Annexure No.	**17 E**
SCAA Dated	**29.02.2008**

BHARATHIAR UNIVERSITY: COMBATORE – 641 046

M.Sc - MATHEMATICS DEGREE COURSE

(SCHOOL OF DISTANCE EDUCATION)

First Year		
Paper 1	**Algebra**	**100**
Paper 2	**Real Analysis**	**100**
Paper 3	**Differential Equations**	**100**
Paper 4	**Numerical Methods**	**100**
Paper 5	**Complex Analysis**	**100**
Second Year		
Paper 6	**Mechanics**	**100**
Paper 7	**Operations Research**	**100**
Paper 8	**Topology**	**100**
Paper 9	**Computer Programming (C++ Theory)**	**100**
Paper 10	**Functional Analysis**	**100**
Total Marks		**1000**

Question Paper Pattern:

Eight questions should be asked (at least one question from each unit) out of which five questions have to be answered (5 X 20 = 100 Marks).

PAPER I – ALGEBRA

UNIT-I:

Group Theory:

Another counting principle – Sylow's theorem – Direct products

UNIT-II:

Ring Theory:

Euclidean rings – A particular Euclidean ring – Polynomial rings – Polynomials over the rational field.

UNIT-III:

Fields:

Extension Fields – Roots of polynomials – More about roots – Solvabilty by radicals.

UNIT-IV:

Fields:

Elements of Galois theory – Finite Fields.

UNIT-V:

Linear Transformations:

Canonical forms: Triangular form –Nilpotent Transformation - Trace and Transpose – Hermitian, unitary and normal Transformations.

Treatment as in:

Topics in Algebra by I.N.Herstein (II Edition)

UNIT I	: Chapter 2 - Sections 2.11 to 2.13.
UNIT II	: Chapter 3 - Sections 3.7 to 3.10.
UNIT III	: Chapter 5 - Sections 5.1,5.3,5 and 5.5.
UNIT IV	: Chapter 5 - Section 5.6.5.7. Chapter 7 - Section 7.1.
UNIT V	: Chapter 6 - Sections: 6.4, 6.5, 6.8 and 6.10.

References:

"A First Course in Abstract Algebra" by J.B.Fraleigh, Narosa Publishing House, New Delhi, 1988.

PAPER II: REAL ANALYSIS

UNIT I:

RIEMANN STILTJES INTEGRAL:

Definition and Existence of the Integral – properties of the integral – Integration and differentiation – Integration of vector valued function – rectifiable curves.

UNIT II:

Uniform convergence and continuity – uniform convergence and integration - uniform convergence and differentiation – equicontinuous families of functions – The Stone Weirstrass theorem

UNIT III:

FUNCTIONS OF SEVERAL VARIABLES:

Linear transformation – contraction principle – Inverse function theorem – Implicit function theorem – determinants – derivatives of higher order – differentiation of integrals

UNIT IV:

LEBESGUE MEASURE AND LEBESGUE INTEGRAL:

Outer measure – Measurable sets and Lebesgue measure – Measurable functions – Littlewood's Theorem - The Lebesgue integral of bounded functions over a set of finite measure – integral of a non – negative function – General Lebesgue Integral – convergence in measure

UNIT V:

DIFFERENTIATION AND INTEGRATION

Differentiation of monotone function – Differentiation of an Integral – Absolute continuity – The Minkovski and Holder Inequalities – Convergence and Completeness – Bounded linear functionals on the L^p spaces.

Treatment as in:

Principles of Mathematical Analysis by W. Rudin, McGraw Hill, New York, 1976.

Unit I – III: Chapters 6, 7, 9.

Treatment as in: Real Analysis by H.L. Roydon, Third Edition, Macmillan, New York, 1988.

Unit IV: Chapters 3 and 4.

Unit V : Chapters 5 and 6.

References:

1. R.G.Bartle, Elements of Real Analysis, 2nd Edition, John Wily and Sons, New York, 1976.
2. W.Rudin, Real and Complex Analysis, 3rd Edition, McGraw-Hill, New York, 1986.

PAPER III: DIFFEENTIAL EQUATIONS

UNIT I:

Systems of first order equations – existence and uniqueness theorem – Fundamental matrix - Non-homogeneous linear systems – linear systems with constant coefficients – linear systems with periodic co-efficients.

UNIT II:

Successive approximation – Picard's theorem - Non-uniqueness of solution – Continuation and dependence on initial conditions, Existence of solutions in the large – Existence and uniqueness of solutions of systems.

UNIT III:

The Cauchy problem: The Cauchy problem – Cauchy – Kowlalewsky theorem – Homogeneous wave equation – Initial – Boundary value problems – Non-homogeneous boundary conditions – Finite string with fixed ends – Non-homogeneous wave equation.

UNIT IV:

Methods of separation of variables: Seperation of variables – The vibrating string problem – Existence and Uniqueness of solution of the vibrating string problem. The heat conduction problem – existence and uniqueness of solution of the heat conduction problem – The laplace and beam equations.

UNIT V:

Boundary value problems: Boundary value problems – Maximum and minimum principles – Uniqueness and continuity theorems – Dirichlet problems for a circle – Dirichlet problems for a circular annulus – Neumann problem for a circle Drirchlet problem for a rectangle – Dirichlet problem involving poission equation – Neumann problem for a rectangle.

Treatment as in:

1. Ordinary differential equations and stability theory by S.G.Deo and V.Raghavendra.

Unit I	-Chapter –4	-	Section 4.2 – 4.7
Unit II	-Chapter – 5	-	Section 5.3 – 5.8.

2. Partial Differential Equations for Scientists and Engineers, 3rd Edition, by Tyn Myint. U with Lokenath Debnath.

Unit III	-Chapter 4:	Sections 4.1 – 4.7
Unit IV	-Chapter 6:	Sections 6.2 – 6.6
Unit V	-Chapter 8:	Sections 8.1 – 8.9

Reference:

1. Theory of Ordinary Differential Equations by E.A.Coddington and N.Levinson.

PAPER IV: NUMERICAL METHODS

Unit I:

SOLUTION OF NONLINEAR EQUATIONS:

Newton's method – Convergence of Newton's method – Fixed point iteration: x=g(x) method – Bairstow"s Method for quadratic factors NUMERICAL DIFFERENTIATION AND INTEGRATION: Derivatives from Differences tables – Higher order derivatives – Divided difference, Central-Difference formulas – Composite formula of Trapezoidal rule – Romberg integration – Simpson's rules.

Unit II:

SOLUTION OF SYSTEM OF EQUATIONS:

The Elimination method – Gauss and Gauss Jordan methods – LU Decomposition method – Matrix inversion by Gauss-Jordan method – Methods of Iteration – Jacobi and Gauss Seidal Iteration – Relaxation method – Systems of Nonlinear equations.

Unit III:

SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS:

Taylor series method – Euler and Modified Euler methods – Runge-Kutta methods – Multistep methods – Milne's method – Adams Moulton method –Convergence Criteria – Systems of equations and Higher Order equations.

Unit IV:

BOUNDARY VALUE PROBLEMS AND CHARACTERISTIC VALUE PROBLEMS: The shooting method – solution through a set of equations – Derivative boundary conditions – Characteristic value problems – Eigen values of a matrix by Iteration – The power method.

Unit V:

NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS:

(Solutions of Elliptic, Parabolic and Hyperbolic partial differential equations) Representation as a difference equation – Solving for the temperatures in a Slab – Iterative methods – The Poisson equation – Derivative boundary conditions – Solving the equation for time-dependent heat flow (i) The Explicit method (ii) The Crank Nicolson method – Parabolic Equations in Two or Three dimensions – The wave equations in two dimensions..

Treatment as in:

1. APPLIED NUMERICAL ANALYSIS' by C.F.Gerald and P.O.Wheatley, Sixth Edition, Pearson Education, New Delhi (2003)..

Reference Books:

1. S.C. Chopra and P.C. Raymond: Numerical Methods for Engineers, Tata McGraw Hill, New Delhi, (2000)
2. R.L. Burden and J. Douglas Faires: Numerical Analysis, P.W.S.Kent Publishing Company, Boston (1989), Fourth Edition.
3. S.S. Sastry: Introductory methods of Numerical Analysis, Prentice Hall of India, New Delhi, (1998).

PAPER V: COMPLEX ANALYSIS

Unit I:

Introduction to the concept of analytic function: Limits and continuity – Analytic functions – Polynomials – Rational functions – Conformality: Arcs and closed curves – Analytic functions in regions – Conformal Mapping – Length and Area – Linear Transformations: The Linear group – The Cross ratio – Elementary Riemann Surfaces.

Unit II:

Complex Integration: Line Integrals Rectifiable Arcs – Line Integrals as Functions of Arcs – Cauchy's theorem for a rectangle - Cauchy's theorem in a disk, Cauchy's Integral formula: The Index of a point with respect to a closed curve – The Integral formula – Higher derivatives Removable singularities, Taylor's Theorem – Zeros and Poles – The Local Mapping – The Maximum principle – chains and cycles.

Unit III:

The Calculus of Residues: The Residue theorem – The Argument principle – Evaluation of definite integrals. Harmonic functions: The Definitions and basic Properties – Mean value property – Poisson's Formula – Schwarz's Theorem.

Unit IV:

Series and Product Developments: Weierstrass Theorem – The Taylor Series – The Laurent Series – Partial fractions and Factorization: Partial Fractions – Infinite Products – Canonical Products – Gamma function – Striling's Formula.

Unit V:

The Riemann Mapping Theorem – Statement and Proff – Boundary Behaviour – Use of the reflection principle – Analytic arcs – Conformal mapping of Polygons: The Behaviour at an angle – The Schwarz – Christoffel Formula – Mapping on a rectangle – General properties of elliptic functions – The Weirestrass ρ-function – The functions $\zeta(z)$ and $\sigma(z)$ – The Differential Equation.

Treatment as in:

1. Complex Analysis by L.V. Ahlfors, Mc Graw Hill, New York, 1979.

Unit I:	Chapter – 2	Sections 1.1 – 1.4
	Chapter – 3	Sections 2.1 – 2.4, 3.1, 3.2 and 3.4
Unit II:	Chapter – 4	Sections 1.1 – 1.5, 2.1 – 2.3, 3.1 - 3.4 and 4.1
Unit III:	Chapter – 4	Sections 5.1 – 5.3, 6.1 – 6.4
Unit IV:	Chapter – 5	Sections 1.1 – 1.3, 2.1 – 2.5
Unit V:	Chapter – 6	Sections 1.1 – 1.4, 2.1 – 2.3
	Chapter – 7	Sections 2.4, 3.1 – 3.3.

PAPER VI: MECHANICS

Unit I:

Survey of Elementary principles: Constraints - Generalized coordinates, Holonomic and non-holonomic systems, Scleronomic and Rheonomic systems. D'Alembert's principle and Lagrange's equations – Velocity – dependent potentials and the dissipation function – some applications of the Lagrange formulation.

Unit II:

Variation principles and Lagrange's equations: Hamilton's principle – Some techniques of calculus of variations – Derivation of Lagrange's Equations from Hamilton's principle – Extension of Hamilton's principle to non-holonomic systems – Conservation theorems and symmetry properties.

Unit III:

Hamilton Equations of motion: Legendre Transformations and the Hamilton Equations of motion-canonical equations of Hamilton – Cyclic coordinates and conservation theorems – Routh's procedure - Derivation of Hamilton's equations from a variational principle – The principle of least action.

Unit IV:

Canonical transformations: The equations of canonical transformation – Examples of Canonical transformations – Poission Brackets and other Canonical invariants The symplectic approach to canonical transformations– integral invariants of Poincare, Lagrange brackets.

Unit V:

Hamilton Jacobi Theory: Hamilton Jacobi equations for Hamilton's principle function – Harmonic oscillator problem - Hamilton Jacobi equation for Hamilton's characteristic function – Separation of variables in the Hamilton-Jacobi equation – Action-angle variables in systems of one degree of freedom.

Text Book:

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

Unit-I:	Chapter 1:	Sections 1.3 – 1.6
Unit-II:	Chapter 2:	Sections 2.1 – 2.4, 2.6
Unit-III:	Chapter 8:	Sections 8.1 – 8.3, 8.5, 8.6
Unit-IV:	Chapter 9:	Sections 9.1– 9.4
Unit-V:	Chapter 10:	Sections 10.1–10.5

References:

1. A.S. Ramsey, Dynamics Pert II, The English Language Book Society and Cambridge University Press, 1972.
2. F. Gantmacher, Lectures in Analytic Mechanics, MIR Publishers, Moscow, 1975.
3. I.M. Gelfand and S.V. Fomin, Calculus of Variations, Prentice Hall.
4. S.L. Loney, An Elementary Treatise on Statics, Kalyani Publishers, New Delhi, 1979.

PAPER – VII OPERATIONS RESEARCH

Unit I:

What is operation research? – Modeling with Linear Programming – Simplex method – Artificial starting solution – Special cases in the Simplex method, Sensitivity Analysis: Graphical solution only.

Unit II:

Duality – Definition – Primal – Dual relationship – Dual simplex method – Transportation model – Assignment model, Transshipment model

Unit III:

Network models – Minimal spanning tree algorithm – Shortest root algorithm (Dijkstra's algorithm only) – CPM - PERT, Maximal Flow model.

Unit IV:

Advanced linear programming – Simplex method Fundamentals – Revised simplex method, Duality: Matrix definition of the Dual problem, Optimal Dual solution.

Unit V:

Simulation modeling – Monte Carlo Simulation – Types of Simulation – Elements of discrete event Simulation – Generation of random numbers, Mechanics of discrete Simulation. Markov Chain, Absolute and n-step transition problem, Classification of the states in Markov Chain, Steady – State Probabilities and Mean Return Times of Ergodic Chains

Treatment as in:

1. Operations Research: An Introduction, by H.A. Taha, Eighth Edition, Prentice Hall of India Private Limited, New Delhi (2006).

Unit I:	Chapter 1:	1
	Chapter 2:	2.1, 2.2.1, 2.2.2
	Chapter 3:	3.1.1, 3.1.2, 3.3.1, 3.3.2, 3.4.1, 4.2, 3.5.1 – 3.5.4, 3.6.1
Unit II:	Chapter 4:	4.1, 4.2.1, 4.2.2, 4.2.3, 4.2.4, 4.4.1
	Chapter 5:	5.1, 5.2, 5.3.1, 5.3.2, 5.4.1, 5.4.2, 5.5
Unit III:	Chapter 6:	6.1, 6.2, 6.3.1, 6.3.3, 6.4.1, 6.4.2, 6.5.1 – 6.5.5
Unit IV:	Chapter 7:	7.1.1, 7.1.2, 7.2.1, 7.2.2, 7.4.1, 7.4.2
Unit V:	Chapter 16:	16.1, 16.2, 16.3.1, 16.3.2, 16.4, 16.5, 17.1-17.4

PAPER – VIII TOPOLOGY

Unit I:

Infinite sets and the Axiom of Choice. Well-ordered sets – The Maximum Principle – Topological spaces – Basis for a Topology – The Order Topology – Product Topology – Closed sets and Limit Points – Continuous Functions – Metric Topology.

Unit II:

Connectedness and Compactness: Connected Spaces – Connected sets in R – Components and path components – Local connectedness – Compact Spaces – Limit Point Compactness – Urysohn Metrization Theorem.

Unit III:

Countability and Separation Axioms: Countability Axioms – Separation Axioms Urysohn's Lemma – Urysohn Metrization Theorem.

Uni IV:

The Tychonoff Theorem – Completely regular spaces – The stone-Cech Compactification - Complete Metric Spaces – Compactness in Metric Spaces – Pointwise and Compact Convergences – The Compact-Open Topology – Ascoli's Theorem

Unit V:

Homotopy of Paths – The Fundamental Group – Covering Spaces – Fundamental Group: Circle, Punctured Plane, S^n.

Text Book:

1. Topology A First Course by James R. Munkres, Prentice Hall of India Private Limited, New Delhi, 2000.

Unit-I:	Chapter 1:	Sections 1.9 – 1.11
	Chapter 2:	Sections 2.1 – 2.9
Unit-II:	Chapter 3:	Sections 3.1 – 3.8
Unit-III:	Chapter 4:	Sections 4.1 – 4.4
Unit-IV:	Chapter 5 & 7	Sections 5.1 – 5.3, 7.1, 7.3 – 7.6.
Unit-V:	Chapter 8:	Sections 8.1 – 8.6

References:

1. J. Dugundji, Topology, Allyn and Bacon, 1966 (Reprinted in India by Prentice Hall of India Private Limited.).
2. George F. Simmons, Introduction to Topology and Modern Analysis, McGraw Hill Book Company, 1963.
3. J.L. Kelley, General Topology, Van Nostrand, Reinhold Co., New York, 1995.
4. L. Steen and J. Seebach, Counter examples in Topology, Holt, Rinehart and Winston, New York, 1970.
5. R. Engelking, General Topology, Polish Scientific Publishers, Warszawa, 1977.
6. Sze – Tsen Hu, elements of General Topology, Holden – Day, Inc. 1965.

PAPER IX: COMPUTER PROGRAMMING
(C++ THEORY)

Unit I:

Principles of object-Oriented Programming: Software crisis – Software evolution – A look at procedure-oriented Programming – Object-oriented Programming Paradigm – Basic Concept of Object-Oriented Programming – Benefits of OOP – Object-Oriented languages – Applications of OOP.

Unit II:

Tokens, Expressions and Control structure: Introduction – Tokens – Keywords – Identifiers and constants – basic data types – User defined data types - Derived data types – Symbolic constants – type compactability – Declaration of variables – Dynamic insulation of variables – Reference variables – operations in C++ - Scope resolution operator – member Dereferencing operators – memory management operators – Manipulators – typr cast operator – expressions and their types – Special assignment expressions – implicit conversions – operator over loading – operator precedence – Control structures.

Unit III:

Functions in C++: Introduction – The main function – Function prototyping – call by reference – return by reference inline functions – default arguments – constant arguments – function over loading – friend and virtual functions – Math library functions –

Managing Console I/O operations: Introduction – C++ streams – C++ stream classes – Unformatted I/O operations - Formatted I/O operations – Managing output with manipulators.

Unit IV:

Classes and Objects: Introduction – C Structures Revisited – Specifying a class – Defining Member Functions – A C++ Program with class – Making an outside Function Inline – Nesting of Member Functions – Private Member Functions – Arrays within a class – Memory Allocation for Objects – Static Data Members – Static Member Functions – Arrays of Objects – Objects as Function Arguments – Friendly functions – Returning Objects – Constant Member Functions.

Constructors and Destructors: Introduction – Constructors – Parameterized Constructors – Multiple Constructors in a class – Constructors with Default Arguments – Dynamic Initializations of Objects – Copy Constructor – Constructing Two dimensional arrays – Constant Objects – Destructors.

Unit V:

Operators Overloading and Type Conversions: Introduction – Defining Operator Overloading – Overloading Unary Operators – Overloading Binary Operators – Overloading Binary Operators Using Friends – manipulating of strings Using Operators – Rules of Overloading Operators.

Inheritance: Extending Classes: Introduction – Defining Derived Classes – Single inheritance – Making a Private Member Inheritable – Multilevel Inheritance – Multiple Inheritance – Hierachial Inheritance – Hybrid Inheritance – Virtual Base Classes – Abstract Classes – Constructors in Derived Classes – Member Classes: Nesting of Classes.

Treatment as in:

Object – Oriented Programming with C++ by E. Balaguruswamy, Tata McGraw-Hill Publishing Company limited, 1999.

Unit I	:	1.1 – 1.8
Unit II	:	3.1 – 3.24
Unit III	:	4.1 – 4.11 and 10.1 – 10.6
Unit IV	:	5.1 – 5.17, 6.1 – 6.7 and 6.9 – 6.11
Unit V	:	7.1 – 7.7 and 8.1 – 8.12

PAPER X: FUNCTIONAL ANALYSIS

Unit I:

Banach spaces – The definition and some examples – Continuous linear transformations – The Hahn-Banach theorem – The natural imbedding of N in N** - The open mapping problem- The conjugate of an operator.

Unit II:

Hilbert spaces – The definition and some simple properties – Orthogonal complements - Orthonormal sets- The Conjugate space H* - The adjoint of an operator – Self-adjoint operators – Normal and unitary operators.

Unit III:

Projections -Matrices – Determinants and the spectrum of an operator – The spectral theorem.

Unit IV:

The definition and some examples of Banach algebra – Regular and singular elements – Topological divisors of zero – The spectrum – The formula for the spectral radius-The radical and semisimplicity

Unit V:

The Gelfand mapping-Applications of the formula $r(x)=\lim\|x^n\|^{(1/n)}$ – Involutions in Banach algebras- The Gelfand-Neumark theorem- Ideals in C(X) and the Banach-Stone theorem.

Treatment as in:

G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw –Hill Book Company, London, 1963.

Unit I:	Sections: 46 – 51.
Unit II:	Sections: 52 – 58.
Unit III:	Sections: 59 – 62.
Unit IV:	Sections: 64 – 69.
Unit V:	Sections: 70 – 74.

Reference Books:

1. C. Goffman and G. Pedrick, A First Course in Functional Analysis, Prentice Hall of India, New Deli, 1987.
2. G. Bachman and L. Narici, Functional Analysis, Academic Press, New York, 1966.
3. L.A. Lusternik and V.J. Sobolev, Elements of Functional Analysis, Hindustan Publishing Corporation, New Delhi, 1971.
4. A.E. Taylor, Introduction to Functional Analysis, John Wiley and Sons, New York, 1958.