DAVANGERE UNIVERSITY

SHIVAGANGOTHRI – 577 007, DAVANGERE, INDIA.

SYLLABUS
FOR

MASTER OF SCIENCE (M. SC.)
SEMESTER SCHEME - CBCS

MATHEMATICS

.

With effect from 2016-17 & onwards

SYLLABUS (CBCS-Scheme)

(W.E.F. : 2016-17)

M.Sc., MATHEMATICS

SEMESTER – I:(With Effect From 2016-17)

	PAPER CODE	PAPER	MARKS ALLOTMENT			TOTAL	CREDIT
			EXAM	IA	LAB		
CORE	MSM 1.1	ALGEBRA	75	25	--	100	05
	MSM 1.2	REAL ANALYSIS-I	75	25	--	100	05
	MSM 1.3	ORDINARY DIFFERENTIAL EQUATIONS	75	25	--	100	04
Supportive	MSM 1.4	DISCRETE MATHEMATICS	75	25	--	100	04
	MSM 1.5	COMPUTER FUNDAMENTALS AND C-PROGRAMMING	75	25	--	100	04
PRACTICAL	MSM 1.6	PROGRAMMING LAB-I	--	--	50	50	02
TOTAL						**550**	**24**

SEMESTER – II : (With Effect From 2016-17)

	PAPER CODE	PAPER	MARKS ALLOTMENT			TOTAL	CREDIT
			EXAM	IA	LAB		
CORE	MSM 2.1	LINEAR ALGEBRA	75	25	--	100	05
	MSM 2.2	REAL ANALYSIS – II	75	25	--	100	05
	MSM 2.3	TOPOLOGY- I	75	25	--	100	04
Supportive	MSM 2.4	COMPLEX ANALYSIS	75	25	--	100	04
	MSM 2.5	PARTIAL DIFFERENTIAL EQUATIONS	75	25	--	100	04
Practical	MSM 2.6:	PROGRAMMING LAB-II	--	--	50	50	02
TOTAL						**550**	**24**

M.Sc., Mathematics Syllabus

SEMESTER – III : (With Effect From 2016-17)

	PAPER CODE	**PAPER**	**MARKS ALLOTMENT**			**TOTAL**	**CREDIT**
			EXAM	IA	LAB		
CORE	MSM 3.1	MEASURE THEORY	75	25	--	100	05
	MSM 3.2	TOPOLOGY-II	75	25	--	100	05
	MSM 3.3	NUMERICAL ANALYSIS	75	25	--	100	04
Supportive	MSM 3.4	DIFFERENTIAL GEOMETRY	75	25	--	100	04
	MSM 3.5	FLUID MECHANICS	75	25	--	100	04
Practical	MSM 3.6:	PROGRAMMING LAB-III	--	--	50	50	02
TOTAL						**550**	**24**

SEMESTER – IV : (With Effect From 2016-17)

PAPER CODE	**PAPER**	**MARKS ALLOTMENT**			**TOTAL**	**CREDIT**
		EXAM	IA/Viva	LAB		
MSM 4.1	RIEMANNIAN GEOMETRY	75	25	--	100	05
MSM 4.2	GRAPH THEORY	75	25	--	100	05
MSM 4.3	FUNCTIONAL ANALYSIS	75	25	--	100	04
MSM 4.4	MAGNETOHYDRODYNAMICS	75	25	--	100	04
MSM 4.5	OPERATIONS REARCH	75	25	--	100	04
MSM 4.5	PROJECT WORK	40	10	--	50	02
TOTAL					**550**	**24**

Sl.No.	**Semester**	**Total Marks**	**Credits**
01	1st Semster	550	24
02	IInd Semster	550	24
03	IIIrd Semester	550	24
04	1Vth Semester	550	24
GRAND TOTAL		**2200**	**96**

INTERDISCIPLINARY PAPER

ELECTIVE-I	**STATISTICAL TECHNIQUES**	40	10	--	50	02

DAVANGERE UNIVERSITY

COURSES HAVING FOCUS ON EMPLOYABILITY/ ENTREPRENEURSHIP/ SKILL DEVELOPMENT

Course Code	Title of the Paper	Activities with direct bearing on Employability/ Entrepreneurship/ Skill development
MSM 1.1	Algebra	Employability and entrepreneurship in teaching profession
MSM 1.2	Real analysis-I	Employability and entrepreneurship in teaching profession
MSM 1.3	Ordinary differential equations	Problem solving skill, Employability in developing software in numerous industries, such as engineering, aviation, automotive.
MSM 1.4	Discrete Mathematics	Computational Skill, Employability in IT industries and statistical Departments.
MSM 1.5	Computer Fundamentals and C-Programming	Computational & Programming Skill, Employability in IT industries and statistical Departments.
MSM 1.6	Programming Lab-I	Programming skill, Employability in IT industries, Entrepreneurship in Produce innovative IT solutions and services based on global needs and trends
MSM 2.1	Linear Algebra	Employability in Pharmaceutical, Agricultural and IT industries
MSM 2.2	Real Analysis – II	Employability and entrepreneurship in teaching profession
MSM 2.3	Topology- I	Skill in handling issues related to machine learning
MSM 2.4	Complex Analysis	Employability and entrepreneurship in teaching profession
MSM 2.5	Partial Differential Equations	Employability in developing software in numerous industries, such as engineering, aviation, automotive, and the like, as a way to test new designs.
MSM 2.6:	Programming Lab-II	Programming skill, Employability in IT industries, Entrepreneurship in Produce innovative IT solutions and services based on global needs and trends
MSM 3.1	Measure Theory	Employability in teaching profession
MSM 3.2	Topology-II	Skill in handling issues related to machine learning
MSM 3.3	Numerical Analysis	Problem Solving Skill, Employability in scientific and research organizations to develop models
MSM 3.4	Differential Geometry	Employability in teaching profession
MSM 3.5	Fluid Mechanics	Employability in industries and research organizations.

MSM 3.6:	Programming Lab-III	Programming skill, Employability in IT industries, Entrepreneurship in Produce innovative IT solutions and services based on global needs and trends
MSM 4.1	Riemannian Geometry	Research skill, Employability in teaching profession
MSM 4.2	Graph Theory	Problem solving skill, Employability in IT industries.
MSM 4.3	Functional Analysis	Employability in teaching profession
MSM 4.4	Magnetohydrodynamics	Employability in industries and research organizations.
MSM 4.5	Operations Research	Computational Skill, Employability in Pharmaceutical, Agricultural, IT industries and statistical departments.
MSM 4.5	Project Work	Ability to do independent investigatory work

SYLLABUS (CBCS-Scheme)
(wef 2016-17)

M.Sc., MATHEMATICS

FIRST SEMESTER

MSM 1.1: ALGEBRA

(Max marks 75+25=100. Credits 05)

MODULE 1: Groups: Reviews of preliminaries on groups: Set theory, Mappings, Integers, Definition of group, Examples, Subgroups.

MODULE 2: Normal subgroups: Quotient groups, Homomorphism, Automorphism, Isomorphism, Fundamental theorem of homomorphism, Cauchy's theorem for finite a.g, Sylow's theorem for a.g, Cayley's theorem.

MODULE 3: Permutation groups: Sylow's theorems, Solvable groups, Direct products of groups and structure of finite Abeliene groups.

MODULE 4: Rings: Reviews of preliminaries on rings: Definitions, Examples, Special classes of Rings, Homomorphisms.

MODULE 5: Ideals: Prime and Maximal ideals' Euclidean and Principle ideal rings; Unique factorization domains, Polynomial rings.

MODULE 6: Fields: Extension fields, Prime fields, Algebraic and Transcendental extensions, Roots of Polynomials, Splitting Fields, Finite Fields, Separable and Inseparable extensions, Perfect and Imperfect Fields, Simple extensions, Galois theory.

References:

1. I. N. Herstein, (1975), Topics in Algebra, 2nd Edition, John-Wiley & Sons, New York.
2. J.B.Fraleigh, (1976), A first course in Abstract Algebra, Addison Wesley.
3. Surjit Singh and Qazi Zameeruddin, Modern Algebra, Vikas Publishing House (1990)
4. S. K. Jain, P. B. Bhattacharya & S. R. Nagpaul, Basic Abstract Algebra, Cambridge University Press (1997).
5. S. Maclane & G. Birkhoff, Algebra, Mc Millan Co., New York (1967)
6. M. Artin, Algebra, Prentice Hall of India (2004)

MSM 1.2: REAL ANALYSIS-I
(Max marks 75+25=100. Credits- 05)

MODULE 1: Real Number System: Ordered sets, Fields, Real field, Extended real number system, Euclidean spaces.

MODULE 2: Basic Topology: Finite, Countable and Uncountable Sets, Metric spaces, Compact sets, Perfect sets, Connected sets.

MODULE 3: Continuity: Limits of function, Continuous function, Continuity and Compactness, Continuity and Connectedness, Discontinuity, Monotonic functions, Infinite limits and limits at infinity.

MODULE 4: Differentiation: The derivative of a real function, Mean value theorems, The continuity of derivatives, Derivatives of higher order, Taylor's theorem, Differentiation of vector valued functions.

MODULE 5: The Riemann–Steiltje's Integral: Definition and existence of the integral, Properties of the integral, Integration and Differentiation, Integration of vector valued functions.

References:

1. Walter Rudin, (1953) Principles of Mathematics Analysis, McGraw-Hill, USA
2. R.R. Goldberg, (1970) Methods of Real Analysis, Xerox college publishing, Waltham, USA
3. T.M. Apostal, (2002) Mathematical Analysis, 2nd edition, Narosa Publishing House.
4. S. L. Gupta & N. R. Gupta, Principles of Real Analysis, Second Edition, Pearson Education (2003)
5. W. R. Wade, An Introduction to Analysis, Second Edition, Prentice Hall of India (International Edition) (2000)
6. Robert G. Bartle & DSonald R. Sherbert, Introduction to real Anlaysis, John Wiley & Sons, Inc, USA (1982)

MSM 1.3: ORDINARY DIFFERENTIAL EQUATIONS
(Max marks 75+25=100. Credits 04)

MODULE-1: Linear equations of second order; Homogeneous equations and general solutions; Green's functions' Variation of parameters, Initial value problems, Wronskian, Boundary value problems; Sturm Liouville theory; Oscillation theorems.

MODULE-2: Homogeneous equation of order n, Initial value problems, Non-homogeneous equations.

MODULE-3: **Power series solution**-Solution near an ordinary point and a regular singular point–Frobenius method–Legendre, Bessel's, Hypergeometric equations and their polynomial solutions (with standard properties).

MODULE-4: Existence and Uniqueness theorems, First order systems, Existence of solution to 1st order equation.

MODULE-5: Linear system of homogeneous and non-homogeneous equations (matrix method) Non-linear equations-Autonomous systems-Phase plane-Critical points–stability-Liapunov direct method-Bifurcation of plane autonomous systems.

References:

1. Eurl A.Coddington, (1989) An introduction to ordinary Differential Equations, Dover Publications.
2. G.F. Simmons, (1974) Differential Equations, TMH Edition, New Delhi.
3. M.S.P.Eastham, (1970) Theory of ordinary differential equations, Van Nostrand, London.
4. S.L.Ross, (1984) Differential equations (3rd edition), John Wiley & Sons, NewYork.
5. E.D.Rainville and P.E. Bedient, (1969) Elementary Differential Equations, McGraw Hill, NewYork.
6. E.A. Coddington and N. Levinson, (1955) Theory of ordinary differential equations, McGraw Hill.
7. A.C.King, J.Billingham and S.R.Otto, (2006) Differential equations, Cambridge University Press.

MSM 1.4: DISCRETE MATHEMATICS

(Max marks 75+25=100. Credits 04)

MODULE-1: Review of set theory and relations: Introduction, product sets, relations, properties of relations, equivalence relations, compatibility relations, composition of relations, partially ordered set.

MODULE-2: Lattice Theory: Partially ordered sets their properties, Lattice as algebraic systems, some special lattices like complete, Distributive Lattice, Complements.

MODULE-3: Boolean Algebra: Boolean algebra as lattices, Demorgan's laws, Boolean expressions, Boolean functions, minterm and maxterm Boolean forms, Propositional Calculus, Logical Connectives, Truth values and tables. **Application of Boolean Algebra:** Application of Boolean Algebra to digital networks and switching circuits and the Karnaugh map method.

MODULE-4: Combinatorics: Combination, permutation, generating function, ordinary generating function, exponential generating function, recurrence relations, principle of inclusion and exclusion, linear recurrence relation with constant coefficients, generating function method.

MODULE-5: Elements of theory of Graphs: Definition of (undirected) graphs, paths, circuits, cycle and sub graphs. Induced sub graphs, degree of vertex, connectivity, planar graphs and their properties. Trees, Euler's formulae for connected planar graphs. **Complete Graphs:** Complete and bipartite graphs, Kuratowski's theorem and its uses. Spanning trees, cut-sets, fundamental cut-sets and cycles. Minimal spanning trees and kruskl's algorithm. Matrix representation of graphs.

MODULE-6: Partitions and Traversability: Eulerian and Hamiltonian graphs.

References:

1. C. L. Liu, (1977) "Elements of Discrete Mathematics ", McGraw-Hill, New York.
2. Purna Chandra Biswal, (2005) Discrete mathematics and graph theory, Prentice Hall, Eastern Economy edition, NewDelhi
3. K.D.Joshi, Fundation of Discrete mathematics,
4. B.Kolman, R.C.Busby, S.C.Ross, (1999) Discrete Mathematical Structures, 4th ed. Prentice-Hall, Englewood Cliffs, NJ
5. J.P.Tremblay and R.Manohar, Discrete mathematical Structure with Applications to Computer Science, tata McGraw Hill Edition (1997)
6. N. Deo, Graph Theory with Applications to Engineering and Computer Sciences prentice Hall of India.
7. F. Harary, Graph Theory, Narosa Publishing House, New Delhi.

MSM 1.5: COMPUTER FUNDAMENTALS AND C-PROGRAMMING
(Max marks 75+25=100. Credits 04)

MODULE 1: Introduction to computers: Definition, History and Generation of Computers, Hardwares and Softwares, I/O devices, Memory devices.

MODULE 2: Problem solving with computer: Steps involved in problem solving, Problem definition, Analysis, Algorithm, Flowchart, Pseudo code, Running the Programme, Debugging, Testing.

MODULE 3: Introduction to 'C': Development of C, Features, Constants and Variables, Data types, Operators and Expressions, Library functions.

MODULE 4: I/O Statements: Formatted and Unformatted I/O, Scanf(), Printf(), Getchar() and Putchar() functions.

MODULE 5: Control Structures: Conditional and Unconditional, If, For, While and Do…While, Switch, Break and Continue, Goto statement.

MODULE 6: Arrays: One and Multi dimensional arrays, Strings and String functions, Bubble sort, Linear and Binary search.

MODULE 7: Functions: Definition, Different types, Advantages, Calling a function, Passing parameters, Call by reference and Call by value, Local and Global variables, Recursive functions.

MODULE 8: Structures and Unions: Defining a structure, Classification, Union, User-defined data types, Pointer to a Structure, Structure as an argument to a function.

MODULE 9: Pointers: Declaration, Operations on Pointers, relationship between arrays and Pointers, Address arithmetic, Array of Pointers, Pointer to a Pointer, Pointer to a Function, Dynamic memory allocation.

Reference:

1. Schaum Series, (1995), C Programming, 9th Edition, Tata McGraw Hill Co.
2. Mullish & Cooper, (1987) The Spirit of C, Jaico Publication House.
3. Yeswant Kanetkar, (2008), Let us C, Infinity science series, Hingham, US.
4. P.B.Kottor, (1999), Introduction to computers and C-programming, Sapna book house publishers, Bangalore.

MSM 1.6: Programming Lab - I

(Max marks 50. Credits 02)

Practicals lab based on MSM-1.5, using C-programming language.

SECOND SEMESTER

MSM 2.1: LINEAR ALGEBRA

(Max marks 75+25=100. Credits- 05)

MODULE-1: Vector spaces and Modules: Elementary basic concepts, Finite vector linear dependence and independence, Basis, Dual spaces, Inner product spaces, Modules.

MODULE-2: Linear Transformations: Properties of Linear Transformation, The algebra of Linear Transformation, Rank and Nullity, Algebra characterization of Algebra.

MODULE-3: Characteristic roots. Matrices, Canonical Forms: Triangular forms, Nilpotent Transformations, Jordan form, Canonical form, Trace and Transpose, Determinants, Inner-product spaces, Hermitian, Unitary and Normal Transformation.

MODULE-4: Bilinear Forms: Real quadratic forms**:** Sylvester's law of Inertia, Criterion for Positive Definiteness. Applications for the above Concepts. Definition of Bilinear forms, Symmetric forms-Orthogonally, Quadratic forms, Hermitian forms, Singular values and its Applications.

References:

1. I. N. Herstein, (1975), Topics in Algebra, 2nd Edition, John-Wiley & Sons, New York.
2. Michael Artin, (1995), Algebra, Prentice hall.
3. Otto Bretscher, (1996), Linear Algebra with Applications, Prentice hall professional technical reference.
4. K. Hoffman and R. Kunze, (1972), Linear Algebra, 2nd Edition, Addison Wesley Publishing Co.
5. L. Smith, Linear Algebra, Springer-Verlag, New York (1984)
6. S. Lang, Introduction to Linear Algebra, Second Edition, Addison Wiley Publishing Co, (1972)

MSM 2.2: REAL ANALYSIS-II

(Max marks 75+25=100. Credits- 05)

MODULE-1: Numerical Sequences and Series: Convergent sequences, subsequences, Cauchy sequences, upper and lower limits some special sequences, series, series of nonnegative terms, the number e, the root and ratio tests, power series, summation by parts, absolute convergence, addition and multiplication of series, rearrangements.

MODULE-2: Sequences and Series of Functions: Uniform convergence, Uniform convergence & continuity, Uniform convergence & integration, Uniform convergence & differentiation, Equicontinuous families of functions and The Stone-Weierstrass theorem.

MODULE-3: Special Functions: Power series, the exponential and Logarithmic functions, the trigonometric functions, the algebraic completeness of the complex field, Fourier Series and the Gamma function.

MODULE-4: Functions of Several Variables: Linear transformations, Differentiation, The contraction principle, The Inverse function theorem, Implicit function theorem, Rank theorem, Determinants, Derivatives of Higher order and differentiation of integrals.

References:

1. H.L. Royden, (2010) Real Analysis, 4th edition, United Kingdom.
2. C. Goffman, (1964) Real Functions, Rinehart and Winston, New York.
3. G. Debarra, (1981) Measure and Integration, Halsted Press, New York.
4. W. Rudin, (1976) Principles of Mathematical Analysis, McGraw-Hill, New York.
5. I.M. Geifand and S.V. Famin, (2000) Calculus of variations, Courier Dover publications. US.

MSM 2.3: TOPOLOGY - I

(Max marks 75+25=100. Credits- 04)

MODULE-1: Topological Spaces: Topological spaces, open sets, closed sets, closure, accumulation points, derived sets, interior, boundary. Bases and sub-bases, dense sets, closure operator, neighbourhood system, sub-spaces, convergence of sequences.

MODULE-2: Continuity and Other Maps: Continuous maps, continuity at a point, continuous maps into R, open and closed maps, homeomorphisms, finite product spaces, projection maps.

MODULE-3: Connectedness: Connected and disconnected spaces, separated sets, intermediate value theorem, components, local connectedness, path connectedness. **Separation axioms:** T_0, T_1 and T_2 (Hausdorff) spaces.

MODULE-4: Compactness: Cover, subcover, compactness, characterizations, invariance of compactness under maps, properties.

MODULE-5: Metric Space: Metrics on sets, distance between sets, diameters, open spheres. Topology induced by metric, equivalent metrics, continuity of distance, convergence in metric space.

MODULE-6: Convergence in Topology: Sequences and subsequences, convergence in topology, sequential compactness, local compactness, one point compactification, Stone-Cech compactification.

References:

1. J.R.Munkres, (1974) A First Course in Topology, Prentice Hall college Div., USA.
2. S.Willard, (1970) General Topology, Addison wesley publishing company, Massachusetts.
3. M.J.Greenberg and J.R.Harper, (1981) Algebraic Topology, A First Course, Benjamin/cummings publishing company, London.
4. James Dugudji, (1966), Topology, Allyn and Bacon, William C Brown Pub., Boston
5. W.J.Pervin, (1964) Foundations of General Topology, Academic Press,
6. J.L.Kelley, (1955) General Topology, D.Van Nostrand Company, Springer-verlag, Newyork. :
7. S.Lipschutz, (1965) Theory and Problems of General Topology, Schaum Publishing Company. :

MSM 2.4: COMPLEX ANALYSIS

(Max marks 75+25=100. Credits-04)

MODULE-1: Analytic functions, Cauchy-Riemann equations. Harmonic functions. Harmonic conjugate functions, their relation to analytic functions.

MODULE-2: Power series. Radius of convergence. Integration and differentiation of power series. Uniqueness of series representation. Relation between power series and analytic functions. Trignometric exponential and logarithmic functions.

MODULE-3: Complex line integral. Bsic properties. Cauchy's theorem for a triangle. Cauchy's integral formula. Liouvilles theorem. Fundamental theorem of algebra. Morera's theorem.

MODULE-4: Singularities. Taylor and Laurent's expansions. Singularities. Poles. Removable and Isolated essential singularities. Classification of singularities using Laurent's expansion. Behaviour of an analytic function in the neighborhood of a singularity. Principles of analytic continuation.

MODULE-5: Residues. Residue theorem and contour integrals. Argument principle, Rouche's theorem, its applications.

MODULE-6: Maximum modules principle, Schwarz's lemma. Some applications of Schwarz's lemma. Basic properties of univalent functions. Open mapping theorem. Deduction of maximum modulus principle using open mapping theorem. Hadamard's three circles theorem. Conformal mapping. Linear transformtions. MODULE disc trnsformations. Sequences and series of functions.

References:

1. L.V. Ahlfors, Complex Analysis
2. John B.Conway, (1978) Functions of One Complex Variable, Springer, Germany
3. T.O.Moore and E.H.Hadlock, Complex Analysis, World Scientific Publishing Co- Pvt. Ltd., Singpore.
4. Serge Lang, Complex Analysis
5. S.Ponnuswamy, (2005) Foundation of Complex Variables, Alpha Science International Oxford, UK.
6. I.Steward and D.Tall, (1983) Complex Analysis, Cambridge University Press, UK.

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MSM 2.5: PARTIAL DIFFERENTIAL EQUATIONS
(Max marks 75+25=100. Credits- 04)

MODULE-1: Basic concepts and definitions of PDE: Domain of Partial Differential Equations, continuous dependence on data (initial conditions, boundary conditions), ill-posed and well posed problems, Linear super position principle. The Cauchy problem of first order PDE, geometrical interpretation-The method of characteristics for semi-linear, quasi-linear and nonlinear partial differential equations of first order PDEs, complete integrals of special nonlinear equations.

MODULE-2: The method of characteristics, the Cauchy problem of second order PDEs, Classification of second-order linear partial differential equations-Canonical forms for hyperbolic, parabolic and elliptic PDEs. Homogeneous and non-homogeneous PDEs with constant coefficients-Variable coefficients-Monge's method-Variational principles-Euler Lagrange equations, weak generalized solution, Linear differential operator and its adjoint operator

MODULE-3: Laplace equation-Boundary value problems–method of separation of variables and transforms. Dirchlet's and Neumann's problems for a rectangle and for a circle-Solution in cylindrical and spherical polar coordinates-Green's function method.

MODULE-4: The Wave Equation-Solution by the method of separation of variables and transforms, Φ-solutions in cylindrical and spherical polar coordinates-Green's function method. The Cauchy problem of hyperbolic Partial differential equation by Riemann Green method.

MODULE-5: The Diffusion equation-Solution by separation of variables and transforms-Duhamel's principle-Solution in cylindrical and spherical polar coordinates-Green's function method.

MODULE-6: Solution of non-linear PDE's successive approximation method, similarity methods and solution and simple special techniques for nonlinear PDEs.

REFERENCE

1. F. John, (1971) Partial differential equations, Springer.
2. F. Treves, (1975) Basic linear partial differential equations, Academic Press.
3. Garabedian, Partial Differential equations
4. L.C.Evans, Partial Differential equations AMS (American Mathematical Society), Providence Rhode Island
5. I.N. Sneddon, (1957) Elements of Partial Differential Equations, McGraw Hill.
6. M.G. Smith, (1967) Introduction to the theory of partial differential equations, Van Nastrand.
7. Shankar Rao, Partial Differential Equations, PHI
8. L.Debnath, (1997) Nonlinear Partial Differential Equations for Scientists and Engineers Birk Hauser, Baston and Bartin.

MSM 2.6: Programming Lab-II

(Max marks 50. Credits- 02)

Practicals lab based on MATLAB PROGRAMMING

THIRD SEMESTER

MSM 3.1: Measure Theory

(Max marks 70+25=100. Credits- 05)

MODULE-1: Lebesge Measure: Outer measure, measurable sets and Lebesgue measure, a non- measurable set, measurable functions, Littlewood's three principles.

MODULE-2: Lebesge Integral: The Riemann integral, The Lebesgue of a bounded function over a set of finite measure, the integral of a non-negative function, the general Lebesgue integral, convergence in measure.

MODULE-3: Differentiation and Integration: Differentiation of monotone functions, functions of bounded variation, differentiation of an integral, absolute continuity, convex functions.

MODULE-3: The Classical Banach Spaces: L^p spaces, the Holder and Minkowski inequalities, convergence and completeness, bounded linear functions on the L^p spaces.

References:

1. H.L.Royden, Real Analysis, Macmillian Library Reference, 2nd Edition, New York (1963)
2. G. De Barra, Measure Theory & Integration, Wiley Eastern Ltd, UK. (1981)
3. P. K. Jain & V. P. Gupta, Lebesue Measure and Integration, Wiley Eastern Ltd., (1986)
4. I. K. Rana, An Introduction to Measure and Integration, Narosa Publishing House (1997)

MSM 3.2: TOPOLOGY-II

(Max marks 75+25=100. Credits-05)

MODULE-1: Separation Axioms: Regular and T_3 spaces, normal and T_4 spaces, Urysohn's lemma, Tietze's extention theorem, Completely regular spaces, Tychonoff's spaces, Completely normal spaces and T_5 spaces.

MODULE-2: Countability Axioms: First countable spaces, second countable spaces, Lindeloff Spaces, separable spaces, countably compact spaces, limit point compact spaces.

MODULE-3: Metric Spaces and Metrizabilty: Separation and countability axioms in metric spaces, convergence in metric spaces, complete metric spaces, Urysohn's Metrisation theorem, Bing's Metrisation theorem, Nagata-Smirnov Metrisation theorem.

MODULE-4: Product Spaces: Arbitrary product spaces, product invariance of separation and countability axioms. Tychonoff's theorem, product invariance of connected ness.

MODULE-5: Algebraic Topology: Homotopy of paths, covering spaces, fundamental group of circles, retractions and fixed points, fundamental theorem of algebra.

References:

1. J.R.Munkres,(1974) A First Course in Topology, Prentice Hall college Div., USA.
2. S.Willard, (1970) General Topology, Addison wesley publishing company, Massachusetts.
3. M.J.Greenberg and J.R.Harper, (1981) Algebraic Topology, A First Course, Benjamin/cummings publishing company, London.
4. James Dugudji, (1966), Topology, Allyn and Bacon, William C Brown Pub., Boston
5. W.J.Pervin, (1964) Foundations of General Topology, Academic Press,
6. J.L.Kelley, (1955) General Topology, D.Van Nostrand Company, Springer-verlag, Newyork. :
7. S.Lipschutz, (1965) Theory and Problems of General Topology, Schaum Publishing Company.

MSM 3.3: NUMERICAL ANALYSIS
(Max marks 75+25=100. Credits:04)

MODULE-1: ERROR ANALYSIS: Aim of numerical analysis, error analysis, propagation of errors.

MODULE-2: THEORY OF ITERATIVE METHODS; Fixed point theorem in metric spaces, Orders of convergence, Approximate methods for nonlinear equations, Solution of algebraic & Transcendental equations, Newton Raphson method, Secant method, Aitken's method, Sturm Sequences, Sturm Sequences, Bairstow's method.

MODULE-3: SOLUTIONS OF LINEAR SYSTEM OF EQUATIONS: Gauss pivotal methods, Gauss-Jordan method, Jacobi & Gauss-Seidel methods, Over relaxation method, Convergence Analysis of these Iteration Methods. Eigen Values and Eigen Vectors, Power method, Inverse Power method.

MODULE-4: INTERPOLATION THEORY: Polynomial interpolation Lagrange, Hermite interpolations, Uniform interpolation, Inverse interpolation, Convergence Analysis, Least square approximation (Both for Discrete data and Continuous function), Curve fitting. Spline approximation, Cubic splines, Existence, Uniqueness, Best approximation property, Application to curve fitting.

MODULE-5: NUMERICAL SOLUTION OF O.D.E: Runge-Kutta methods, Predictor-Corrector methods, Quassilinearization methods, Solution of boundary value problems by method by, Finite difference methods and Shooting Method.

MODULE-6: NUMERICAL SOLUTION OF P.D.E: Numerical solutions of Partial differential equations; Solutions of Parabolic, Hyperbolic and elliptic equations using Finite difference method.

References:

1. A. Ralston, (1965) A First Course in Numerical Analysis, McGraw-Hill, New York. (Suggested Text Book)
2. E.K. Blum, (1972) Numerical Analysis & Computation, Addison-wesley, USA.
3. P. Henrici, (1964) Elements of Numerical Analysis, John wiley and sons, New York.
4. F.R.Hindebrand, (1956) Introduction to Numerical Analysis, McGraw-Hill, New York.
5. F.Szidarovszky and S.Yakowitz, (1978) Principles & Procedures of Numerical Analysis, Plenum Press, New York.
6. M.K. Jain, Numerical Solution to Differential Equations, Wiley Eastern (1990)

MSM 3.4: DIFFERENTIAL GEOMETRY

(Max marks 70+25=100. Credits-04)

MODULE-1: Calculus on Euclidean Space: Introduction, Euclidean space, Tangent Vectors, Vector field, Directional derivatives, Curves in R^3.

MODULE-2: Differential Forms: 1-Forms, Differential forms, Mappings on Euclidean spaces, Derivative map, Dot product on R^3, Dot product of tangent vectors, Frame at a point.

MODULE-3: Surfaces in R^3: Calculus on a Surface, Cross product of tangent vectors, Curves in R^3, Arc length, Reparametrization, The Frenet formulas, Frenet frame field, Curvature and Torsion of a unit speed curve.

MODULE-4: Frame Fields: Arbitrary speed curves, Frenet formulas for arbitrary speed curve, Covariant derivatives, Frame field on R^3, Connection forms of a frame field, Cartan's structural equations.

MODULE-5: Calculus on a Surface: Calculus on a Surface, Co-ordinate patch, Proper patch, Surface in R^3, Monge Patch, Patch computations, Parameterization of a cylinder, Differentiable functions and tangent vectors, Tangent of a Surface, Tangent plane, Vector field, Tangent and Normal Vector field on a Surface, Mapping of surfaces, Topological properties of Surfaces, Manifolds.

MODULE-6: Shape operators: Definition of Shape Operator, Normal curvature, Gaussian curvature, Computational techniques, Special curves in Surfaces.

References:

1. Barret O'Neil, (1966) Elementary Differential Geometry, Academic Press, NewYork.
2. T.J. Willmore, (1959) An introduction to Differential Geometry, Clarendon Press in Oxford.
3. Nirmal Prakash, (1981) Differential Geometry – An Integrated approach, Tata McGraw-Hill Pub. Co. Ltd, NewDelhi.
4. Y. Matsushima, (1972) An Introduction to Differential Manifolds, Marcel Dekkar Inc., New York.

MSM 3.5: FLUID MECHANICS
(Max marks 75+25=100. Credits-04)

MODULE-1: Motion of in viscid fluids: Pressure at a point in a fluid at rest and that in motion, Euler's equation on motion, Barotropic flows, Bernoullis equations in standard forms, Illustrative examples thereon, Vortex motion, Circulation, Kelvin's circulation theorem, Helmhotz Vorticity equation, Performance in Vorticity and Circulation, Kelvin's Minimum Energy Theorem, Illustrative examples.

MODULE-2: Two Dimensional flows of in viscid fluids: Meaning of two dimensional flows and Examples, Stream function, Complex potential, Line Sources and Line Sinks, Line Doublets and Line Vortices, Milne Thomson circle theorem and Applications, Blasius theorem and Applications.

MODULE-3: Motion of Viscous fluids: Stress tensor of viscous fluid flow, Stoke's law, Navier stoke's equation, Simple exact solutions of the Navier-Stoke's equation, Standard applications, **i)** Plane Poiseuille and Hagen Poiscuile flows **ii)** Couette flow **iii)** Steady flow between concentric cylinders **iv)** Beltrami flows **v)** Unsteady flow near an oscillating plate **vi)** Slow and steady flow past a rigid sphere and cylinder. Diffusion of Vorticity, Energy dissipation due to Viscosity, Dimensional analysis (Brief discussion), Reynolds number, Laminar and Turbulent flows, Examples of flow at low and high Reynolds number, Brief discussion of boundary layer theory with illustrative examples.

MODULE-4: Gas Dynamics: Compressible fluid flows, Standard forms of equations of State, Speed of sound in a gas, Equations of motion of Non-Viscous and Viscous Compressible flows, Subsonic, Sonic and supersonic flows, Isentropic flows, Gas Dynamical Equations, Illustrative examples.

References:

1. F.Chorlton, (1967), A text book of Fluid Dynamics, D.Van Nostrand Company.
2. L.M.Milne-Thomson, (1969) Theoretical Hydrodynamics, The Macmillan Company, USA.
3. S.W.Yuan, (1976) Foundations of Fluid Mechanics, Prentice hall of India Pvt. Ltd., NewDelhi.
4. D.S. Chandrashekharaiah & L.Debnath, (1994) Continuum Mechanics, Academic Press.

MSM 3.6: PROGRAMMING LAB - III

(Max marks 50. Credits 02)

Practicals lab based on MSM-3.3 using C-programming language.

FOURTH SEMESTER

MSM-4.1: RIEMANNIAN GEOMETRY

(Max marks 75+25=100. Credits 05)

MODULE-1: Differential Manifolds: Manifolds, Topology of manifolds, Smooth functions – Tangent, Vectors, Diff, maps, Jacobian of derivative map, Vector fields, Curves and Integral curves, Standard connections on R^n

MODULE-2: Reimannain Manifolds: Riemannian metric, Riemannian connection, Fundamental theorem of Riemannian geometry, Curvature and Torsion tensors, Bianchi identities, Sectional curvature, Space of constant curvature, Curves and Geodesics in Riemannian manifolds.

MODULE-3: Hypersurface of R^n: - Gauss map, Weingarten map, Equations of Gauss and Codazzi.

MODULE-4: Tensors & Forms, Exterior derivative, Contraction, Lie derivative, General covariant derivative, Schur's theorem, One parameter group of transformations, Complex vector field.

References:

1. Barret O'Neil, (1966) Elementary Differential Geometry, Academic Press, NewYork.
2. N.J. Hicks, (1965) Notes on Differential Geometry, Van Nostrand
3. Y. Matsushima, (1972) An Introduction to Differential Manifolds, Marcel Dekkar Inc., New York.
4. Nirmal Prakash, (1981) Differential Geometry – An Integrated approach, Tata McGraw-Hill Pub. Co. Ltd, NewDelhi.
5. W.M. Boothby, (1986) An Introduction t Differential Manifolds and Reimannian Geometry, 2nd Edition, Academic Press. :.

MSM 4.2: GRAPH THEORY
(Max marks 75+25=100. Credits :04)

MODULE-1: Factorization – 1-factorization, 2-factorization, Decomposition and labeling of Graphs.
Coverings: Vertex covering, edge covering, independence number and matchings and matching polynomials.

MODULE -2: Planarity: Planar graphs, outerplanar graphs, Kuratowaski criterion for planarity and Eulers polyhedron formula.
Graph valued functions: Line graphs, subdivision graph and total graphs.

MODULE -3: Colorings: Chromatic numbers and chromatic polynomials.
Spectra of Graphs: Adjacency matrix, incidence matrix, characteristic polynomials, eigen values, graph parameters, strongly regular graphs and Friendship Theorem.

MODULE -4: Groups and Graphs: Automormphism group of a graph, operation on permutation graphs, the group of a composite graphs.
Domination: Dominating sets, domination number, domatic number and its bounds, independent domination of a number of a graph, other domination parameters.
Theory of External graphs and Ramsey Theory.

REFERENCES

1. M.Behzad, G.Charatrand and L.Lesniak-Foster: Graphs and Diagraphs, Wadsworth, Belmont, Calif (1981)
2. Narasing Deo: Graph Theory with Applications to Engineering and Computer Science, Prentice Hall, India (1995)
3. J.A. Bondy and V.S.R.Murthy: Graph theory with Applications, MacMillan, London.
4. F.Buckley and F. Harary: Distance in Graphs, Addison-Wesley(1990)
5. Diestel: Graph Theory, Springer-Verlag, Berlin.
6. R. Gould: Graph Theory, The Benjamin / Cumming Publ.Co.Inc.Calif(1988)
7. F.Harary: Graph Theory, Addison Wesley, Reading mass(1969)
8. O.ore: Theory of Graphs, Amer-Maths. Soc. Collg. Publ.-38, providence(1962)
9. D.Cvetkovic, M. Doob and H. Sachs, Spectra in Graphs, Academic Press, New York (1980)
10. Tulasiraman and M.N.S. Swamy: Graphs, Networks and Algorithms, John Wiley (1989)
11. Bela Bollobas, Modern Graph Theory, Springer (1998)
12. Reinhard Diestel, Graph Theory, 2nd Edition, Springer (2000)

MSM 4.3: FUNCTIONAL ANALYSIS

(Max marks 75+25=100. Credits :04)

MODULE-1: A Review of metric topology, Completeness, Contraction Mapping Theorem, Arzeia – Ascolis Theorem and Baire Category Theorem and their Applications.

MODULE-2: Normed linear spaces, Hahn-Banach Theorem, Banach spaces, Open mapping and Closed Graph Theorem, Uniform Boundedness Principles.

MODULE-3: Hilbert spaces, Orthogonal Projections, Riesz Lemma, Orthogonal and Orthonormal systems, Riesz representation theorem, Bounded linear operators on Hilbert spaces, Normal and self adjoint operations, Spectral theory for self adjoint and normal operations.

References:

1. G.F.Simmons, (1963) Introduction to Topology & Modern Analysis, McGraw-Hill.
2. Goffman & Pedrick, (1965) First Course in Functional Analysis, Prentice-Hall, USA.
3. A.E. Taylor & D.C. Lay, (1958) Introduction to Functional Analysis, John and Willey & sons, US :
4. Walter Rudin, (1973) Functional Analysis, McGraw-Hill Education, New York.

MSM 4.4: MAGNETOHYDRODYNAMICS

(Max marks 75+25=100. Credits :05)

MODULE-1: Electrodynamics: Outline of electromagnetic MODULEs and Electrostatics, Derivations of Gauss Law, Faraday's Law, Ampere's Law and Solenoidal property, Dielectric material, Conservation of charges, Electromagnetic boundary conditions.

MODULE-2: Basic Equations: Outline of Basic equations of MHD, Magnetic Induction equation, Lorentz force, MHD approximations, Non-dimensional numbers, Velocity, Temperature and Magnetic field boundary conditions.

MODULE-3: Exact Solutions: Hartmann flow, isothermal boundary conditions, Temperature distribution in Hartmann flow, Hartmann-Couette flow.

MODULE-4: Applications: Concepts in Magnetostatics, Classical MHD and Alfven waves, Alfven theorem, Frozen-n-phenomena and equipartition of energy by Alfven waves.

References:

1. V.C.A.Ferraro and Plumpton, (1961) An Introduction to Magnetofluid Mechanics, Oxford university Press, USA.
2. P.H.Roberts, (1967) An Introduction to Magnetohydrodynamics, American Elsevier Pub. Comp., New York.
3. Allen Jeffrey, (1966) Magnetohydrodynamics, Oliver and Boyd, New York.

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MSM 4.5: OPERATIONS RESEARCH

(Max marks 75+25=100. Credits :04)

MODULE-1: Linear Programming: Introduction, Formulation of LPP, General mathematical model of LPP. Slack and Surplus variables, Canonical and Standard form of LPP, Graphical method, Standard LPP and Basic solution, Fundamental Theorem of LPP, Simplex Algorithm, Big-M method and Revised Simplex Algorithm.

MODULE-2: Concept of duality: Formulation of dual LPP, Duality theorem, Advantages of duality, Dual Simplex Algorithm and Sensitivity Analysis.

MODULE-3: Transportation Problem: Introduction, Transportation Problem, Loops in Transportation Table, Methods for finding initial basic Feasible Solution, Tests for Optimality, Unbounded Transportation Problem.

MODULE-4: Assignment problem: Mathematical form of the Assignment Problem, Methods of solving Assignment Problem, Variations of the Assignment Problem.

MODULE-5: Game Theory: Introduction, 2x2 Game, Solution of Game, Network Analysis by Linear Programming, Brow's Algorithm. Shortest route and Maximal flow Problems, CPM and PERT.

MODULE-6: Queuing Theory: Introduction to Stochastic Process, Markov chain, t.p.m., c-k equations, Poisson process, Birth and Death process, Concept of queues, Kendall's notation, m/m/1, m/m/s queues and their variants.

References:

1. H.A.Taha, (1982) Operations Research- An introduction, 8th Edition, Prentice Hall or Pearson Education. NJ.
2. B.E.Gillet, (1976), Introduction to Operations Research , Tata Mc Grow Hill publishing Co. Ltd. New York.
3. F.S. Hiller & G.J. Leibermann, (1967) Introduction to Operations Research, Holden-Day, San Francisco.
4. J.K. Sharma, (2007) Operations Research Theory and Applications, Third Edition, Macmilan Indian Limited, New Delhi.

PROJECT

MSM 4.6: PROJECT WORK

(Max marks 40+10=50. Credits-02)

Dissertation-40+ Viva-Voce-10

QUESTION PAPER PATTERN

For all the theory papers of all the semesters :

- **Total EIGHT questions covering the syllabus.**
- **Each questions Carrying 15 marks.**
- **Answer any five full Questions.**
- **Maximum Marks 75**
- **Duration 3 hours.**

ELECTIVE

INTERDISCIPLINARY PAPER

STATISTICAL TECHNIQUES

(Max marks 40+10=50. Credits 02)

MODULE-1: Probability: Random experiment, Sample space and events, Axioms of probability, Conditional probability and independence, Addition, Multiplication and Bay's theorem, Concept of rays expectation and covraiance.

MODULE-2: Statistical Methods: Preparation of frequency tables, Computation of Means, Variances, Co-variances and Coefficients, Rank correlation & regression, Tests of significance, Chi-square test for good of fit.

MODULE-3: Interpolation: Errors; finite difference operators; Newton's forward and backward interpolation formulae, Lagrange's interpolation formula, curve fitting by least-square approximation.

MODULE-4: Numerical differentiation and Integration: Finite difference formulae for differentiation, Trapezoidal and Simpson's rules of integration.

MODULE-5: Solutions of System of Linear Algebraic equations: Solution of system of linear algebraic equation by direct and iterative methods: Gauss elimination, LU decomposition, Gauss-Jordan, Cholesky, Jacobi, Gauss-Seidel, SOR methods, Eigen values and Eigen vectors by power methods.

References:

1. M.K.Jain, S.R.K.Iynger, R.K. Jain, (1996) Numerical method for Scientists and Engineer, 3rd edition, New Age International Pvt Ltd Publishers.
2. S.S.Sastry, (2004) Introductory methods of Numerical Analysis, Third Edition, Prentice Hall of India Pvt., Ltd., Delhi.
3. H.A.Taha, (1982) Operations Research- An introduction, 8th Edition, Prentice Hall or Pearson Education. NJ.
4. J.K. Sharma, (2007) Operations Research Theory and Applications, Third Edition, Macmilan Indian Limited, New Delhi.