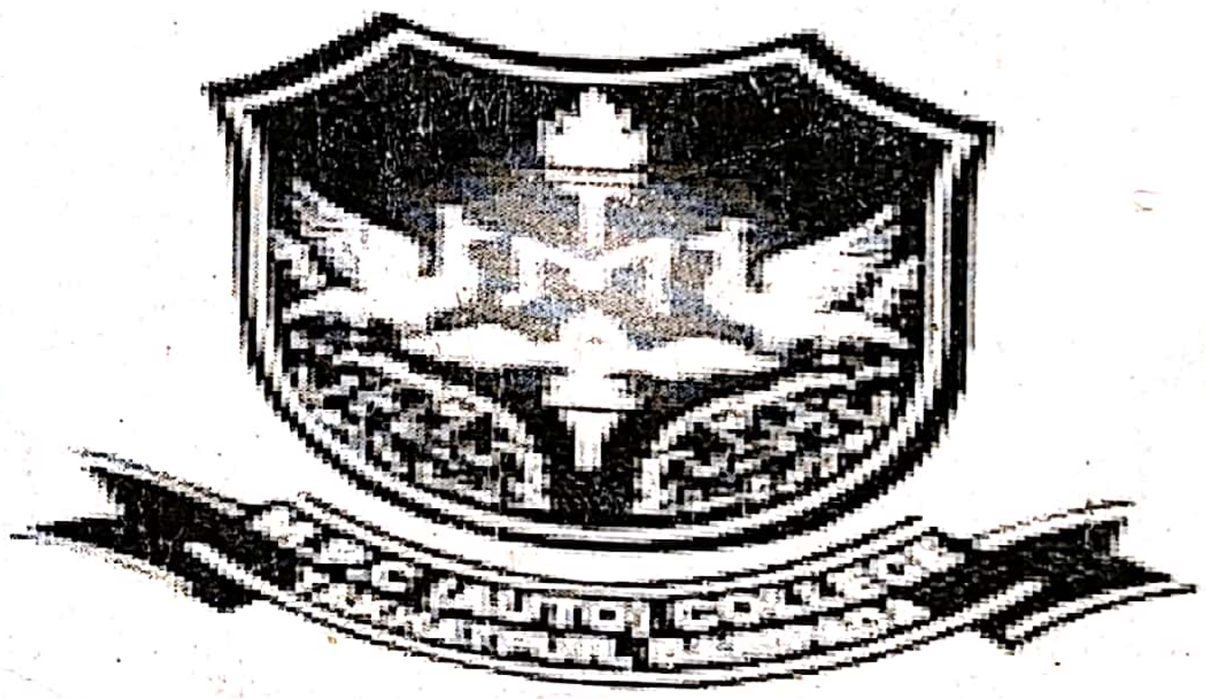
COURSES OF STUDIES

(CBCS PATTERN)

M.SC./ M.A. IN MATHEMATICS



P.G. DEPARTMENT OF MATHEMATICS

M.P.C AUTONOMOUS COLLEGE

TAKHATPUR, BARIPADA

P.G DEPARTMENT OF MATHEMATICS
M.P.C AUTONOMOUS COLLEGE, TAKHATPUR, BARIPADA
M.SC / M.A MATHEMATICS- COURSE STRUCTURE UNDER CBCS
(FOR THE ACADEMIC YEAR 2018-19 ONWARDS)

SEM- I	PAPER NO.	COURSE TITLE	CREDIT	EXAM HRS	MARKS		TOTAL
					MID TERM	END TERM	
	MT-CC-101	Real Analysis	4	3	20	80	100
	MT-CC-102	Complex Analysis	4	3	20	80	100
	MT-CC-103	Graph Theory	4	3	20	80	100
	MT-CC-104	Differential Equation	4	3	20	80	100
	MT-CC-105	Practical on C-Programming	6	6	--	100	100
	Total		**22**		**80**	**420**	**500**
SEM- II	MT-CC-201	Topology	4	**3**	20	80	100
	MT-CC-202	Numerical Analysis	4	3	20	80	100
	MT-CC-203	Discrete Mathematics	4	3	20	80	100
	MT-CC-204	Linear Algebra	4	3	20	80	100
	MT-CC-205	Practical on C-Programming	6	6	--	100	100
	Total		**22**		**80**	**420**	**500**
SEM- III	MT-CC-301	Functional Analysis	4	3	20	80	100
	MT-CC-302	Abstract Algebra	4	3	20	80	100
	MT-CC-303	Operation Research	4	3	20	80	100
	MT-CC-304	Practical on C++ Programming	6	6	--	100	100
	MT-OEC-305	Basic Mathematics	4	4	--	100	100
	Total		**22**		**60**	**440**	**500**
SEM- IV	MT-CC-401	Probability & Statistics	4	3	20	80	100
	MT-CC-402	Measure Theory	4	3	20	80	100
	MT-DEC-403-A OR MT-DEC-403-B	Fuzzy Logic & Set Theory OR Numerical Solution to ODE & PDE	4	3	20	80	100
	MT-DEC-404-A OR MT-DEC-404-B	Nonlinear Functional Analysis Number Theory. OR Design & Analysis of Algorithm	4	3	20	80	100
	MT-DC-405	Dissertation, Presentation & Viva	6	6	--	100	100
	Total		**22**		**80**	**420**	**500**

SEMESTER-I

PAPER:MT-CC-101

REAL ANALYSIS

Time: 3 Hrs. FM:100 $\begin{pmatrix} \text{Mid Sem(Written Test)} = 20 \\ End\ Sem = 80 \end{pmatrix}$

Unit-I: Metric spaces: Open sets, Closed sets, Continuous functions, Completeness, Cantor intersection theorem, Baire category theorem, Compactness, Totally boundedness, Finite intersection property.

Unit-II: Riemann-Stieitjes integral: Definition and existence of the integral, Properties of the integral, Differentiation and integration.

Unit-III: Sequence and Series of functions: Uniform convergence, Uniform-Convergence and continuity, Uniform convergence and integration.

Unit-IV: Uniform convergence and differentiation: Equicontinuity, Ascoli's Theorem, Weierstrass approximation theorem.

Books Recommended:

1. Apostol T. Mathematical Analysis, Narosa Publishers
2. Rudin W. Principle of Mathematical Analysis, McGraw-Hill

Books for Reference:

1. H.L. Royden: Real Analysis (Third Edition, Prentice-Hall of India)
2. Hewitt E. and Stomberg K. Real and Abstract Analysis: A Modern Treatment of the Theory of Functions of a Real variable, Springer
3. K.Ross K. Elementary Analysis: The Theory of Calculus, Springer

PAPER:MT-CC-102

COMPLEX ANALYSIS

Time: 3 Hrs

FM:100 $\begin{pmatrix} \textbf{Mid Sem(Viva voce)} = 20 \\ \\ \textit{End Sem} = 80 \end{pmatrix}$

Unit- I: Mobius transformations, Cross ratio; Complex integration: Power-series representation of analytic functions, Zeros of analytic functions.

Unit-II: Cauchy theorem and integral formula, The index of a point with respectto a closed curve, the general form of Cauchy's theorem.

Unit-III: Open Mapping Theorem; Classification of singularities: Residuetheorem and applications.

Unit-IV: The Argument Principle: The Maximum modulus Principle; Schwarz's lemma; Phragmen-Lindelof Theorem.

Books Recommended:

1. R. V. Churchill and J.W. Brown: Complex Variables and Applications (Fifth Edition, McGraw- Hill Publishing Company, 1990).
2. AhlforsL.V. : Complex Analysis, McGraw Hill.

Books for Reference:

1. J.B. Conway: Function of Complex Variable(Springer-Verlag, International Student Edition, Narasa Publishing House-1980)
2. RudinW. : Real and Complex analysis, McGraw-Hill Book Co

PAPER: MT-CC-103

GRAPH THOERY

Time: 3 Hrs

FM:100 $\begin{pmatrix} \textbf{Mid Sem(Written Test)} = 20 \\ \\ \textit{End Sem} = 80 \end{pmatrix}$

Unit-I: Graphs, Basic concepts, Different types of Graphs, Incidence and degree of a graph, Isolated and Pedant vertex, Isomorphism, Subgraphs. Walk, path and circuit of a graph, Cutsets, cut vertices, plannar graph, Euler formula, Hamiltonian paths and Circuits.

Unit-II: Chromatic numbers, Incidence matrix, Adjacent matrix, Directed graphs, Types of diagraphs, Adjacency matrix of digraphs.

Unit-III: Trees and Properties, Rooted trees, Binary trees, Spanning trees, prime's &kruskal's algorithm, minimal tree, Directed trees.

Unit-IV: Enumeration of graphs, Signal flow graphs, **Network flows:** Graphs as models of flow of commodities, Flows, Maximal flows and Minimal cuts, Max-flow, Min-cut theorem.

Books Recommended:

1. C. Vasudev: Graph Theory with Applications, New Age International Publishers, New Delhi
2. NarsinghDeo: Graph Theory with Applications to Engineering and Computer science, Prentice-Hall of India

Books for Reference:

1. J.P. Tremblay, R. Manohar: Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw-Hill Edn.
2. Y.N. Singh: Mathematical Foundation of Computer Science, New Age International Publishers

PAPER:MT-CC-104

DIFFERENTIAL EQUATIONS

Time: 3Hrs FM:100 $\begin{pmatrix} \textbf{Mid Sem(Seminar)} = 20 \\ \\ \boldsymbol{End\ Sem} = 80 \end{pmatrix}$

Unit-I: Ordinary differential equation-first order equation, Picard's theorem(existence & uniqueness of solution to first order ordinary differential equation). Application of first order equation to physical problems.

Unit-II: Systems of first order differential equations, equations with regular Singular points, stability of linear systems, Introduction to power Series solutions.

Unit-III: Special ordinary differential equations arising in physics and some Special functions(e.g. Bessel's functions, Legendre polynomials, Gamma functions) and their orthogonality.

Unit-IV: Oscillations- Sturm Liouville theory, Greens function in BoundaryValue problems.

Books Recommended:

1. Coddington E. A. : An Introduction to Ordinary Differential Equations, Prentice Hall
2. Differential Equations, Tata McGraw HillseymourLipschutz: Schaum's outline of Theory and Problems of Data Structure.
3. J. Sinharoy and S. Padhy: A Course on Ordinary and Partial Differential Equations, Kaliyani Publishers.

Books for Reference:

1. Hsieh P.F. and Sibuya Y. Basic Theory of Ordinary Differential Equations, UTX, Springer
2. Ross S.L. Differential Equations, Wiley
3. Apostol T. Calculus, Volume II, John Wiley & Sons{ASIA} Pvt Ltd
4. Deo S.G., Lakshmikantham V. and Raghavendra V. Textbook of Ordinary Differential Equations, Tata-McGraw-Hill Publishing Co.Ltd

PAPER:MT-CC-105

COMPUTER PROGRAMMING LAB.-C LANGUAGE

Full Marks:100 **Time: 6 Hrs**

Experiment-60, Viva-Voce-20, Record-20

1. Implement the following by using C
   - i. Compute the factorial of a given number using do while loop & recursion.
   - ii. Write a program to find the sum of n natural number.
   - iii. Write a program to arrange the number in ascending and descending order.
   - iv. Write a program to generate Fibonacci sequence.
   - v. Write a program to solve the quadratic equation ax^2 + bx +c=0
   - vi. Write a program to implement the structure
   - vii. Write a program to implement nested structure
   - viii. Write a program to manipulate pointer
   - ix. Write a program to compute the series like 1 +1/2 +1/3 +.....+1/n etc.
   - x. Write a program to implement storage classes
   - xi. Write a program to implement call by address & call by value

Books Recommended:

1. Byron Gottfried: Programming with C(Schaum's Outline), 2nd Edn, Tata McGraw-Hill Publishing Company Ltd, New Delhi
2. E. Balagurusamy: Programming in ANCI C, Tata McGraw-Hill Publishing Company Ltd, New Delhi

SEMESTER-II

PAPER:MT-CC-201

TOPOLOGY

Time: 3 Hrs **FM:100** $\begin{pmatrix} \textbf{Mid Sem(Written Test)} = 20 \\ \\ \textbf{End Sem} = 80 \end{pmatrix}$

Unit-I: Infinite sets, The axioms of choice, Well-Ordered sets, Topological spaces, Basis and Sub basis for a topology, The order, Product and Subspace topology, Closed sets and Limit points.

Unit-II: Continuous functions and Homomorphism, Metric topology, Product Topology, Connected spaces, Connected sets in real line, Components &Local connectedness.

Unit-III: Compact spaces, Compact sets in real line, Limit point compactness,Local compactness.

Unit-IV: The Countability Axioms, The separation axioms, Normal spaces. The Urysohn Lemma, the Urysohn metrization theorem. The Tychonoff theorem.

Books Recommended:

1. J. R. Munkress: Topology , A first course (Prentice Hill of India, Pvt. Ltd. 2000)

Books for Reference:

1. K.D. Joshi: Introduction to General Topology, Wiley Easter Ltd. 1983
2. W. J. Pervin: Foundation of General Topology, Academic Press, 1964
3. S. Nanda and S. Nanda: General Toplogy, Mac-millan, India

PAPER:MT-CC-202

NUMERICAL ANALYSIS

Time: 3 Hrs

FM:100 $\begin{pmatrix} \text{Mid Sem(Assignment)} = 20 \\ End\ Sem = 80 \end{pmatrix}$

Unit-I: Solutions of equations one and two variables: Fixed point iteration method. Accelerating of convergence, Zeros of polynomials and Muller's method. Newton's method

Unit-II: Interpolation: Hermite interpolation, Cubic spline interpolation, Parametric Curves, Least square approximation, Discrete L. S. approximation, Orthogonal polynomials, Chebyshev polynomials and Economization, Rationalapproximation.

Unit-III: Numerical solution of ordinary differential equations- Picard's method, Taylor's series method, Euler's method, Modified Euler's method.

Unit-IV: Runge's method, Runge-Kutta method, Predictor- Corrector methods- Milne's method, Adams-Bashforth method.

Books Recommended:

1. Numerical Analysis (7^{th} Edition) by R. L. Burden and J. D. Faires (Books/ Cole. Thomson learning)
2. Methods of Numerical Integration (4^{th} Edition) by P. J. Davis and Rabinowitz (AP)
3. Introduction to Numerical Analysis by A.Z. Aitkason, Mc-Graw Hill
4. Introduction to Numerical Analysis by K E Atkinson, Wiley Students Edition

PAPER:MT-CC-203

Discrete Mathematics

Time: 3 Hrs

FM:100 $\begin{pmatrix} \textbf{Mid Sem(Written Test)} = 20 \\ \\ \textit{End Sem} = 80 \end{pmatrix}$

Unit-I: Graphs: Graphs and Graph models, Graph terminology and special type of graphs, representing graphs and Graph Isomorphism, Connectivity, Euler and Hamilton paths, Shortest path problems, Plannar graphs

Unit-II: Trees: Introduction to trees, Applications of trees, Tree traversal, Spanning trees, Prime's & Kruskal's algorithm, minimal spanning trees & Directed trees.

Unit-III: Boolean Algebra: Boolean functions, Representing Boolean functions, Logic gates, Minimization of Circuits

Unit-IV: Modelling computation: Languages and Grammers and Languages, Finite state machines with output, finite state machines with no output, Language recognition, Turing machines

Books Recommended

1. Discrete Mathematics and its Appklications, Kenneth H. Rosen, Tata Mc-Graw Hill Education private Limited, Seventh Edition (Indian adaptation by Kamala Krithivasan), 2012

Books for Reference

1. Discrete Mathematics structures with Application to Computer Science- J.P. Tremblay and R. Monohar
2. Discrete Mathematics for Computer Scientists and Mathematics by Joe L. Mott, AbrahamKandel and Theodore P. Baker(Prentice-Halia).

PAPER:MT-CC-204

LINEAR ALGEBRA

Time: 3 Hrs

FM:100 $\begin{pmatrix} \textbf{Mid Sem(Quiz)} = 20 \\ \\ \textit{End Sem} = 80 \end{pmatrix}$

Unit-I: Dual space, Finite dimensional vector space, Isomorphism of finite vector space, Annihilator, Linear transformation, Algebra of linear transformation, isomorphism of LT, Cauchy Hamilton theorem, Invertible LT, Singular LT, Characteristic roots.

Unit-II: Cannonical Forms: Triangular form,Triangular matrix,Nilpotent Transformation, Introduction to Rational Cannonical and Jordan Cannonical form, Trace and transpose.

Unit-III: Determinants and related theorems, Consistency of linear system of equations, Gauss Jordan method for finding the inverse, Caley- Hamilton theorem.

Unit-IV: Hermitian, Unitary and Normal transformations, Complex Matrices, Conjugate of a Matrix, Hermitian and Skew matrices, Unitary Matrix.

Books Recommended:

I.N Hersstein, Topics in Algebra, Wiley

Books for Reference:

1. K. Hoffman an R. Kunze, Linear Algebra, PHI, 1971
2. S. Roman, Advanced Linear Algebra, Springer, 2007

PAPER:MT-CC-205

COMPUTER PROGRAMMING LAB-C LANGUAGE

Full Marks: 100 **Time: 6 Hrs**

Experiment-60, Viva-Voce-20, Record-20

Implement the following by using C

i. Write a program for fitting of curves using Least square method .

ii. Write a program for fitting of curves using Newton's Forward interpolation method.

iii. Write a program for fitting of curves using Lagrange interpolation method.

iv. Write a program to solve the following equations using Gauss Elimination method

$2x+y+z=0$

$3x+2y+3z=0$

$x+4y+9z=0$

v. Write a program to solve the following equations using Gauss Jacobi method

$20x_1 +20x_2- 2x_3=17$

$3x_1 +20x_2 - x_3=-18$

$2x_1 - 3x_2+ 2x_3=25$

vi. Write a program to find an approximate value of y corresponding to x=0.1 , given that dy= f(x,y)=(1+xy), y=2 when x=0, h=0.1 using Euler's method.

vii. Write a program to find an approximate value of y corresponding to x=0.1 , given that $\frac{dy}{dx}$ = f(x,y)= x^2+y, y=1 when x=0, h=0.05 using modified Euler's method.

viii. Write a program to find an approximate value of y corresponding to x=0.4 , given that $\frac{dy}{dx}$ = f(x,y)= $1+y^2$, y=0 when x=0, h=0.2 using RungeKutta 4th order method.

ix. Write a program to implement RungeKutta 2nd order method of differential equation using C-File.

Books Recommended:

1. Byron Gottfried: Programming with C(Schaum's Outline), 2nd Edn, Tata McGraw-Hill Publishing Company Ltd, New Delhi
2. E. Balagurusamy: Programming in ANCI C, Tata McGraw-Hill Publishing Company Ltd, New Delhi

SEMESTER-III

PAPER:MT-CC-301

FUNCTIONAL ANALYSIS

Time: 3 Hrs **FM:100** $\begin{pmatrix} \textbf{Mid Sem(Written Test)} = 20 \\ \\ \textbf{End Sem} = 80 \end{pmatrix}$

Unit-I: Fundamental of normed spaces: Normed spaces, Examples, Continuity of linear maps, Equivalent norms, Hahn-Banach theorem for real line spaces, Banach spaces and examples, Quotient spaces.

Unit-II: Bouneded linear maps on Banach spaces: Uniform bounded principle, Open mapping theorems, Closed graph theorems, Spectrum of a bounded operator.

Jnit-III: Spaces of bounded linear functional: Dual and Transposes, Dual of Lp([a,b]) and :([a,b]), weak and weak* convergence, Reflexivity.

Jnit-IV: Geometry of Hilbert spaces: Inner product spaces, Hilbert spaces and Examples, rthogonal sets, Bessel's inequality, Complete Orthogonal sets and Preserval identity.

ooks Recommended

1. B. V. Limaye- Functional Analysis , New Age International Ltd(2nd Edn), 1995.
2. Erwin Kreyszig- Introductory Functional Analysis with applications.

PAPER-XII:MT-CC-302

ABSTACT ALGEBRA

Time: 3 Hrs

FM:100 $\begin{pmatrix} \textbf{Mid Sem(Quiz)} = 20 \\ \\ End\ Sem = 80 \end{pmatrix}$

Unit-I: Ring Theory: Definition and examples of Ring, Some special classes of ring, Homomorphisms, Ideals.

Unit-II: Quotient Rings, More Ideals and Quotient Rings, The field of Quotients of an Integral Domain, Euclidean rings, A particular Euclidean ring, Polynomial rings, Polynomials over the rational field.

Unit-III: Modules, Extension Fields, The Transcendence of e.

Unit-IV: Roots of Polynomials, More about Roots, The Elements of Galois Theory.

Books Recommended:

1. I. N. Herstein: Topics in Algebra, Vikas Publishing House Pvt. Ltd.
2. C. Musili: Introduction to Rings and Modules, Narosa.

Books for Reference:

1. Seymour Lipschutz: Theory and Problems of Linear Algebra, Scham's Outline Series: Mcraw-Hill Book Company.
2. David S. Dummit, Richard M. Foot: Abstract Algebra, Wiley Publication.

PAPER: MT-CC-303
OPERATION RESEARCH

Time: 3 Hrs

FM:100 $\begin{pmatrix} \textbf{Mid Sem(Written Test)} = 20 \\ \\ \textbf{End Sem} = 80 \end{pmatrix}$

Unit-I: Integer Programming: Fractional cut method-all integer, Fraction cut method-mixed integer, Branch and bound method. **Goal programming:** introduction, Formulation of linear goal programming problem, Graphical goal attainment method, simplex method for goal programming problem.

Unit-II: Revised simplex method, Transportation problem: Introduction, Soultion of TP(North-West Corner method, Least-Cost method, Vogel's Approximation method), Test for optimality, Degeneracy in TP, Transportation algorithm(MODI method).

Unit-III: Assignment problem, The travelling salesman problem, Sequencing problem: ntroduction, Processing n jobs through two machines, Processing two jobs through k nachines, **Games & Strategies:** Introduction, Two-person zero-sum games, The maximin-ninimax principle, Games without Saddle points-Mixed Strategies, Dominance Property.

Jnit-IV: Network scheduling by PERT/CPM: Introduction, Network and basic components, ogical sequencing, Rules of network construction, Critical path analysis, **Non-linear rogramming methods:** Introduction, General Non-linear Programming Problems, onstrained Optimization with Equality Constraints, Constrained Optimization with inequality onstraints.

ooks Recommended:

1. KantiSwarup, P. K. Gupta, Man Mohan: Operations Research, Sultan Chand & Sons Publishers, New Delhi

ooks for Reference:

1. M.e. Joshi and K.M. Moudgalya- Optimization Theory and Practice, Narosa Publishing House-2001
2. J.A. Suyman- Practical Mathematical Optimization, Springer-2005
3. S.D. Sharma: Operations Research, KedarNath Ram Nath& Co Publishers, Meerut

PAPER:MT-CC-304

COMPUTER PROGRAMMING LAB.- C++ LANGUAGE

Full Marks:100 **Time: 6 Hrs**

Experiment-60, Viva-voce-20, Record-20

Implement the following by using C++

i. Implementation of simple C++ programs
ii. Implementation of Classes, Friend functions, Static data members, Constructors, Destructors, Inheritances etc

Books Recommended:

1. E. Balagurusamy: Object-Oriented Programming with C++, 2nd edition, Tata McGraw-Hill Publishing Company Ltd

Books for Reference:

1. M.A Welss: Data Structure and Algorithm Analysis in C++, Reason Education,2000
2. S. B. Lippoman and J.Lamyoie: C++ primer-Klesley, 1998

PAPER:MT-OEC-305

Basic Mathematics

Time: 3 Hrs **Full Marks:100**

Unit-I: Sets: Sets and their representation: Empty set, Finite sets, Infinite sets, Equal sets, Subsets, Subsets of a set of real numbers, Power sets, Universal set, Venn diagram, Union and intersection of sets, difference of sets, Compliment of a sets, Problems based on sets.

Unit-II: Quadratic Equation: Solution of quadratic equation in real system. Sequence and Series: Sequence and series, Arithmetic progression(A.P), Arithmetic mean(A.M), Geometric Progression(G.P), General term of a G.P, Sum of nth term of a G.P, Arithmetic and Geometric series, Geometric mean(G.M), Harmonic mean(H.M).

Unit-III: Trigonometric Function: Sign of trigonometric function, Trigonometrical ratio,compound angle, multiple angle, submultiple angles, multiple and submultiple formulawith simple problems. **Trigonometric equation:** Principle solutions and general solutions, solutions of trigonometric equations.

Unit-IV: Determinants: Determinants, problem on determinants, minor and cofactors. **Matrices:** Matrices, type of matrices, operation on matrices, transpose of a matrices.

Books for Recommended:

1.Dhirendra Kumar Dalai: Text Book of mathematics, Kaliyani Publisher.

2.Elements of Mathematics, Vol. I

SEMESTER-IV

PAPER:MT-CC-401

PROBABILITY AND STATISTICS

Time: 3 Hrs

FM:100 $\begin{pmatrix} \text{Mid Sem(Written Test)} = 20 \\ End\ Sem = 80 \end{pmatrix}$

Unit-I: Random Variables: Function of Random variables, moments & generating function, Characteristic function, Multiple random variables, Independence random variables. **Discrete and continuous probability Distribution:** Introduction and Motivation, Discrete Uniform Distribution, Binormal, Negative Binormal and Poisson Distribution.

Unit-II: Continuous Uniform Distribution, Normal Distribution, Gamma and exponential Distributions, Covarience, correlation & moments, Conditional expectation.

Unit-III: Measures of Central Tendency, Measures of Dispersions, Measure of Skewness and Kurtosis, **Multivariate Analysis:** Correlation, Correlation Coefficients, Rank Correlation, Regression Analysis, Multiple Regression.

Unit-IV: Sampling Theory: Population and Sample, Sampling with and without Replacement, Random Samples, Population Parameters, Sample Statistics, Sampling Distributions, Sampling Distribution of Mean and Variance.

Books Recommended:

1. Ronald E. Walpole Sharon L. Myers, Keying Ye, " Probability and Statistics For. Engineers and Scientists", 8th Edition, Pearson Education.
2. J. N. Kapur, H.C. Saxena" Mathematical Statistics" S Chand.
3. Murray R Spiegel, John J Schiller, R AluSrinivsan, " Probability and Statistics" 3rd EditionSchaum's Out Lines.

Books for Reference:

1. ParimalMukhopadhyay, " Mathematical Statistic" Books and Allied(P) Ltd.
2. Robert V. Hogg and Allen T. Craig, " Introduction to Mathematical Statistics" Pearson Education Asia.

PAPER:MT-CC-402

MEASURE THEORY

Time: 3 Hrs **FM:100** $\begin{pmatrix} \textbf{Mid Sem(Written Test)} = 20 \\ \\ \boldsymbol{End\ Sem} = 80 \end{pmatrix}$

Unit-I: Lebesgue Measure: Measurable sets of Measure Zero, Lebesgue Outer Measure, The Sigma- Algebra of Lebesgue Measurable sets, Borel Set, Outer and Inner Approximation of Lebesgue Measurable Sets.

Unit-II: Lebesgue Measure: Countable additivity, Continuity and The Borel- Cantelli Lemma, Nonmeasurable sets, Lebesgue Measurable functions, Sums,Products and Compositions.

Unit-III: Lebesgue Measurable functions: Sequntial Pointwise Limits and Simple Approximation, Littlewood's Three Principles, Egoroff's Theorem and Lusin's Theorem.

Unit-IV: Lebesgue Integration: The Riemann Integral, The Lebesgue Integral of a bounded Measurable Function over a Set of Finite Measure, The bouneded Convergence Theorem, The Lebesgue Integral of a Measurable Nonnegative Function, Fatou's Lemma, The Monotone Convergence Theorem.

Books for Recommended:

Royden H. L. Real Analysis, Macmillan

Books for Reference:

1. De Barra G. Measure Theory an Integration, New Age International
2. Halmos P. R. Measure Theory, Graduate Text in Mathematics, Springer-Verlag
3. Cohn D. L. Measure Theory, Springer

PAPER:MT-DEC-403-A(ELECTIVE-I)

FUZZY LOGIC AND SET THEORY

FM:100 $\begin{pmatrix} \textbf{Mid Sem(Assignment)} = 20 \\ End\ Sem = 80 \end{pmatrix}$

Time: 3 Hrs

Unit-I: Introduction, Fuzzy sets, Representation methods of fuzzy set, Expansion of Fuzzy set.

Unit-II: Certain number associated with a fuzzy set: α-cut set of fuzzy set A, Strong α- Cut set A, Level Set, Properties of α-Cuts and Strong α-Cuts of fuzzy set A.

Unit-III: Certain Crisp Sets associated with a fuzzy set: Convex fuzzy set, Fuzzy number, Quasi fuzzy number, Triangular fuzzy number, Trapezoidal fuzzy number. **Standard operation of fuzzy set:** Complement of fuzzy set A, Union of fuzzy set A and B, intersection of fuzzy set A and B, Law of contradiction and of Excluded middle.

Unit-IV: The magnitude of fuzzy set: Scalar cardinality, Relative cardinality, Fuzzy cardinality, Subset, equality, empty set and largest fuzzy set, Fuzzy point.

Books Recommended:

1. H. J. Zimmermann, Fuzzy set theory and its applications, Kluwer academic Publishers, 1998.

OR

PAPER:MT-DEC-403-B

NUMERICAL SOLUTION TO ODE AND PDE

Time: 3 Hrs

FM:100 $\begin{pmatrix} \textbf{Mid Sem(Assignment)} = 20 \\ \\ \textit{End Sem} = 80 \end{pmatrix}$

Unit-I: Ordinary Differential equations(ODE): Solutioms of Initial Value Problems by Taylor Series, Euler, Improved Euler methods for First and Second order differential equations

Unit-II: Ordinary Differential Equations(ODE): Solutions of initial Value Problems, Modified Euler, Runge-Kutta methods for first and second order differential equations

Unit-III: Multistep method(Milne and Adams Bashforth), Consistency, stability and convergence aspects of the methods of IVP.

Unit-IV: Boundary Value Problems: Shooting and finite difference methods.

Books Recommended:

1. Smith G. D. Numerical Solutions to Partial Differential Equations, Oxford University Press
2. Jain M. K. and Iyengar S.R.K. Numerical methods for scientific and engineering computation

PAPER: MT-DEC-404-A(ELECTIVE-II)

NUMBER THEORY

Time: 3 Hrs

FM: 100(Mid sem(Viva voce)=20,End sem=80))

Unit-I: Arithmetical functions and Dirichlet Multiplication: Introduction, Mobius function $\mu(n)$, the Euler Totient function for $\phi(n)$. A relation connecting ϕ and μ. A product formula for $\phi(n)$ and $\mu(n)$. Dirichlet product of arithmetical functions. Dirichlet inverses and the Mobius inversion formula. Multipliactive functions.

Unit-II: Residue classes and Complete residue systems, Linear congruences, Congruences: Reduced residue systems and the Euler-Fermat theorem, Polynomial congruences modulo p, Lagrange's theorem, Applications of Lagrange's theorem.

Unit-III: Simultaneous linear congruences, The Chinese remainder theorem, Applications of Chinese remainder theorem, Polynomial congruence with prime power moduli.

Unit-IV: Periodic Arithmetical Function: functions periodic modulo k, existence of finite fourier series for arithmetic functional, Ramanujan sum and generalizations.

Books Recommended:

1. Tom M. Apostol: Introduction to Analytic Number Theory, Springer International, Norosa Publishing House.

Books for Reference:

1. Ramanujachanjkumanuri and Christina Romero: Number Theory with Computer Applications, Printice Hall, New Jery-1998
2. H. Delfs & H. Knebl- Introduction to Cryptography Principle and Application, Springr Verlag-2002
3. D. R. Stinson: Cryptography- Theory of Practice (3rd Edn) Chapman Hall/ Crc-2006

(Nrendra Kaur To be introduced)

PAPER:MT-DEC-404-A(ELECTIVE-II)

NONLINEAR FUNCTIONAL ANALYSIS

Time: 3 Hrs

FM:100 $\begin{pmatrix} \textbf{Mid Sem(Viva voce)} = 20 \\ \\ \textbf{End Sem} = 80 \end{pmatrix}$

Unit-I: Fixed point theory, Banach contraction mapping theorem, Contractive type mappings.

Unit-II: Generalization of Banach contraction mapping theorem, Fixed point theorem of other types.

Unit-III: Nonlinear operators, monotone, strictly monotone and strongly monotone operators, their properties and applications

Unit-IV: Bounded operators on Hilbert Spaces: Bounded operators and adjoints, Normal, Unitary and self-adjoint operators.

Books Recommended:

1. Zeidler E. Nonlinear Functional Analysis and its applications, Springer
2. Ambrosetti A., Arcoya D., Birkhauser. An introduction to Nonlinear Functional Analysis and Elliptic Problems.
3. B. V. Limaye: Functional Analysis, New Age International Ltd (2nd Edn), 1995

Number Theory paper introduced instead of Non-Linear Functional Analysis.

OR

PAPER:MT-DEC-404-B

DESIGN AND ANALYSIS OF ALGORITHMS

Time: 3 HrsFM:100 $\begin{pmatrix} \textbf{Mid Sem(Viva voce)} = 20 \\ \\ \textit{End Sem} = 80 \end{pmatrix}$

Unit-I: The role of algorithms in computing: Algorithms as a technology, **Running time of an algorithm:** Definition, Best case, Average case, Worst case running time of an algorithm. **Growth of functions:** Asymptotic notations, Standard notation and Common function.

Unit-II: Recurrences: The substitution method, The recursion-tree method, The master method. Insertion sort algorithm, **The divide and conquer approach:** Merge sort algorithm and its analysis.

Unit-III: Heap sort: Heaps, Maintaining the heap property, Building a heap, The heap sort algorithms and its analysis. **Quick sort:** Description of quick sort, Performance of quick sort, Analysis of quick sort.

Unit-IV: Sorting in linear time: Counting sort algorithm. **Dynamic programming:** Matrix chain multiplication algorithm, Longest common subsequence and its analysis.

Books Recommended:

1. Thomas H. Coreman, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein: Introduction to Algorithms (2nd Edition, Prentice Hall of India, New Delhi)

Books for Reference:

1. S. K. Basu: Design Methods & Analysis of Algorithm (Printice-Hall of India, New Delhi)

PAPER: MT-DC-405

Dissertation, Presentation& Viva

ull Marks: 100

Time: 6 Hrs

issertation-60, Presentation-20, Viva-Voce-20

opics

1. Algebra
2. Complex Analysis
3. Differential Equation
4. Numerical Analysis
5. Graph Theory