



(Non Grading)

S.No	Sub. Code	Sub. Name	Theory Max. Marks				Practical Max Marks		Total Marks
			End Sem.		Mid Sem./ Assignment Average of two				
			Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	
1	MSM101T	Advanced Abstract Algebra-I	85	28	15	05	-	-	100
2	MSM102T	Real Analysis	85	28	15	05	-	-	100
3	MSM103T	Topology -I	85	28	15	05	-	-	100
4	MSM104T	Complex Analysis-I	85	28	15	05	-	-	100
5	MSM105T	(Any one of the following) Differential Equation I	85	28	15	05	-	-	100
	MSM106T	Advanced Discrete Mathematics-I	85	28	15	05	-	-	100
	MSM107T	Programming in C-I	50	17	15	05	-	-	65
	MSM107P	Programming in C-I	-	-	-	-	35	12	100
Total Marks									500



Dr. A.P.J. Abdul Kalam University, Indore

Class: M.Sc. Mathematics

Semester: I

Subject: Mathematics –I

Title of Paper: Advanced Abstract Algebra-I (Compulsory Paper)

Unit I:

Normal and Subnormal series of groups, Composition Series, Jordan –Holder series.

Unit II:

Solvable and Nilpotent groups.

Unit III:

Extension field, Roots of polynomials, Algebraic and Transcendental Extension, splitting fields and normal extensions, separable extensions.

Unit IV:

Perfect field, Finite field, Primitive elements, Algebraically closed fields.

Unit:V

Automorphism of extension, Galois extension, Fundamental theorem of Galois theory, Solution of polynomial solvable by radicals, Insolvability of general equation of degree 5 by radicals.

Book Recommended:

1. I.N.Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.
2. V.Sahni & V. Bist. Algebra, Narosa Publishing House.

Reference Books:

- 1.N.Jacobson, Basic Algebra, vols I&II, W.H.Freeman,1980.
2. M.Artin, Algebra, Prentice - Hall of India, 1991.
3. S.Kumaresan, Linear Algebra, A Geometric Approach, Prentice - Hall of India, 2000.
4. D.S.Dummit & R.M.Foote, Abstract Algebra, II Ed, John Wiley & Sons, Inc, New York.
5. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul. Basic Abstract Algebra Cambridge University Press.



Dr. A.P.J. Abdul Kalam University, Indore

Class-M.Sc. Mathematics

Semester: I

Subject : Mathematics –II

Title of paper: Real Analysis (Compulsory Paper)

UNIT-I

Definition and existence of Riemann Stieltjes integral, properties of the integral, Integration and differentiation, The fundamental theorem of integral calculus, integration by parts, Integration of vector-valued functions, Rectifiable curves.

UNIT-II

Integration of vector –valued functions, Rectifiable curves, Rearrangement of terms of a series, Riemann's theorem.

UNIT-III

Point wise and uniform convergence, Cauchy criterion for uniform convergence ,Weirstrass M-test, Abel's test and Dirichlet's test for uniform convergence, uniform convergence and continuity, uniform convergence and Riemann Stieltjes integration ,uniform convergence and differentiation, existence of a real continuous nowhere differentiable function, Weierstrass approximation theorem, Power series, Uniqueness theorem for power series, Abel's and Tauber's theorem.

UNIT-IV

Functions of several variables : linear transformations, Derivative in an open subset of $\mathbb{R}^n$, Chain rule, Partial derivatives, directional derivatives, derivatives of higher order, the contraction principle, inverse function theorem, Implicit function theorem, Taylor's theorem.

UNIT-V

Implicit function theorem, Jacobians, extremum problems with constraints, Lagrange's multiplier method, Differentiation of integrals, Differential forms.

Text Books

1.Walter Rudin,Principales of Mathematical Analysis, McGraw Hill.

Reference Books :

1. T.M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, 1985.
2. Gabriel Klambauer, Mathematical Analysis, Marcel Dekkar, Inc. New York, 1975.
3. A.J. White, Real Analysis; an introduction. Addison-Wesley Publishing Co., Inc.,1968



Dr. A.P.J. Abdul Kalam University, Indore

Class: M.Sc. Mathematics

Semester: I

Subject: Mathematics –III

Title of Paper: Topology-I (Compulsory Paper)

Unit I

Relations, Countable and uncountable sets, Infinite sets and the Axiom of choice, Cardinal numbers and their arithmetic, Schroeder-Bernstein theorem, Cantor's theorem and continuum hypothesis, Zorn's lemma, Well-ordering theorem.

Unit II

Definition and examples of topological space, Closed sets and limit points. Closure of a set, Dense subset, neighborhoods, Interior, exterior and boundary of a set, Arived set, Bases and Subbases.

Unit III

Continuous Functions and homeomorphisms. The product topology. The metric topology. The quotient topology, continuity of a function from a space into a product of spaces.

Unit IV

First and second countable spaces, Separable spaces, Second countability and separability, Compactness:-definition and examples of compact spaces, compact subspace Connected spaces.

Unit V

Path Connectedness, Connected spaces, Connectedness on real line, Components, Locally connected spaces. Connectedness and product spaces

Books Recommended :

1. James R. Munkres, Topology (Second edition), Prentice-hall of India

References :

1. George F. Simmons, Introduction to topology and modern analysis, McGraw Hill Book Company Inc.

2. N. Bourbaki, General topology, Springer-verlag.

3. K.D.Joshi, Introduction to topology, Wiley Eastern.

4. J.L.Kelley, General topology, Affiliated East-West press Pvt Ltd.



Dr. A.P.J. Abdul Kalam University, Indore

Class: M.Sc. Mathematics

Semester: I

Subject: Mathematics –IV

Title of Paper: Complex Analysis-I (Compulsory Paper)

Unit I:

Complex integration, Cauchy's Theorem, Cauchy's Integral formula, Cauchy Goursat Theorem, Higher ordered derivatives.

Unit II:

Morera's theorem, Liouville's theorem, Fundamental theorem of algebra, Taylor's and Laurent's Theorem.

Unit III:

The Maximum Modulus Principle, Schwarz Lemma, Singular points, singularities, Meromorphic functions, problems based on Laurent's series, Argument Principle, Rouché's theorem.

Unit IV:

Residue theory, evaluation of integrals, Properties and classification.

Unit V:

Bilinear transformation, Fixed points, Cross ratio, Normal form of Bilinear Transformation, definitions and examples of conformal mappings, Hadamard three circles theorem.

Books Recommended:

1. J.B. Conway : Functions of one Complex variable, Springer-verlag.
2. S. Ponnusamy : Foundations of Complex Analysis, Narosa Pub, '97

References :

1. George F. Simmons, Introduction to topology and modern analysis, McGraw Hill Book Company Inc.
2. Alföhrs : Complex Analysis



Dr. A.P.J. Abdul Kalam University, Indore

Class: M.Sc. Mathematics

Semester: I

Subject: Mathematics –V

Title of Paper: Differential Equations-I (Optional Paper)

Unit I

Maximal interval of existence, Extension theorem and corollaries, Kamke's convergence theorem, Knesser's theorem. (Statement only) Differential inequalities and uniqueness: Gronwall's inequality, Maximal and minimal solutions, Differential inequalities.

Unit II

A theorem of Wintner, Uniqueness theorems, Nagumo's and Osgood's criteria. Egres points and Lyapunov functions, Successive approximations, Differential inequalities and Uniqueness Gronwall's inequality.

Unit III

Initial value problems and the equivalent integral equation. Basic theorems: Ascoli- Arzela theorem, a theorem on convergence of solutions of a family of initial value problems. Picard Lindelof theorem, Peano's existence theorem and corollary

Unit IV:

Linear differential equations : Linear systems, Variation of constants, reduction to smaller systems, Basic inequalities, constant coefficients, Floquet Theory Adjoint system, Higher order equations.

Unit V:

Floquet theory, adjoint systems, Higher order equations. Dependence on initial conditions and parameters: Preliminaries, continuity, and differentiability.

Books Recommended :

1. P.Hartman, Ordinary differential equations, John Wiley, 1964.
2. Walter Rudin, Principles of Mathematical Analysis, (3rd edition),

References :

1. W.T.Reid, Ordinary differential equations, John Wiley & sons, New York, 1971.
2. E.A.Coddington & N.Levinson, Theory of ordinary differential equations, McGraw Hill, NY, 1955.



Dr. A.P.J. Abdul Kalam University, Indore

Class: M.Sc. Mathematics

Semester: I

Subject: Mathematics –V

Title of Paper: Advanced Discrete Mathematics- I (Optional Paper)

Unit I:

Formal logic: statement, Connectives, Tautologies, Normal Forms, ordering Forms, Ordering and uniqueness of Normal form.

Unit II:

Semigroups and Monoids: definition and examples of Semigroups and Monoids (including those pertaining to concatenation operation) Homomorphism of semigroups and monoids, Congruent relation and Quotient Semigroups and Subsemigroups, and submonoids direct products, Basic homomorphisms theorem.

Unit III:

Lattices: Lattices as partially ordered Sets, their properties, Lattices as algebraic systems, Sublattices, Direct products and homomorphism, Some special lattices e.g. Complete Complemented and Distributive Lattices.

Unit IV:

Boolean Algebras: Boolean Algebras as lattices, Various Boolean identities, Sub-algebras, Direct products and Homomorphism, Join-irreducible elements.

Unit V:

Boolean Functions: Boolean Forms and Free Boolean Algebras, Sum- of -products canonical forms, Product -of-sum canonical forms, value of Boolean Expressions and Boolean functions, Representation and minimization of Boolean functions, Application of Boolean algebra to switching theory(using And, Or and Not gates),The karnaugh map method.

Books Recommended:

1. J.P. Trembly and R. Manohar, Discrete Mathematical Structures with Application to Computer Science, McGraw-Hills Book Co.,1997

References :

1. C.L. Liu, Elements of Discrete Mathematics, McGraw-Hills Book Co.
2. N. Deo., Graph Theory with Application to Engineering and Computer Sciences, Prentice Hall of India.



Dr. A.P.J. Abdul Kalam University, Indore

Class: M.Sc. Mathematics

Semester: I

Subject: Mathematics –V

Title of Paper: Programming in C-I (Optional Paper)

Unit I:

An overview of programming languages, Programming Basics: Basic Structure of C program (First C program), Identifiers, Keywords, Constants, Variables and Arithmetic expression, Variable names, data Types and Sizes, constants, Scalar Data Types-declarations, different types of integers, Different kinds of Integer Constants, Character Constants, Floating point type Constant, Initialization.

Unit II:

Operators and Expressions- precedence associatively and order of evaluation, unary plus and minus operators, Arithmetic operators, increment and decrement operators, comma Operators, relations operators, logical operators, bit-manipulation operators, Bitwise assignment operators and expressions, Conditional expressions, cast operators, size of operators, conditional operators, memory operator, Input and Output functions(formatted and unformatted)

Unit III:

Control Flow-Statements and blocks, conditional Branching if, if –else, nested if else, looping: do while, while and for loop, nested loops.

Unit IV

The break and continue statement, the Goto statement and Labels, exit statement, switch statement, infinite loop.

Unit V

Type Conversions, Mixing types explicit conversions-casts, enumeration types, void data type, Typedefs, preprocessor directives, formatting source files, continuation Character, integer and float conversions , type conversion in assignment.

Books recommended :

1. Brain W Kernigham & Dennis M Ritchie the C programmed Language 2nd Edition (ANSI features), Prentice Hall 1989

References :

1.Samuel P. Harkison and Gly L Steele Jr. C: A Reference manual, 2nd Edition Prentice Hall 1984.



(Non Grading)

S.No	Sub. Code	Sub. Name	Theory Max. Marks				Practical Max Marks		Total Marks
			End Sem.		Mid Sem./ Assignment Average of two				
			Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	
1	MSM201T	Advanced Abstract Algebra II	85	28	15	05	-	-	100
2	MSM202T	Lebesgue Measure & Integration	85	28	15	05	-	-	100
3	MSM203T	Topology II	85	28	15	05	-	-	100
4	MSM204T	Complex Analysis II	85	28	15	05	-	-	100
5	MSM205T	(Any one of the following) Differential Equation II	85	28	15	05	-	-	100
	MSM206T	Advanced Discrete Mathematics-II	85	28	15	05	-	-	100
	MSM207T	Programming in C-II	50	17	15	05	-	-	65
	MSM207P	Programming in C-II	-	-	-	-	35	12	35
Total Marks									500



Dr. A.P.J. Abdul Kalam University, Indore

Class: M.Sc. Mathematics

Semester: II

Subject: Mathematics -I

Title of Paper: Advanced Abstract Algebra II (Compulsory Paper)

Unit I:

Modules: Introduction and examples, Submodules and quotient modules, sums, Cyclic Module, R- Homomorphism and Isomorphism.

Unit II:

Simple and semi-simple modules, free modules, Schur's lemma.

Unit III:

Noetherian and Artinian rings and modules, Hilbert Basis Theorem, Power series, Associated primes, primary decomposition, Wedderburn - Artin theorem.

Unit IV:

Uniform module, Primary modules, Moether – leskar theorem, Fundamental structure theorem and its application, Abelian groups.

Unit V:

Nilpotent transformations, Index of Nilpotency, Invariant of nilpotent transformation, The primary decomposition theorem.

Book Recommended:

1. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul. Basic Abstract Algebra Cambridge University press(Indian Edition)

Reference Books:

1. I. I.N.Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.
2. M.Artin, Algebra, Prentice - Hall of India, 1991.
3. N.Jacobson, Basic Algebra, vols I&II, W.H.Freeman, 1980.
4. S.Kumaresan, Linear Algebra, a Geometric Approach, Prentice - Hall of India
5. D.S.Dummit & R.M.Foote, Abstract Algebra, II Ed, John Wiley & Sons, Inc, New York.



Dr. A.P.J. Abdul Kalam University, Indore

Class: M.Sc. Mathematics

Semester: II

Subject: Mathematics -II

Title of Paper: Lebesgue Measure and Integration (Compulsory Paper)

Unit I:

Lebesgue outer measure, measurable sets, Regularity, Measurable functions, Borel and Lebesgue measurability, Non-measurable sets.

Unit II:

Integration of Non-negative functions, The general integrals, Integration of series, Riemann and Lebesgue integrals.

Unit III:

The four derivatives, Functions of Bounded variations, Lebesgue Differentiation theorem, Differentiation and Integration.

Unit IV:

The L^p -Space, Convex functions, Jensen's inequality, Holder and Minkowski inequalities, Completeness of L^p .

Unit V:

Dual of L^p ($1 \leq p < \infty$) Convergence in measure, Uniform and almost uniform convergence.

Books Recommended:

1. G. de. Barra, Measure Theory and Integration, Wiley Eastern Limited, 1981.

References:

1. Lebesgue Measure and integration: an introduction, Frank Burk, Wiley Interscience Publication, 1998.
2. H.L. Royden, Real Analysis (4th edition), Macmillan Publishing Company, 1993.
3. Inder K. Rana, an Introduction to Measure and Integration, Narosa Publishing House, Delhi, 1997.



Dr. A.P.J. Abdul Kalam University, Indore

Class: M.Sc. Mathematics

Semester: II

Subject: Mathematics -III

Title of Paper: Topology II (Compulsory Paper)

Unit I:

Separation axioms, T_0 , T_1 , T_2 , T_3 , T_4 ; their characterization and basic properties, Urysohn's lemma.

Unit II:

Compactness, Continuous functions and compact sets, Basic properties of compactness, Compactness and finite intersection property, sequentially and Countably compact sets. Local compactness and one-point compactification, Compactness in metric spaces, Equivalence of compactness, Countable compactness and Sequential compactness in metric spaces

Unit III:

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

Unit IV:

Embedding and metrization Embedding lemma and Tychonoff Embedding The Urysohn metrization theorem Nets and Filters: Topology and convergence of nets, Hausdorffness and nets, Compactness and nets, Filters and their convergence, Canonical way of converting nets to filters and vice-versa, Ultra filters and compactness.

Unit V:

The fundamental group and covering spaces: Homotopy of paths, the fundamental group, Covering spaces, the fundamental group of the circle and the fundamental theorem of algebra.

Books Recommended:

1. James R. Munkres, Topology (Second edition), Prentice-hall of India
2. George F. Simmons, Introduction to topology and modern analysis, McGraw Hill Book Company Inc.

References:

1. N. Bourbaki, General topology, Springer-verlag.
2. K.D.Joshi, Introduction to topology, Wiley Eastern.
3. J. L. Kelley, General topology, Affiliated East-West press Pvt Ltd.



Dr. A.P.J. Abdul Kalam University, Indore

Class: M.Sc. Mathematics

Semester: II

Subject: Mathematics -IV

Title of Paper: Complex analysis –II (Compulsory Paper)

Unit I:

Spaces of analytic functions, Hurwitz's theorem, Montel's theorem, Riemann Mapping theorem, Weierstrass Factorisation theorem.

Unit II:

Gamma function & its properties, Riemann Zeta function, Riemann's functional equation, Runge's theorem and Mittag-Leffler's theorem, Relation Between Gamma and Zeta Functions, Infinite Product.

Unit III:

Analytic continuation, uniqueness of direct analytic continuation and analytic continuation along a curve, power series method of analytic continuation, Schwartz Reflection Principle, Mean value Theorem, Poisson Kernel, Problem Based on analytic continuation. .

Unit IV:

Canonical products, Jensen's formula, order of an entire function, exponent of convergence, Hadamard's factorization theorem, range of an analytic function, Bloch's theorem, The Little Picard theorem, Schottky's theorem, Great Picard theorem.

Unit V:

Harmonic functions on a disk, Dirichlet problem, Green's function.

Books Recommended:

1. J.B.Conway: Functions of one Complex variable, Springer-verlag.
2. S. Ponnusamy : Foundations of Complex Analysis, Narosa Pub, '97

References:

1. Alföhrs : Complex Analysis



Dr. A.P.J. Abdul Kalam University, Indore

Class: M.Sc. Mathematics

Semester: II

Subject: Mathematics -V

Title of Paper: Differential equation –II (Optional Paper)

Unit I:

Poincare- Bendixson theory: Autonomous systems, Umlanfsatz, index of a stationary point, Poincare- Bendixson theorem, and stability of periodic solutions, Rotation Point, foci, nodes and saddle points.

Unit II

Second Order Boundary Value Problem, Sturm-Liouville boundary value problems, Number of zeros.

Unit III

Dependence on Initial Conditions and Parameters preliminaries, Nonoscillatory equations and principal solutions, Nonoscillation theorems.

Unit IV

Linear second order equations: Preliminaries, Basic facts, Theorems of Sturm, Sturm Liouville Boundry value Problem, Number of zeros, No oscillatory Equations and Principal Solutions.

Unit V:

Use of Implicit function and fixed point theorems: Periodic solutions, linear equations, nonlinear problems, Higher order Differentiability.

Books recommended:

1. P. Hartman, Ordinary differential equations, John Wiley, 1964.

References:

1. W. T. Reid, Ordinary differential equations, John Wiley & sons, New York, 1971.

2. E. A. Coddigton & N. Levinson, Theory of ordinary differential equations,



Dr. A.P.J. Abdul Kalam University, Indore

Class: M.Sc. Mathematics

Semester: II

Subject: Mathematics -V

Title of Paper: –Advanced Discrete Mathematics-II (Optional Paper)

Unit I

Graph theory: Definition of undirected & directed graph, Simple graph, Multi graph, Isomorphic graph, Path, Reachability and Connectedness, Simple path, Simple cycle, Unilaterally connected, Strongly connected.

Unit II

Matrix Representation of Graphs, adjacency matrix, Reachability matrix, Warshal's algorithm, Trees, Directed tree, Terminal node.

Unit III

Grammars and Languages: Phrase-Structure Grammars, Rewriting rules, Derivations, Sentential Forms, Language generated by Grammar, Regular, Context-free and Context sensitive Grammar and Languages, Notion of Syntax Analysis, Polish Notation, Conversion of Infix Expressions to Notations.

Unit IV

Finite State Machine: Introductory Sequential Circuits, Equivalence of Finite State Machines, Finite-State machines and their transition table diagram, Reduced Machines, Homomorphism.

Unit V:

Introductory Computability Theory: Finite-State Acceptors and Regular Grammars, Nondeterministic finite automation, Machines and Partial Recursive Functions.

Books recommended :

1. J.P. Trembly and R. Manohar, Discrete Mathematical Structures with Application to Computer Science, McGraw-Hills Book Co.,1997

References :

1. C.L. Liu, Elements of Discrete Mathematics, McGraw-Hills Book Co.
2. N. Deo., Graph Theory with Application to Engineering and Computer Sciences, Prentice Hall of India.



Dr. A.P.J. Abdul Kalam University, Indore

Class: M.Sc. Mathematics

Semester: II

Subject: Mathematics -V

Title of Paper: Programming in C–II (Optional Paper)

Unit I

Functions: Basics and Anatomy of Function: Definition, Declaration & prototypes, calling use and features of functions, Passing value between function, External variables, Scope rule, call by value, call by reference(only concept), Static variables, Register variables, Block Structure, Recursion : need of recursion, types of recursion.

Unit II

Arrays and multidimensional Arrays: array concept and initialization, memory map of 1D and 2D array, storage classes- automatic, extern, static, register, global variable, Command line arguments.

Unit III

Array of characters, string constant and variable, Character Input/ Output statements, array of strings, string handling functions, standard library string function strlen(), strcmp(), etc, Mathematical functions<math.h>.

Unit IV

Pointer: Definition & declaration, Address, pointers and function arguments, pointer & arrays, Address arithmetic, character pointers and functions, pointer arrays, Initialization of pointer arrays, pointer to function, use of pointer, malloc(), calloc(), library function.

Unit V:

Structures: Basics of Structures, Structure and Functions, Arrays of Structure, Pointer to Structure, Self referential structure, Unions.

Books recommended :

1. Brain W Kernigham & Dennis M Ritchie the C programmed Language 2nd Edition (ANSI features), Prentice Hall 1989

References :

1.Samuel P. Harkison and Gly L Steele Jr. C: A Reference manual, 2nd Edition Prentice Hall 1984.



(Non Grading)

S.No	Sub. Code	Sub. Name	Theory Max. Marks				Practical Max Marks		Total Marks
			End Sem.		Mid Sem./ Assignment Average of two				
			Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	
1.	MSM301T	Functional Analysis-I	85	28	15	05	-	-	100
2.	MSM302T	Advanced Special Function-I	85	28	15	05	-	-	100
3.	MSM303T	Theory of Linear Operators-I	85	28	15	05	-	-	100
4.	MSM304T	Advanced Numerical analysis-I	85	28	15	05	-	-	100
5.	MSM305T	(Optional Paper) Operation Research-I	85	28	15	05	-	-	100
	MSM306T	Analytic Number Theory-I	85	28	15	05	-	-	100
	MSM307T	Integral Transform-I	85	28	15	05	-	-	100
	MSM308T	Fundamental of Computer Science (Theory)-I	50	17	15	05	-	-	65
	MSM308P	Fundamental of Computer Science (Practical)-I	-	-	-	-	35	12	35
	MSM309T	Integration Theory-I	85	28	15	05	-	-	100
Total Marks									500



Dr. A.P.J. Abdul Kalam University, Indore

Class	: M.Sc/ M.A. (Mathematics)
Semester	: III
Title of subject/Group	: Functional Analysis -I
Paper No.	: I
Compulsory / Optional	: Compulsory

Unit I

Normed linear spaces , Banach Spaces and examples. Properties of Normed linear Spaces. Completeness proof of Banach Spaces. Quotient spaces.

(1.Chapter 2 Sect 2.2, 2.3 & Exercises)

Unit II

Finite dimensional Normed spaces & subspaces, Equivalent norms, Compactness and Finite Dimension, Riesz Lemma, Linear Operators.

(1. Chapter 2 Sect 2.4, 2.5,2.6 & Exercises)

Unit III

Bounded and Continuous Linear Operators , Linear Functionals.

(1. Chapter 2 Sect 2.7,2.8 & Exercises)

Unit IV

Linear Operators and Functionals on and Finite Dimensional Spaces, Normed Spaces of Operators, Dual Space.

(1. Chapter 2 Sect 2.9, 2.10 & Exercises)



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Unit V

Zorn's Lemma , Hahn-Banach Theorem , Hahn-Banach Theorem for Complex Vector Spaces and Normed Spaces , Application to Bounded Linear Functionals on $C[a,b]$.

(1.Chapter 4 Sect 4.1 to 4.4 & Exercises)

Text Books

1. E. Kreyszig Chapter 2 (2.1 to 2.10 & 4.1 to 4.4), Introductory Functional Analysis with applications, John Wiley & Sons New York.

Reference

1. G.F. Simmons, Introduction to Topology & Modern Analysis Mc Graw Hill New York 1963.
2. B. Choudhary and Sudarsan Nanda. Functional Analysis with applications, Wiley Eastern Ltd.



Dr. A.P.J. Abdul Kalam University, Indore

Class	: M.Sc/ M.A. (Mathematics)
Semester	: III
Title of subject/Group	: Advanced Special functions-I
Paper No.	: II/III/IV/V
Compulsory / Optional	: Optional Gr-II(4)

Unit – I

The Gamma and Beta Functions : The Euler or Mascheroni constant γ , The Gamma function, A Series for $\Gamma'(z)/\Gamma(z)$, Evaluation of $\Gamma(1)$ and $\Gamma'(1)$, The Euler Product for $\Gamma(z)$, The Difference equation $\Gamma(z+1) = z \Gamma(z)$, The Beta function, the value of $\Gamma(z)\Gamma(1-z)$, the factorial function, Legendre's duplication formula, Gauss Multiplication theorem.

(3.Chapter 2 Page 19 - 41)

Unit –II

Hypergeometric functions : Hypergeometric functions, Integral Representation of $F(a, b, c, z)$, Hypergeometric differential equation, Simple transformation, Quadratic transformation.

(3. Chapter 3 Page 42-72)

Unit –III

Generalized Hypergeometric functions : The function ${}_pF_q$, A differential equation, Contiguous function relations, a simple integral, Saalschutz theorem, Whipple's theorem, Dixon's theorem, Kummer's theorem, Ramanujan's theorem.

(3.Chapter 4 Page 73-106)



Unit –IV

Bessel Functions : Definition of $J_n(z)$, Bessel differential equation, Differential recurrence relations, pure recurrence relation, Generating function, Bessel's integral, Index half and n odd integer.

(3. Chapter 5 Page 107 ----156)

Unit –V

Legendre Polynomials: A generating function, Differential recurrence relations, pure recurrence relation, Legendre's differential equation, the Rodrigues formula, Bateman's generating function, Additional generating functions, Hypergeometric forms of $p_n(x)$, Special properties of $p_n(x)$, More generating functions, Laplace's first integral form, Orthogonality.

(3. Chapter 6 Page 157- 208)

Text Books

1. Rainville. E.D, Special functions, The Macmillan co., New York 1971.
2. Srivastava, H.M. Gupta, K.C. and Goyal, S.P., the H-functions of one and Two Variables with applications, South Asian Publication, New Delhi.
3. Saran, N., Sharma S.D. and Trivedi, - Special Functions with application, Pragati prakashan, 1986.



Dr. A.P.J. Abdul Kalam University, Indore

Class	: M.Sc/ M.A. (Mathematics)
Semester	: III
Title of subject/Group	: Theory of Linear operators– I
Paper No.	: II/III/IV/V
Compulsory / Optional	: Optional Gr-III(1)

Unit I

Spectral theory in normed linear spaces, basic concept concepts : regular value, resolvent, types of spectra(point, continuous and residual Spectra)and exercises explaining these concepts.

(1. Chapter 7 ,Sect 7.1,7.2).

Unit II

Spectral properties of Bounded Linear operators, Properties of Resolvent and spectrum, spectral mapping theorem for polynomials.

(1, Chapter 7, sect 7.3&7.4).

Unit III

Spectral radius of a bounded linear operator on a complex Banach space, Banach Algebras and their properties.

(1, Chapter 7, sect 7.5,7.6&7.7)

Unit IV

General properties of Compact linear operators

(1, Chapter 8, sect 8.1,8.2).



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Unit V

Spectral properties of Compact linear operators on Normed Linear spaces (1, Chapter 8, sec.8.3,8.4)

Note : Exercises based on the theory are expected to be solved.

Recommended books:

- 1. E.Kreyszig : Introductory Functional Analysis with applications, John wiley & sons, New York.**

Reference Books :

1. P.R.Halmos: Introduction to Hilbert space and the theory of spectral multiplicity, second edition, Chelsea publishing co.NY 1957
2. N.Dunford and J.T.Schwartz, Linear operator-part 3 Interscience/wiley, New York 1958-71



Dr. A.P.J. Abdul Kalam University, Indore

Class	: M.Sc/ M.A. (Mathematics)
Semester	: III
Title of subject/Group	: Advanced Numerical Analysis-I
Paper No.	: II/III/IV/V
Compulsory / Optional	: Optional Gr-III(3)

Unit – I

Introduction : Interpolation, Linear Interpolation and Higher Order Interpolation. Hermite Interpolation, Piecewise and Spline Interpolation, Piecewise quadratic Interpolation, Piecewise cubic interpolation, Piecewise cubic interpolation using Hermite Type Data, Quadratic Spline Interpolation, Cubic Spline Interpolation and its derivation, Problems .

(1.Chapter 4 section 4.1,4.5 and examples, section 4.6 and examples.)

Unit – II

Bivariate Interpolation : Lagranges and Newtons Bivariate Interpolation polynomials and their derivation, Approximation : Discrete and continuous data, Least Square Approximation.

(1. Chapter 4 section 4.7 and examples , section 4. 8 and examples, section 4.9 and examples.)

Unit – III

Orthogonal, Gram-Schmidt Orthogonalizing Process, Legendre and Chebyshev Polynomials.

(1.Chapter 4 section 4.9 definition 4.3 and 4.4 and subsections, examples.)



Unit- IV

Uniform Approximation, Uniform Polynomials Approximation (chebyshev), Chebyshev Polynomials Approximation and Lanczos Economization, Rational Approximation , Choice Of Methods.

(1.Chapter 4 section 4.10 and subsection, Examples, Section 4.11, Section 4.12, examples.)

Unit- V

Numerical Differentiation : Method Based On Interpolation, Non uniform and uniform nodal points, Quadratic Interpolation, Method based on Finite Difference Operators, Method based on Undetermined Coefficient, Optimum Choice Of Step Length.

(1.Chapter 5 section 5.2 and subsection, Examples, Section 5.3)

Text Book

1. **Numerical Methods, Jain, Iyanger and Jain, New Age International Edition 2012.**



Dr. A.P.J. Abdul Kalam University, Indore

Class	: M.Sc/ M.A. (Mathematics)
Semester	: III
Title of subject/Group	: OPERATIONS RESEARCH-I
Paper No.	: II/III/IV/V
Compulsory / Optional	: Optional Gr-IV(1)

Unit I

Operations Research - Introduction. Origin and Development of Operations Research, Nature and Features of Operations Research, Models in Operations Research, General Solution Methods for Operations Research, Phases of Operations Research, Uses and Limitations of Operations, Linear Programming Problems : Introduction Mathematical Formulation, Graphical Solution Method.

(1. Chapter 1 sect. 1.1 to 1.8, 1.10, Examples & Exercises, 1. Chapter 2 sect 2.1,2.2, 2.3, 2.4, Examples & Exercises ,1. Chapter 3 sect 3.1,3.2, Examples & Exercises)

(2. Chapter 1 sect 1.1,1.2,1.6, Chapter 2 sect 2.1,2.2)

Unit II

General Linear Programming Problem, Theory of Simplex method, Computational Procedure, Numerical problems, Solutions of simultaneous linear equations, inverse of a matrix using simplex method.

(1.Chapter 3 sect 3.3, 3.4, 3.5, Chapter 4 sect 4.1,4.2, 4.3, 4.6, 4.7,

Unit III

Use of artificial variables, Big-M method, Two phase method, Problem of degeneracy and resolution of degeneracy, Applications of simplex method.

(1 Chapter 4 sect 4.4,4.5, 4.8 , Examples & Exercises)



Dr. A.P.J. Abdul Kalam University, Indore

Unit IV

Concept of duality : Introduction, General Primal-Dual pair, formulating a dual problem, primal-dual pair in matrix form, economic interpretation of duality, duality and simplex method, Fundamental Properties and Theorems of duality, complementary slackness, dual simplex method.

(1. Chapter 5 section 5.1, to 5.9, Examples and Exercises)

Unit V

Post optimality analysis, integer programming, revised simplex method.

(1. Chapter 6, Chapter 7: 7.1 to 7.4, Chapter 9: 9.1 to 9.2, Examples and Exercises)

Recommended Books

1- Kanti Swarup, P.K. Gupta and Manmohan, Operations Research, Sultan Chand & Sons, New Delhi, fifteenth revised edition.

2- H.A. Taha, Operations Research - An introduction, Macmillan Publishing co. Inc. New york

Reference Books

1. S.D, Sharma, Operation Research,

2. F.S, Hiller and G.J. Lieberman, Industrial Engineering Series, 1995.



Dr. A.P.J. Abdul Kalam University, Indore

Class	: M.Sc/ M.A. (Mathematics)
Semester	: III
Title of subject/Group	: Analytic Number Theory-I
Paper No.	: II/III/IV/V
Compulsory / Optional	: Optional Gr-V(3)

Unit I

Characters of finite abelian groups, The character group, The orthogonality relations for characters, Dirichlet characters, Sums involving Dirichlet characters.

(1. Chapter 6, Section 6.4 to 6.10)

Unit II

Dirichlet characters, Sums involving Dirichlet characters, Dirichlet's theorem on primes in arithmetic progressions.

(1 Chapter 7, Section 7.1 to 7.8)

Unit III

The half-plane of absolute convergence of a Dirichlet series, the function defined by Dirichlet series, Euler products, The half-plane of convergence of Dirichlet series

Unit IV

Analytic properties of Dirichlet series, Mean value formulas for Dirichlet series Integral formula for the coefficient of Dirichlet series, Integral formula for the partial sums of a Dirichlet series.

(1. Chapter 11, Section 11.7 to 11.12)

Unit V

Properties of the gamma function, Integral representation of Hurwitz zeta functions, Analytic continuation of Hurwitz zeta functions, Hurwitz Formula.

(1. Chapter 12, Section 12.1 to 12.7)



Dr. A.P.J. Abdul Kalam University, Indore

Books Recommended:

1. T.M. Apostol, Introduction to Analytic Number Theory, Narosa Pub.House, 1989.



Dr. A.P.J. Abdul Kalam University, Indore

Class	: M.Sc/ M.A. (Mathematics)
Semester	: III
Title of subject/Group	: Integral Transform – I
Paper No.	: II/III/IV/V
Compulsory / Optional	: Optional Gr-V(4)

Unit I

Laplace Transform of the derivative of $f(t)$, Laplace Transform of Integrals multiplication by t , Multiplication by t^n , Division by t use of Laplace transform to unit step function(Heaviside's unit functions) use of Laplace Transform to Bessel function ,Inverse Laplace Transform of derivatives, convolution, Heaviside's expansion theorem , problem depends on Convolution.

(1. Chapter 1 section I (page 7-57), section II (Page 58-114)

Unit II

Application of Laplace Transform to Solutions of ordinary Differential Equations With constant Coefficients.

(1. Chapter 1 section III (page 115 - 139) excluding problem 1,4,5 (page 116-120))

Unit III

Solution of Simultaneous ordinary Differential Equations by Laplace Transform. Solution of ordinary differential equations with variable coefficients by Laplace Transform.

(1. Chapter 1 section III (page 140-149) problems 23-28 including problem

Unit IV

Solutions of Partial differential Equations by Laplace transform Application of Laplace transform to integral equation.

(1. Chapter 1 section III (page 150 - 160), section IV (Page 161-173)



Unit V

Heat conduction equations. Problems based on Heat conduction equation using Laplace transform.

(1. Chapter V (page 354 -361) including problems dependent on it on exercise page 371)

Books recommended:-

1. Integral Transform by Goyal & Gupta.



Dr. A.P.J. Abdul Kalam University, Indore

Class	: M.Sc/ M.A. (Mathematics)
Semester	: III
Title of subject/Group	: Fundamentals of Computer Science (Theory and Practical)–I
Paper No.	: II/III/IV/V
Compulsory / Optional	: Optional Gr-VI(1)

Unit I

Introduction to Object Oriented Programming in C++, Need of Object-Oriented Programming, Characteristics of Object-Oriented Languages, Class, Object and Scopes, Nested Classes.

1.Chapter 1 and sections, Chapter 6 and sections.

Unit II

Pointer class member, class initialization, constructor and destructor, assignment and distribution, Virtual Functions and Friend Functions

1.Chapter 6 and sections, Chapter 11 and sections.

Unit III

Overloading : Function and Operators, Templates, Types of Templates and class templates.

1.Chapter 8 and sections, Chapter 14 and sections.

Unit IV

Class Inheritance and their Types, Multiple and Virtual Inheritance.

1.Chapter 9 and sections.



Unit V

Operating System: Introduction, What Operating Systems Do, Computer-System Organization, Computer-System Architecture , Operating-System architecture, Operating-System Operations, Process Management, Memory Management ,Storage Management, Protection and Security, Distributed Systems, Special-Purpose Systems , Client-Server Computing , Peer to Peer Computing, Open-Source Operating Systems . (Only Basic Concept of these all.)

2. Chapter 1 section 1.1 to 1.13

Text Books

- 1. Robert Lafore Object Oriented Programming in C++, Forth edition, Sams Publishing Indianapolis, IN 46290 USA**
- 2. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne , Operating System Concept Wiley India Pvt. Ltd, Eights edition**

References :

1. S.B. LIPMAN, , J. LAJOI, C++ PRIMER,ADDISON
2. B.Stroustrup, The c++ programming languages, Addison – Westey.
3. Andrew S Tanenbaum, Modern Operating System, Pearson International, Third edition.



Dr. A.P.J. Abdul Kalam University, Indore

Class	: M.Sc/ M.A. (Mathematics)
Semester	: III
Title of subject/Group	: Integration Theory-I
Paper No.	: II/III/IV/V
Compulsory / Optional	: Optional Gr-VI(3)

(1, Chapter 11, Sec.5).

Unit I

General Measures: Examples and Properties, Semi-finite & sigma finite measures.

(1, Chapter 11, Sect.1)

Unit II

Completion of a measure and measurable functions.

(1, Chapter 11 ,relevant parts of Sec.1 & Sec.2).

Unit III

Integration of Measurable functions

(1, Chapter 11, Sec.3).

Unit IV

Signed Measures, Hahn decomposition Theorem, Mutually singular measures, Jordan decomposition Theorem.



Unit V

Radon Nykodym Theorem, Lebesgue decomposition Theorem

(1, Chapter 11, Sec.6).

Note : Exercises based on the theory are expected to be solved

Recommended Books:

1.H.L.Royden, Real Analysis, Macmillan publishing co.Inc,New York,4th edition,1993.

Reference Books:

1. P.R.Halmos, Measure Theory, Van Nostrand.
2. I.K.Rana, Introduction to Measure and Integration, Narosa Publishing House, New Delhi.



(Non Grading)

S.No	Sub. Code	Sub. Name	Theory Max. Marks				Practical Max Marks		Total Marks
			End Sem.		Mid Sem./ Assignment Average of two				
			Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	
1	MSM401T	Functional Analysis-II	85	28	15	05	-	-	100
	MSM402T	Advanced Special Function-II	85	28	15	05	-	-	100
2	MSM403T	Theory of Linear Operators-II	85	28	15	05	-	-	100
4	MSM404T	Advanced Numerical analysis-II	85	28	15	05	-	-	100
5	MSM405T	(Optional Paper) Operation Search II	85	28	15	05	-	-	100
	MSM406T	Analytic Number Theory-II	85	28	15	05	-	-	100
	MSM407T	Integral Transform-II	85	28	15	05	-	-	100
	MSM408T	Fundamental of Computer Science (Theory)-II	50	17	15	05	-	-	65
	MSM408P	Fundamental of Computer Science (Practical)-II	-	-	-	-	35	12	35
	MSM409T	Spherical Trigonometry and Astronomy	85	28	15	05	-	-	100
	Job Oriented Project work		100	33					100
Total Marks									600



Dr. A.P.J. Abdul Kalam University, Indore

Class	: M.Sc/ M.A. (Mathematics)
Semester	: IV
Title of subject/Group	: Functional Analysis-II
Paper No.	: I
Compulsory / Optional	: Compulsory

Unit I

Inner Product Space Hilbert Space, Further Properties of Inner Product Spaces Orthogonal complements and Direct sum, Orthonormal Sets and Sequences. Schwarz, triangle and Bessel Inequality.

(1. Chapter 3 Sect 3.1 to 3.4 & Exercises)

Unit II

Series related to orthonormal sequences & sets, Total orthonormal sets & sequences Representation of Functionals on Hilbert Spaces , Riesz's Theorem, Riesz Representation Theorem.

(1. Chapter 3 Sect 3.5, 3.6, 3.8 & Exercises)

Unit III

Adjoint operator, Hilbert Adjoint Operator , Self Adjoint Operator, Unitary and Normal Operators

(1. Chapter 3 Sect 3.9 , 3.10, Chapter 4: 4.5 & Exercises)

Unit IV

Adjoint Operator, Reflexive Spaces, Category Theorem. Uniform Boundedness Theorem, Strong and Weak Convergence.

(1. Chapter 4 Sect 4.6 to 4.8 & Exercises)



Dr. A.P.J. Abdul Kalam University, Indore

Unit V

Convergence of Sequences of Operators and Functionals, Application of Summability of Sequences, Open Mapping Theorem ,Closed Linear Operators , Closed Graph Theorem.

(1.Chapter 4 Sect 4.9, 4.10, 4.12, 4.13 & Exercises)

Text Books

1.E. Kreyszig Introductory Functional Analysis with applications, John Wiley & Sons New York.

Reference

1. G.F. Simmons, Introduction to Topology & Modern Analysis Mc Graw Hill,- New York 1963.
2. B. Choudhary and Sudarsan Nanda.Functional Analysis with applications, wiley Eastern Ltd.



Dr. A.P.J. Abdul Kalam University, Indore

Class	: M.Sc/ M.A. (Mathematics)
Semester	: IV
Title of subject/Group	: Advanced Special functions-II
Paper No.	: II/III/IV/V
Compulsory / Optional	: Optional Gr-II(4)

Unit – I

Hermite Polynomials :Definition of Hermite Polynomials $H_n(x)$, pure recurrence relations, Differential recurrence relations, Rodrigue's formula, other generating functions, Othogonality, Expansion of Polynomials, more generating functions.

(3.Chapter 7 Page 209-238)

Unit –II

Simple Laguerre Polynomials : Solution of Laguerre's Differential Equation, Generating Function, Rodrigue's Formula, Recurrence Relations, Laguerre Polynomials for particular values of n and x , Differential Equation of $L_n(x)$, Orthogonal Property of $L_n(x)$, Other Integral Relation.

(3.Chapter 8-I Page 239 – 257)

Unit –III

Generalized Laguerre Polynomials :Definition, Recurrence Relations, Rodrigue's Formula and Othogonality, Expansion, Some Special Result, More Generating Relations.

(3.Chapter 8-II Page 257 – 279)



Dr. A.P.J. Abdul Kalam University, Indore

Unit –IV

Chebyshev Polynomials :Independent Solution of Chebyshev's Equation, Expansion of $T_n(x)$ and $U_n(x)$, Generating Functions, Recurrence Relations, To determine $T_n(x)$ and $U_n(x)$ for given value of n , Orthogonal Properties of $T_n(x)$ and $U_n(x)$.

(3.Chapter 9 Page 280 -293)

Unit –V

The Jacobi Polynomials: The Jacobi polynomials, Bateman's generating function, The Rodrigues formula, Orthogonality, Differential recurrence relations, pure recurrence relation

(3. Chapter 10 Page 294 – 325)

Text Book

1. Rainville. E.D,Special functions, The Macmillan co., New York 1971.
2. Srivastava, H.M. Gupta, K.C. and Goyal, S.P.,The H-functions of One and Two Variables with applications, South Asian Publication, New Delhi.
3. Saran,N.,Sharma S.D. and Trivedi, - Special Functions with application, Pragati prakashan ,1986.



Dr. A.P.J. Abdul Kalam University, Indore

Class : M.Sc/ M.A.
(Mathematics)

Semester : IV

Title of subject/Group : Theory of Linear Operators– II

Paper No. : II/III/IV/V

Compulsory / Optional : Optional Gr-III(1)

Unit I

Behaviour of compact linear operators with respect to solvability of operator equations, Fredholm type theorems, Fredholm alternative theorem, Fredholm alternative for integral equations.

(1, Chapter 8, Sec 8.5, 8.6, 8.7).

Unit II

Spectral properties of bounded self adjoint operators on complex Hilbert spaces.

(1, Chapter 9, sec. 9.1&9.2)

Unit III

Positive operators and their square roots.

(1, Chapter 9, sec. 9.3&9.4).

Unit IV

Projections on complex Hilbert spaces and their properties.

(1, Chapter 9, sec. 9.5&9.6,).



Unit V

Spectral family of a bounded self adjoint linear operator and Spectral representation of bounded self adjoint linear operator.

(1, Chapter 9, sec 9.7, 9.8 & 9.9).

Note : Exercises based on the theory are expected to be solved .

Recommended books:

- 1. E.Kreyszig : Introductory Functional Analysis with applications, John wiley & sons, New York.**

Reference Books :

1. P.R.Halmos: Introduction to Hilbert space and the theory of spectral multiplicity, second edition, Chelsea publishing co.NY 1957
2. N.Dunford and J.T.Schwartz, Linear operator-part 3, Interscience/wiley, New York 1958-71



Dr. A.P.J. Abdul Kalam University, Indore

Class	: M.Sc/ M.A. (Mathematics)
Semester	: IV
Title of subject/Group	: Advanced Numerical Analysis-II
Paper No.	: II/III/IV/V
Compulsory / Optional	: Optional Gr-III(3)

Unit-I

Extrapolation Methods (Richardson Extrapolation) , Partial Differentiation and its estimations, Ordinary Differential Equations : Initial Value Problems, Reduction Of Higher Order Equation, Existence and Uniqueness, Test equations , System Of Linear First Order Differential Equation With Constant Coefficients and its theorem, Multi Step Methods , Various types of Explicit and Implicit Multistep Methods, General Multi Methods. Examples.

(1.Chapter 5 Section 5.4 , Section 5.5, Chapter 6 Section 6.1 and subsections, Section 6.6 , Definition 6.1,6.2,6.3,6.4 and examples)

Unit- II

Maximum order of k-step methods and theorems, Convergence Of Multi Step Methods, Predictor and Corrector Method, Modified Predictor and Corrector Method, Stability Analysis of Multistep Methods and theorems : First Order and Second Order differential equations.

(1.Chapter 6 Section 6.6 and subsections , Definition , 6.5,6.6,6.7 and examples. Section 6.7 and subsections, Section 6.8 and subsections.)



Dr. A.P.J. Abdul Kalam University, Indore

Unit-III

Ordinary Differential Equation , Boundary Value Problems : Shooting Method, Alternate Method , Nonlinear Second Order Differential Equation.

(1.Chapter 7 section 7.1 , Section 7.2 and subsections)

Unit -IV

Finite Difference Methods Linear Second Order Differential Equations, Local Truncation Error, Derivative Boundary Conditions, Solutions Of Tridiagonal System, Nonlinear Second Order Differential Equation, Convergence Of Difference Schemes and theorems, Stability Of Finite Difference Schemes

(1.Chapter 7 section 7.3 and subsections)

Unit-V

Finite Element Method, Solution of the Variation Problem, Ritz Method (Galerkin equations), Finite Elements, Linear Lagrange Polynomial, Ritz Finite Element Method, Finite element solution of Linear Boundary Value Problems, Assembly Of Element Equations, Mixed Boundary Conditions

(Chapter 7 section 7.4 and subsections)

Text Book

1. **Numerical Methods, Jain, Iyanger and Jain, New Age International Edition 2012.**



Dr. A.P.J. Abdul Kalam University, Indore

Class	: M.Sc/ M.A. (Mathematics)
Semester	: IV
Title of subject/Group	: OPERATIONS RESEARCH-II
Paper No.	: II/III/IV/V
Compulsory / Optional	: Optional Gr-IV(1)

Unit I

Transportation problems : Introduction, General transportation problem, duality in TP, Transportation Table , LP formulation of T.P., Initial solution of transportation problem : North - West Corner Method, Least – Cost Method, Vogel's Approximation Method, test for optimality by MODI (u-v method) method, economic interpretation, degeneracy in transportation problems, stepping stone algorithm.

(1.Chapter 10 sect 10.1 to 10.14, Examples and Exercises)

Unit II

Assignment problem : Introduction, Mathematical formulation of assignment problem, Solution of assignment problem : Hungarian Method , Special Cases: Unbalanced Assignment Problem, Maximisation Assignment Problems., Prohibited A.P., Dual of the assignment problem, Travelling Salesman problem. Dynamic Programming : Introduction, Characteristics , Dynamic Programming Algorithms.

(1. Chapter 11 sect 11.1 to 11.6, Chapter 13 sections 13.1 to 13.4,

Unit III

Network analysis : Introduction , Basic Terminology/Components, Rules of network construction, Critical Path Method (CPM), PERT Calculation, Difference between CPM /PERT.

(1. Chapter 25, sections 25.1 to 25.11, Examples and Exercises)



Dr. A.P.J. Abdul Kalam University, Indore

Unit IV

Game theory : Introduction, Two- person Zero - Sum Games, Basic Terms, The Maximix -Minimax principle, games without saddle points - Mixed strategies, dominance property, Graphical solution of $2 \times m$ and $m \times 2$ games, Arithmetic method for $n \times n$ games, Solution of $m \times n$ games by Linear Programming, General solution of $m \times n$ rectangular games, Limitations.

(1. Chapter 17, section 17.1 to 17.11, Examples and Exercises)

Unit V

Non-Linear programming Techniques Kuhn -Tucker Conditions with Non - negative Constraints, Quadratic Programming, Wolfe's simplex method, Beals method, Separable Convex Programming, Separable programming algorithm.

(1. Chapter 27, sections 27.1 to 27.7 , Chapter 28, 28.3 to 25.8, Examples and Exercises)

Recommended Books

1- Kanti Swarup, P.K. Gupta and Manmohan, Operations Research, Sultan Chand & Sons, New Delhi, fifteenth revised edition.

2- H.A. Taha, Operations Research - An introduction, Macmillan Publishing co. Inc. New york

Reference Books

1. S.D, Sharma, Operation Research,
2. F.S, Hiller and G.J. Lieberman, Industrial Engineering Series, 1



Dr. A.P.J. Abdul Kalam University, Indore

Class	: M.Sc/ M.A. (Mathematics)
Semester	: IV
Title of subject/Group	: Analytic Number Theory-II
Paper No.	: II/III/IV/V
Compulsory / Optional	: Optional Gr-V(3)

Unit I

Functional equation for the Riemann zeta function , Functional equation for the Hurwitz zeta function, Properties of Bernoulli numbers and Bernoulli polynomials.

(1. Chapter12 Section 12.8 to 12.12)

Unit II

Analytic proof of prime number theorem: A contour integral representation for $\frac{\psi_1(x)}{x^2}$, Upper bounds for $|\zeta(s)|$ and $|\zeta'(s)|$ near the line $\sigma = 1$.

(1. Chapter13 Section 13.1 to 13.4)

Unit III

The non-vanishing of $\zeta(s)$ on the line $\sigma = 1$, completion of the proof of the prime number theorem, Zero-free regions for $\zeta(s)$.

(1. Chapter13 Section 13.5 to 13.8)

Unit-IV

Geometric representation of partitions, Generating functions of partitions, Euler's pentagonal number theorem.

(1. Chapter14 Section 14.1 to 14.5)



Dr. A.P.J. Abdul Kalam University, Indore

Unit V

Euler's recursion formula for $p(n)$, Jacobi's triple product identity, The partition identity of Ramanujan.

(1. Chapter 14 Section 14.6 to 14.11)

*Exercise based on theory are expected to be solved.

Books Recommended:

1. T.M. Apostol, Introduction to Analytic Number Theory, Narosa Pub. House, 1989.



Dr. A.P.J. Abdul Kalam University, Indore

Class	: M.Sc/ M.A. (Mathematics)
Semester	: IV
Title of subject/Group	: Integral Transform – II
Paper No.	: II/III/IV/V
Compulsory / Optional	: Optional Gr-V(4)

Unit I

Laplace wave Equations, Problems based on wave equations using Laplace Transform.

(1.chapter 5 (page 362 – 373))

Unit II

Electric Circuits, Applications to Beams, Problems based on it using Laplace Transform.

(1.chapter 5 (page 342 – 334))

Unit III

The Complex Fourier Transform, Inversion Formula, Fourier cosine and sine Transform.

(1.chapter 2 section I(page 174 – 208) excluding section 2.3 and convolution theorem)

Unit IV

Properties of Fourier Transforms, Convolution & Parseval's identity.

(1.chapter 2 section II(page 213 – 216) Theorem 9 (convolution theorem) and 2.3))



Unit V

Fourier Transform of the derivatives, Finite Fourier Sine & Cosine Transform, Inversion formula for Sine & Cosine Transform, Operational and combined properties of finite Sine & Cosine Fourier Transform. Application of infinite Fourier Transform)

(1.chapter 2 section II(page 209) problem 8 – 26 (Page 222 – 240) , Chapter 6 problem 1-6 (page 375 – 380))

Books recommended:-

1. Integral Transform by Goyal & Gupta.



Dr. A.P.J. Abdul Kalam University, Indore

Class	: M.Sc/ M.A. (Mathematics)
Semester	: IV
Title of subject/Group	: Fundamentals of Computer Science (Theory and Practical) –II
Paper No.	: II/III/IV/V
Compulsory / Optional	: Optional Gr-VI(1)

Unit I

Data Structure: Analysis of Algorithms time and space requirements, Rate of growth, Standards Notations Big O, Θ (Theta), Ω (Sigma) , Array as an ADT, Stacks, Queues and Linked Lists, their Operations and Representations/implementations.

1. Chapter 1, Section 1.2 Chapter 2, Section 2.1,2.2,2.3.Chapter 4 section 4.1,4.2
2. Chapter 1 and sections (Exercise)

Unit II

Introduction to Trees and Binary Trees , Representation of general tree and Binary Tree, Sequential and Lists Representations of Binary tree, Binary search tree Implementations and evaluation, Extended ,Threaded and AVL Tree , B-Tree (concept only).

1. Chapter 5, Section 5.1,5.2,5.4,5.54 , Chapter 7 Section 7.2.
2. Chapter 8 and Sections

Unit III

Hashing – Open and Closed, Hash Function, sorting techniques, selection sort, Shell Sort, Quick Sort, Heap Sort, bubble sort and their analysis.

1. Chapter 7, Section 7.4
- 2 . Chapter 9 and Sections.



Unit IV

An Introduction to database System, Purpose and role of database system, Database Architecture. Database Users and Administrators. Structure of Relational Databases Database Schema, Keys, Schema Diagrams , Relational Query Languages , Relational Operations

Introduction to the Relational Model- Relational Algebra, Tuple Relational Calculus, Domain Relational Calculus

3. Chapter 1 section 1.11-1.12, Chapter 2, 2.1-2.6 ,Chapter 6 Section 6.1 – 6.4.

Unit V

Introduction to SQL, Overview of the SQL Query Language, SQL Data Definition, Basic Structure of SQL Queries ,Additional Basic Operations, Set Operations ,Null Values ,Aggregate Functions ,Nested Subqueries , Modification of the Database.

Join Expressions , Views , Transactions ,Integrity Constraints , SQL Data Types and Schemas ,Authorization

Relational Database design Normalization upto BCNF, Query Optimization strategies.

3. Chapter 3 Section 3.1 – 3.9, Chapter 4 Section 4.1-4.6, Chapter 8 Section 8.1,8.2,8.3 Chapter 13 Section 13.1

Text Book

1. **Data Structures Using C and C++, Yedidyah Langsam, Moshe J., A.M. Tenenbaum, Pearson Education.**
2. **Yashwant Kanetkar, BPB publications Ltd. New Delhi, 1st Edition.**
3. **DATABASE SYSTEM CONCEPTS Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Published by McGraw-Hill Sixth edition.**
4. **Robert L. Kruse, Bruce P. leung, Clovis L. Tondo, Data Structures and Program Design in C, Prentice- Hall Of India, New Delhi**



Dr. A.P.J. Abdul Kalam University, Indore

Class	: M.Sc/ M.A. (Mathematics)
Semester	: IV
Title of subject/Group	: Integration Theory – II
Paper No.	: II/III/IV/V
Compulsory / Optional	: Optional Gr-VI(3)

Unit I

Outer Measure and Measurability.

(1, Chapter 12, Sec.1).

Unit II

Measure on algebra, Measure on semi-algebra, Extension theory of these measures.

(1, Chapter 12, Sec.2).

Unit – III

Product Measures, Fubini's Theorem, Tonelli's Theorem, Examples to illustrate these theorems.

(1, Chapter 12, Sec.4).

Unit IV

Basic results on Locally compact Hausdorff Spaces, Baire Sets, Baire Measures, regularity of measures on locally compact Hausdorff Spaces.

(1, Chapter 13, Sec.1&2).

Unit V

Construction of Borel Measures, Integration of continuous functions with compact support on locally compact spaces, Riesz-Markov Theorem.

(1, Chapter 13, Sec.3&4).



Dr. A.P.J. Abdul Kalam University, Indore

Note : Exercises based on the theory are expected to be solved .

Recommended Books:

1. H.L.Royden, Real Analysis, Macmillan publishing co.Inc,New York,4th edition,1993.

Reference Books:

1. P.R.Halmos,Measure Theory, Van Nostrand.
2. I.K.Rana, Introduction to Measure and Integration, Narosa Publishing House, New Delhi.
3. Ole A.Nielson, An Introduction to Integration and Measure Theory , Canadian Mathematical Society Series of Monographs and advanced Texts, Wiley-Interscience Publication.