Words and Rules for Writers, Plagiarism and how to avoid it, Plagiarism Detection Programs.

SECTION D

Documentation :- MLA System of Documentation ; Parenthetical Documentation, Format for Work Cited, Using Footnotes and Endnotes to Document Sources and add Observations and Comments – Guidelines and Format ; APA System of Documentation, Traditional System of Documentation (CMS).

Presentation of Research Paper:- Title Page, Table of Contents, Forward and Preface, Abstract, Presentation Footnote. Finished Form of Paper – Revising, Editing, Proofreading, Peer Review Checklist, Submitting Electronically. Model Research Papers.

Reference Books:

1) Gibaldi, Joseph. *MLA Handbook for Writers of Research Papers.* 7th ed. New Delhi: East-West Press, 2009
2) Kothari, C.R. *Research Methodology: Methods and Techniques*. New Delhi: New Age International Ltd, 1985.
3) Rahim, F. Abdul. *Thesis Writing: A Manual for Researchers*. New Delhi: New Age International Pvt Ltd, 1996.
4) Laurie Rozakis, *Schaum's Quick Guide to Writing Great Research Papers*, M/cGraw- Hill 2007.
5) Anthony C. Winkler / Jo Ray McCuen –Metherel, *Writing the Research Paper*. Wadsworth Cengage Learning. 2008

EVALUATION SCHEME

Report writing consisting of about 1,000 words, on any subject of the student's choice, in the field of research.

Prepare atleast two Research Papers as per AMS Format. Your **research paper** must be 3 pages **minimum** plus reference page, typed (approx. 250 words per page) on a research topic of the student's choice.

Seminar presentation, on Report Writing and Research Papers.

Total marks: 100.

Manav Rachna University, Faridabad
Department of Mathematics
PROJECT

(A). Project Guidelines:

I. Overview:

The aim of the project is to synthesize different types of knowledge and skills that the students have developed over the course of the degree to produce a substantial piece of work that forms the new idea/knowledge/application of mathematics.

. The project may be in the context of graduate level Mathematics for B.Sc (H) mathematics students and post graduate level Mathematics for M.Sc mathematics students, the students are not restricted to this boundary. It can combine mathematical and/or scientific knowledge from areas like Sciences, Engineering, Humanities, Management and the use of technology.

II. Project Component Scheme:

The project module is of **six credits i.e. 300 marks**, which is based on a combination of 4 different components:

(a).Development of Project Proposal
(b).Project title and methodology
(c). Project Report
(d). Presentation of the project

Development of Project Proposal:

To start a project, the students should identify a project area or problem that he/she wish to tackle. This can be informed by the students own curiosity or with help of supervisor /project review committee etc, by which the student experience of learning and assessing, ideas that should have met elsewhere in the degree.

Project title and methodology:

The students will decide the title of the project proposal followed by literature survey. They would present their ideas and prepare the frame of the proposed title. He/ She should explain the methods and techniques used for the completion of the project.

Project Report:

After finding the output of the project the student will prepare a detailed report for the same with help of the supervisor. The aim of the project report is to explain the context of the work and show what distinguishes it from what has been done before. It should not be simply a compression list of results and ideas presented elsewhere rather, the students should try to explain the importance and uniqueness of his /her work.

Presentation of the project:

The purpose of the presentation is for the students to describe the key details of his/her project. What were he /she trying to find out? How did he or she did this? What are the results? What are conclusions?

The student presentation should run to **15** minutes including 5 minutes of questions/answers.

III. Project Submission:

There will be following steps

(a) First the **student** will provide the soft or hard copy of his /her project work to DRC members nominated by coordinator and HOD of the department including supervisor.
(b) The student will present his/her project work in the DRC in two times during the project work.
(c) The student will be responsible for any types of Plagiarism.
(d) The supervisor and HOD will fix a date for the viva and decide an external examiner.
(e) It mandatory to get a no objection certificates from the HOD before submission the project work to the examination cell.

(B). Evaluation Guidelines: The total marks of the project are 300 marks i.e. **six credits.**

The following points will be including evaluating the project work

I. Development of the project proposal- **(20 Marks)**
II. Literature review - **(20 Marks)**
III. Presentation - **(30 Marks)**
IV. Scientific merit of project - **(20 Marks)**
V. Structure and content - **(30 Marks)**
VI. Spelling and grammar - **(20 Marks)**
VII. Plagiarism [negative marks can be given] - **(30 Marks)**
VIII. Presentation **– (30 Marks)**
IX. Documentation via LaTeX **– (20 Marks)**
X. Viva and Comments of the external examiner - **(80 Marks)**

(C) Departmental Formalities:
The students will apply for project work module by filing the form (attached here)