**THE MADURA COLLEGE (Autonomous), MADURAI – 625 011**

**(AFFILIATED TO MADURAI KAMARAJ UNIVERSITY)**

**RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC**

**PROGRAMME: M.Sc., Mathematics** **COURSE CODE : 1PGM1(2015 On & Upto 2014)**

**COURSE TITLE : Real Analysis** **QN.NO : 1401**

**TIME : 3 Hours** **MAX.MARKS :75**

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**Unit I: Continuity:** Limits of Functions- Continuous Functions - Continuity and Compactness- Continuity and Connectedness- Discontinuities- Monotonic Functions - Infinite Limits and Limits at Infinity.

**Unit II: Differentiation:** The Derivative of a Real Function- Mean Value Theorems - The Continuity of Derivatives - L'Hospital's Rule - Derivatives of Higher Order - Taylor's Theorem - Differentiation of Vector - valued Functions.

**Unit III: The Riemann - Stieltjes Integral:** Definition and Existence of the Integral - Properties of the Integral - Integration and Differentiation - Integration of Vector - Valued Functions - Rectifiable Curves.

**Unit IV: Sequences and Series of Functions:** Discussion of Main Problem - Uniform Convergence - Uniform Convergence and Continuity - Uniform Convergence and Integration - Uniform Convergence and Differentiation - Equicontinuous Families of Functions - The Stone -Weierstrass Theorem.

**Unit V: Some Special Functions:** Power Series - the Exponential and Logarithmic Functions - the Trigonometric Functions the Algebraic Completeness of the Complex Field- Fourier series - The Gamma Function.

**Text book:** Principles of Mathematical Analysis by Walter Rudin, 3rd Edition, Tata McGraw-Hill international Edition (1976).
Chapters: 4, 5, 6, 7, 8.

**Reference books:** 1. Mathematical Analysis by T.M. Apostol, 28th Reprient 2002, Narosa Publishing House.
2. Introduction to Real Analysis by S.K. MAPA, 4th Edition 2004, Sarat Book Distributors.

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# THE MADURA COLLEGE (Autonomous), MADURAI – 625 011

**(AFFILIATED TO MADURAI KAMARAJ UNIVERSITY)**

**RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC**

**PROGRAMME: M.Sc., Mathematics** **COURSE CODE : 1PGM2(2015On & Upto 2014)**

**COURSE TITLE : Algebra** **QN.NO : 1403**

**TIME : 3 Hours** **MAX.MARKS :75**

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**Unit I: Group Theory:** Definition of a Group – Some Examples – Some Preliminary Lemmas – Subgroups – A Counting Principle - Normal Subgroups.

**Unit II: Quotient and Permutation groups:** Quotient Groups – Homomorphism – Automorphisms – Cayley's Theorem – Permutation Groups.

**Unit III: Sylow's theorem and Direct Products:** Another Counting Principle – Sylow's Theorems – Direct Products – Finite Abelian Groups.

**Unit IV: Ring Theory:** Definition and Examples of Rings – Some Special Classes of Rings – Homomororphisms – Ideals and Quotient Rings – More Ideals and Quotient Rings – The Field of Quotient of an Integral Domain.

**Unit V: Polynomial Rings:** Euclidean Rings – A Particular Euclidean Ring -Polynomials over the Rational Fields – Polynomial Rings over Commutative Rings.

**Text Book:**

Topics in Algebra by I. N. Herstein, 2nd Edition 2006, John Wiley and Sons.
Chapters: 2 (2.1 to 2.14), 3 (3.1 to 3.11).

**Reference Books:**

1. University Algebra by N.S. Gopalakrishnan, New Age Publications, New Delhi, 2010
2. A First Course in Abstract Algebra by J.B. Fraleigh, Dorling Kindersley (India) Pvt. Limited (2003).

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**THE MADURA COLLEGE (Autonomous), MADURAI – 625 011**
**(AFFILIATED TO MADURAI KAMARAJ UNIVERSITY)**
**RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC**

**PROGRAMME: M.Sc., Mathematics** **COURSE CODE : 1PGM3 (2015 on & Upto 2014)**

**COURSE TITLE : Topology** **QN.NO : 1405**

**TIME : 3 Hours** **MAX.MARKS :75**

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**Unit I: Topological Spaces:**

Definition and Examples of Topological space - Basis for a topology – The order topology – The product topology of two topological spaces – The subspace topology - Closed sets and limit points.

**Unit II: Continuity and Product Topology:**

Continuous Functions - Equivalent formulations of Continuity – Homeomorphisms - Constructions of continuous functions - The product topology – The Metric Topology - The quotient topology.

**Unit III: Connectedness:**

Connected spaces – Connected subspaces of Real Line - Components and local connectedness - Compact spaces.

**Unit IV: Compactness:**

Compact subspaces of the Real Line – Limit Point Compactness - Local compactness – The Tychonoff Theorem.

**Unit V: Separation axioms:**

The Countability axioms – The Separation axioms - Normal spaces - The Uryshon lemma.

**Text Book:**

Topology by J. R. Munkres, 2nd Edition 2014, PHI Learning Private Limited.
Sections: 12 to 33 and 37.

**Reference Books:**

1. An Introduction to Topology by B.Mendelson, 3rd edition, CBS Publishers.
2. Introduction to Topology and Modern Analysis by G.F.Simmons, 12th Reprint 2010, Tata McGraw - Hill Publications.

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# THE MADURA COLLEGE (Autonomous), MADURAI – 625 011

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**RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC**

**PROGRAMME: M.Sc., Mathematics** **COURSE CODE : 1PGM4 (2015 On / 3PGM2 Upto 2014 )**

**COURSE TITLE : Differential Equations** **QN.NO : 1407**

**TIME : 3 Hours** **MAX.MARKS :75**

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**Unit I: Linear Equation of the first order:**

Introduction – Classification – Initial and boundary value problems – Purpose of theoretical considerations – First order linear equation – Exact equation – Separable equations.

**Unit II: Linear Differential Equation of the Higher Order:**

Introduction – Higher order equation – A modeling problem – Linear independence – Equations with constant coefficients – Equations with variable coefficients Wronskian – Variation of parameters – Some standard methods.

**Unit III: Solutions in Power series:**

Introduction – Second order linear equations with ordinary properties – Legendre equations and Legendre polynomials – Second order equations with regular singular point – Properties of Bessel functions.

**Unit IV: Partial Differential Equation of first Order:**

Introduction – Origins of first order partial differential equations – Linear equation of first order – Integral surfaces passing through a given curve – Orthogonal to a given system of surfaces – Cauchy's method of characteristics – Compatible system of first order equations – Charpit's method – Special types of first order equation.

**Unit V: Partial Differential Equation of Second Order:**

Introduction – The origin of second order equation – Linear partial differential equation with constant coefficients – Linear partial differential equation with variable coefficients.

**Text Books:**

1. Text Book of Ordinary Differential Equations – F.G. Deo, L. Lakshmikandan, V. Ragavendra, 2nd Edition, Tata-McGraw Hill (1997).

Chapters:

1. (Sec. 1.1, 1.3, 1.4, 1.6 - 1.9), 2(Sec. 2.1 - 2.9), 3(Sec. 3.1 - 3.5).

2. Elements of partial differential equations – I.N. Snedon, International Student Edition, McGraw Hill (1957).

Chapter: 2(Sec. 2.1 - 2.11), 3(Sec.3.1, 3.4, 3.5).

**Reference Books:**

1. An Introduction to Ordinary Differential equations by Earl A. Coddington, PHI (2013).
2. Partial Differential Equations by K. S. Bhamra, PHI (2010).

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**(AFFILIATED TO MADURAI KAMARAJ UNIVERSITY)**

**RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC**

**PROGRAMME: M.Sc., Mathematics** **COURSE CODE : 1PGM5 (2015 on & Upto 2014)**

**COURSE TITLE : Theory of Numbers** **QN.NO : 1409**

**TIME : 3 Hours** **MAX.MARKS :75**

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**Unit I: Divisibility:**

Introduction – Definition – Division algorithm – Euclidean algorithm – Primes – Fundamental theorem of arithmetic.

**Unit II: Congruence:**

Definition – Fermat's theorem – Wilson's theorem – Solutions of congruence's - Congruence's of degree 1 - Function of $\varphi(n)$.

**Unit III: Quadratic Reciprocity:**

Quadratic residues – Lemma of Gauss – Gaussian reciprocity law - Jacobi symbol.

**Unit IV: Functions of Number theory:**

Greatest integer function – Arithmetic function – Moebius inversion formula – Multiplication of arithmetic function.

**Unit V: Diophantine equations and continued fractions-**

Definition – The linear equation - Positive solutions – Other linear equations - The equation $x^2 + y^2 = z^2$ - the equation $x^4 + y^4 = z^2$ - Euclidean algorithm – Uniqueness – Infinite continued functions.

**Text book:**

An introduction to the theory of numbers by Ivan Niven and Herbert Zuckerman, 3rd Edition 1972, Wiley Eastern Limited.

Chapters: 1, 2(2.1-2.4), 3, 4(4.1-4.4), 5(5.1-5.6), 7(7.1-7.3).

**Reference Books:**

1. Introduction to Analytic Number Theory by Tom M. Apostol, Narosa Publishing Housing Pvt. Ltd. (1998).

2. A Course in Number Theory by Neal Koblitz, 2nd Edition, Springer-Verlag (2002).

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**RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC**

**PROGRAMME: M.Sc., Mathematics** **COURSE CODE : 2PGM1 (2015 On & Upto 2014)**

**COURSE TITLE : Measure Theory** **QN.NO : 1411**

**TIME : 3 Hours** **MAX.MARKS :75**

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**Unit I**: **Measure on the Real Line:**

Lebesgue Outer Measure - Measurable Sets - Regularity - Measurable Functions.

**Unit II**: **Integration of Functions of a Real Variable:**

Borel and Lebesgue Measurability - Hausdorff Measures on the Real Line - Integration of Non-negative Functions - The General Integral.

**Unit III**: **Integration of Functions of a Real Variable (Continued):** I

ntegration of Series - Riemann and Lebesgue Integrals - The Four Derivates.

**Unit IV**: **Inequalities and the $L^P$ Spaces:**

The $L^P$ Spaces - Convex Functions - Jensen's Inequality - The Inequalities of Holder and Minkowski - Completeness of $L^P$ (M).

**Unit V**: **Signed Measures and their Derivatives:**

Signed Measures and the Hahn Decomposition - The Jordan Decomposition - The Radon-Nikodym Theorem.

**Text Book:**

Measure Theory and Integration by G. de Barra, 1st Edition 1981(Reprint: 2008), New Age International Publishers.

Chapters: 2(sect. 2.1- 2.4, 2.5, 2.6), 3(sec.3.1 - 3.4), 4(sec.4.1 only), 6(sec.6.1 - 6.5), 8(8.1 - 8.3).

**Reference Books:**

1. Principles of Mathematical Analysis by Walter Rudin, Third edition, McGraw Hill, International Student Edition (1976).
2. Real analysis by H.L Royden, Third Edition, Prentice-Hall of India Private ltd (2004).

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**RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC**

**PROGRAMME: M.Sc., Mathematics** **COURSE CODE : 2PGM2 (2015 on & Upto 2014)**

**COURSE TITLE : Linear Algebra** **QN.NO : 1413**

**TIME : 3 Hours** **MAX.MARKS :75**

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**Unit I: Vector Spaces and Modules:**

Elementary Basic Concepts of Vector Spaces – Linear independence and Basis – Dual Spaces – Inner Product Spaces – Modules.

**Unit II: Fields:**

Extension Fields – Roots of Polynomials – Construction with Straightedge and Compass - More about Roots.

**Unit III: Galois Theory:**

The Elementary Galois Theory –Solvability by Radicals – Galois group over the Rational – Finite Fields.

**Unit IV: Linear Transformations:**

The Algebra of Linear Transformations – Characteristic Roots – Matrices – Canonical Forms: Triangular Form only.

**Unit V: Matrices and Linear Operators:**

Trace and Transpose – Determinants - Hermition, Unitary and Normal Transformations.

**Text Book:**

Topics in Algebra by I. N. Herstein, 2nd Edition 2006, John Wiley and Sons.

Chapters: 4 (4.1 – 4.5), 5 (5.1, 5.3 – 5.8), 6 (6.1 – 6.4, 6.8 – 6.10), 7 (7.1).

**Reference Books:**

1. A First Course in Abstract Algebra by J.B. Fraleigh, Dorling Kindersley (India) Pvt. Limited (2003).

2. Linear Algebara by Kenneth Hoffman and Ray Kunze, Second Edition, PHI Leaner's Private Limited (2012).

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**RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC**

**PROGRAMME: M.Sc., Mathematics** **COURSE CODE : 2PGM3 (2015 on) / 1PGM4(Upto 2014)**

**COURSE TITLE : Classical Mechanics** **QN.NO : 1415**

**TIME : 3 Hours** **MAX.MARKS :75**

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**Unit I: Survey of Elementary Principle:**

Introduction - mechanics of a particle – mechanics of a system of particles – constraints' - D'Alembert's principle and Lagrange's equation.

**Unit II: Survey of Elementary Principle (Continued):**

Velocity dependent potentials and the dissipation function- simple applications of the lagrangian formulation – some techniques of the calculus of variations.

**Unit III: Lagrange's equation and Hamilton's equation:**

Derivation of Lagrange's equation from Hamilton's principle – extension of Hamilton's principle to non –Holonomic systems – Advantages of a variational principle formulation – conservation theorems and symmetry properties.

**Unit IV: The two – body central force theorem:**

Reduction to the equivalent one-body problem – the equation of motion and first integrals – the equivalent one-dimensional problem and classification of orbits – the virial theorem.

**Unit V: Kepler problem:**

The differential equation for the orbit and integrable power-law potentials – conditions for closed orbits (Betrand's theorem) – the Kepler problem - Inverse square law of force - The motion in time in the Kepler problems – the Laplace -Runge-Lenz vector.

**Text Book**:

Classical Mechanics by Herbert Goldstein, 2nd edition, Pearson New International Edition (2001). Chapters: 1, 2, 3(3.1-3.9).

**Reference Books:**

1. Classical Mechanics by K. Sankara Rao, PHI (2005).
2. Classical Mechanics by J. C. Upadhyana, Reprint 2009, Himalaya Publishing House.

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**RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC**

**PROGRAMME: M.Sc., Mathematics** **COURSE CODE : 2PGM4(2015 on)/ 2PGM3 (Upto 2014)**

**COURSE TITLE : Numerical Analysis** **QN.NO : 1417**

**TIME : 3 Hours** **MAX.MARKS :75**

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**Unit I: Transcendental and Polynomial Equations:**

Iterative method based on second degree equations-Muller method - Chebyshev method – Multi point iteration methods - Rate of convergence for Muller and chebyshev method.

**Unit II: System of linear and Algebraic equations:**

Eigen value and Eigen vectors- Jacobi Method for symmetric matrices- Given method for symmetric matrices - House Holder method for symmetric matrices - Rutishauser method for arbitrary matrices – Power method for finding largest Eigen values and Eigen vectors.

**Unit III: Interpolation and Approximation:**

Piecewise linear interpolation- Piecewise quadratic interpolation- linear spline interpolation- Quadratic spine interpolation, Cubic spline interpolation.

**Unit IV: Differentiation and Integration:**

Introduction- Numerical Differentiation-Extrapolation methods- Partial differentiation- Numerical Integration-Methods based on Interpolation.

**Unit V: Ordinary Differential Equations:**

Initial value problems- Introduction-Differential Equations- Numerical Methods.

**Text Book:**

Numerical Methods by M.K. Jain, S.R.K. Iyengar, R.K. Jain, 6th Edition 2012, New Age International Pvt. Ltd. Publisher.

Chapters: (2.1, 2.2, 2.3, 2.4, 2.5), (3.1,3.2,3.4,3.5,3.6), (4.1,4.2,4.3,4.4,4.5,4.6), (5.1,5.2,5.4,5.5,5.6,5.7), (6.1,6.2,6.3).

**Reference Books:**

1. Numerical Analysis by Francis Scheid, Schaum's Series, Tata McGraw - Hill (1968).

2. Numerical Analysis by David Kincaid and Ward Cheney, 3rd Edition 2009, AMS Publication.

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**(AFFILIATED TO MADURAI KAMARAJ UNIVERSITY)**

**RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC**

**PROGRAMME: M.Sc., Mathematics** **COURSE CODE : 2PGM5(2015 on & Upto 2014)**

**COURSE TITLE : Fuzzy Mathematics** **QN.NO : 1419**

**TIME : 3 Hours** **MAX.MARKS :75**

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**Unit I: Crisp Sets and Fuzzy Sets:**

Introduction - Crisp Sets– The Notation of Fuzzy Sets- Basic Concepts of fuzzy sets- Classical Logic - Fuzzy Logic.

**Unit II: Operations on Fuzzy Sets:**

General discussion- Fuzzy Complements- Fuzzy Union - Fuzzy Intersection- Combinations of Operations- General Aggregation Operations.

**Unit III: Fuzzy Relations:**

Crisp and Fuzzy Relations- Binary Relations- Binary Relations on a Single Set- Equivalence and similarity Relations- Compatibility or tolerance Relations- Fuzzy Relation techniques.

**Unit IV: Fuzzy Measures:**

General discussion - Belief and Plausibility measures- Probability measures- Possibility and Necessity measures.

**Unit V: Uncertainty and Information:**

Types of uncertainty- Measures and Fuzziness- Classical measures and uncertainty- Management and Decision making.

**Text Book:**

Fuzzy Sets, Uncertainty and Information by George J. Klir and Tina A. Folger, Edition 2012, PHI. Chapters: 1, 2, 3(3.1- 3.5, 3.8), 4(4.1- 4.4), 5(5.1-5.3), 6(6.5).

**Reference Books:**

1. Fuzzy sets, theory and its applications by H. J. Zimmermann, 4th edition, Springer International edition (2010).

2. Fuzzy sets and their applications by Pundir. Pundir(Fourth Revised Edition 2012),Pragati Prakashan Educational Publishers.

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**RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC**

**PROGRAMME: M.Sc., Mathematics** **COURSE CODE : 3PGM1(2015 on)/ 2PGM4 (Upto 2014)**

**COURSE TITLE : Complex Analysis** **QN.NO : 1421**

**TIME : 3 Hours** **MAX.MARKS :75**

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**Unit I: Complex Functions:**

Introduction to the Concept of Analytic Function - Limits and Continuity - Analytic Functions - Polynomials - Rational Functions - Elementary Theory of Power Series - Sequences - Series - Uniform Coverage's - Power Series - Abel's Limit Theorem

**Unit II: Analytic Functions as Mappings:**

Conformality - Arcs and Closed Curves - Analytic Functions in Regions - Conformal Mapping - Length and Area - Linear Transformations - The Linear Group - The Cross Ratio – Symmetry.

**Unit III: Complex Integration:**

Fundamental Theorems - 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.

**Unit IV: Local Properties of Analytical Functions:**

Removable Singularities - Taylor's Theorem - Zeros and Poles - The Local Mapping - The Maximum Principle. The General Form of Cauchy's Theorem - Chains and Cycles - Simple Connectivity - Homology - The General Statement of Cauchy's Theorem - Proof of Cauchy's Theorem - Locally Exact Differentials - Multiply Connected Regions.

**Unit V: The Calculus of Residues:**

The Residue Theorem - The Argument Principle - Evaluation of Definite Integrals- Harmonic Functions - Definition and Basic Properties - the Mean-value Property - Poisson's Formula - Schwarz's Theorem - the Reflection Principle.

**Text Book:**

Complex Analysis by Lars Ahlfors, 3rd edition, McGraw - Hill International Editions (1979). Chapters: 2(sec. 1, 2), 3(sec. 2, 3 (3.1 to 3.3 only)), 4(sec. 1- 3, .4 (4.1to 4.5 only), 5, 6.

**Reference Books:**

1. Complex analysis by V. Karunakaran, 2nd Edition 2009, Narosa Publications.
2. Functions of Complex Analysis: Theory and Applications by K.K. Dube,
3. I K International Publishing House Pvt. Ltd. (2009).

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**RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC**

**PROGRAMME: M.Sc., Mathematics** **COURSE CODE : 3PGM2(2015 on) / 4PGM1(Upto 2014)**

**COURSE TITLE : Differential Geometry** **QN.NO : 1423**

**TIME : 3 Hours** **MAX.MARKS :75**

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**Unit I: The Theory of Space Curves:**

Introductory remarks about space curves - Definitions - Arc length - Tangent, normal, and binormal - Curvature and torsion of a curve given as the intersection of two surfaces - Contact between curves and surfaces - Tangent surface, involutes and evolutes.

**Unit II: The Theory of Space Curves (continued) and the Metric: Local Intrinsic Properties of a Surface:**

Intrinsic equations, fundamental existence theorems for space curves -Helices -Definition of a surface -Curves on a surface -Surfaces of revolution –Helicoids.

**Unit III: The Metric: Local Intrinsic Properties of a Surface(continued):**

Metric -Direction coefficients -Families of curves - Isometric correspondence -Intrinsic properties -Geodesics -Canonical geodesic equations -Normal property of geodesics.

**Unit IV: The Metric: Local Intrinsic Properties of a Surface (continued):**

Existence theorems - Geodesic parallels - Geodesic curvature - Gauss-Bonnet theorem - Gaussian curvature - Surfaces of constant curvature - Conformal mapping -Geodesic mapping.

**Unit V: Second Fundamental Form: Local Non-Intrinsic Properties of a Surface:**

The second fundamental form - Principal curvatures - Lines of curvature - Developable - Developable associated with curves on surfaces - Minimal surfaces - Ruled surfaces.

**Text Book:**

An Introduction to the Differential Geometry by T.J Willmore, Oxford University Press (2008). Chapters: I (sec.1- 9), II (sec.1 – 20), III (sec.1 – 8).

**Reference Books:**

1. Differential geometry of Three Dimensions by C.E. Weatherburn, Edition 1964, Reprint 1971, The English Language Book Society and Cambridge University Press.

2. Differential Geometry by P.P. Gupta, G.S. Malik and S.K. Pundir, 4th edition 2012, Pragati Prakashan.

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**RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC**

**PROGRAMME: M.Sc., Mathematics** **COURSE CODE : 3PGM3(2015 On & Upto 2014)**

**COURSE TITLE : Statistics** **QN.NO : 1425**

**TIME : 3 Hours** **MAX.MARKS :75**

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**Unit I: Distributions of functions of Random Variables**:

Sampling theory -Transformation of variables of discrete type - Continuous type - T-distribution - F-distribution

**Unit II: Order Statistics:**

Order statistics and its distribution - Moment generating function technique - Distribution of $\overline{X}$ and $\frac{ns^2}{\sigma^2}$

**Unit III: Limiting distribution:**

Stochastic convergence - Limiting moment generating function - Central limit theorem, some theorems on limiting distribution

**Unit IV: Estimation Theory:**

Point estimations - measures of quality estimators, confidence of intervals and means - Confidence interval for variances - Bayesian estimation.

**Unit V: Testing of hypothesis:**

Statistical hypothesis - Cartesian best tests - Uniformly most powerful tests - Likely hood ratio test.

**Text Book:**

Introduction to Mathematical Statistics by Robert V. Hogg, Alex T. Craig, 4th edition, Macmillan Publishing Co. Inc(1970).

Chapters: 4, 5, 6, 7.

**Reference Books:**

1. Statistical Methods by S. P. Gupta Revised Edition 2011, S.Chand Publishing.

2. Fundamentals of Mathematical Statistics by S.C. Gupta, V.K. Kapur, Reprint 2000, Sultan Chand & Sons.

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**RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC**

**PROGRAMME: M.Sc., Mathematics** **COURSE CODE : 3PGM4(2015 on & Upto 2014)**

**COURSE TITLE : Operation Research** **QN.NO : 1424**

**TIME : 3 Hours** **MAX.MARKS :75**

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**Unit I: Deterministic Inventory Models:**

General Inventory Model - Role of Demand in the Development of Inventory Models - Static Economic-Order-Quantity (EOQ) Models - Classic EOQ model - EOQ with Price Breaks - Multi-Item EOQ with Storage Limitation.

**Unit II: Queuing Systems:**

Why Study Queues? - Elements of a Queuing Model - Role of Exponential Distribution - Pure Birth and Death Models (Relationship between the Exponential and Poisson Distributions) - Pure Birth Model - Pure Death Model - Generalized Poisson Queuing Model.

**Unit III: Queuing Models:**

Specialized Poisson Queues - Steady-State Measures of Performance - Single-Server Models - Multiple-Server Models.

**Unit IV: Classical Optimization Theory:**

Unconstrained Problems - Necessary and Sufficient Conditions - The Newton-Raphson Method - Constrained Problems - Equality Constraints - Inequality Constraints.

**Unit V: Nonlinear Programming Algorithms:**

Unconstrained Algorithms - Direct Search Method - Gradient Method - Constrained Algorithms - Separable Programming - Quadratic Programming - Chance-Constrained Programming - Linear Combinations Method.

**Text Book:**

Operations Research: An Introduction by Hamdy A. Taha, 6th Edition, PHI (1997).
Chapters: 11(11.1-11.3), 17(17.1-17.5, 17.6(17.6.1-17.6.3)), 20(20.1-20.3), 21(21.1, 21.2(21.2.1-21.2.5)).

**Reference Books:**

1. Operations Research (Theory and applications) by J. K. Sharma, 3rd Edition, Macmillan India Limited (2007).
2. Resource Management Techniques (Operations Research) by Prof. V. Sundaresen, K.S. Ganapathy Subramanian and K. Ganesan, New Revised Edition 2000, A.R Publications.

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**RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC**

**PROGRAMME: M.Sc., Mathematics** **COURSE CODE : 3PGM5(2015 on)/ 4PGM5 (B) (2011 – 14)**

**COURSE TITLE : Data Structures using C and C++** **QN.NO : 1429**

**TIME : 3 Hours** **MAX.MARKS :75**

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**Unit I**:
The Stack – Definition and example, representing stack in C, Infix, Prefix, and Postfix notations. Recursion – recursive definition and process of Fibonacci sequence, Binary search and Tower of Hanoi problem.

**Unit II:**
Queues and Lists – The Queue and its sequential representation, Linked List, List in C, other List Structures-Circular List-Stack as Circular List-Queue as a Circular List-Primitive operations on Circular List.

**Unit III:**
Trees – Binary Trees, Binary Tree representations, Huffman algorithm, Representing List as Binary Trees, Trees and their applications.

**Unit IV:**
Sorting – Exchange Sorts, Selection and Tree Sorting, Insertion Sorts, Merge and Radix Sorts, Searching – Sequential searching – Indexed sequential search – Interpolation search.

**Unit V:**
Graphs and their Applications - Graphs, A flow problem, Graph traversal and spanning Forests.

**Text Book:**
Data Structures using C and C++ by Yedidyah Langsam, Moshe J. Augenstein, Aaron M. Tenenbaum, 2nd Edition 2000, PHI.
Chapter 2 (2.1,2.2,2.3), 3 (3.1,3.2,3.3) 4 (4.1,4.2,4.3,4.5) 5 (5.1,5.2,5.3,5.4,5.5) 6 (6.2,6.3,6.4,6.5) 7 (Relevant headings only) 8 (8.1,8.2,8.4)

**Reference Books:**
1. C and Data structures by P. Radha Ganesan, Scitech Publication (2000).
2. Data structures and program design in C by Robert L. Kruse, Bruce P. Leung and Clovis L. Tondo, Reprint Edition 1998, PHI.

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**RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC**

**PROGRAMME: M.Sc., Mathematics** **COURSE CODE : 3PGM5 (2015 on & Upto 2014)**

**COURSE TITLE : Statistical Methods** **QN.NO : 1433**

**TIME : 3 Hours** **MAX.MARKS :75**

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**Unit I:**

Introduction Meaning and Scope – Measures of Central Value – Arithmetic Mean – Relationship among the Averages.

**Unit II:**

Measures of Dispersion – Introduction – Range – Quartile Deviation – Mean Deviation – Standard Deviation – Coefficient of Variation.

**Unit III:**

Introduction – Skewness – Measures of Skewness – Karl Pearson's Coefficient of Skewness – Kelly's Coefficient of Skewness.

**Unit IV:**

Introduction – Correlation and Regression – Karl Pearson's Coefficient of Correlation – Spearman's Rank Correlation Coefficient – Lines of Regression.

**Unit V:**

Introduction Index Numbers – Methods of Constructive Index Number (unweighted Index Numbers, Weighted Index Numbers) – Test of Adequacy of Index Number Formulae – Consumer Price Index Numbers – Aggregate Expenditure Method – Family Budget Method.

**Text book:**

Statistical Methods by S. P. Gupta, Revised Edition 2011, Sultand Chand & Sons Publisher.
Chapters**:** 7, 8, 9, 10, 11, 13.

**Reference books:**

1. Statistics by R.S.N. Pillai Bagavathi, Reprint 2010.
2. Statistical Methods by S.C. Gupta, Reprint 2000, Sultand Chand & Sons Publisher.

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# THE MADURA COLLEGE (Autonomous), MADURAI – 625 011

**(AFFILIATED TO MADURAI KAMARAJ UNIVERSITY)**

**RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC**

**PROGRAMME: M.Sc., Mathematics** **COURSE CODE : 4PGM1(2015 on) / 3PGM1 (Upto 2014)**

**COURSE TITLE : Graph theory** **QN.NO : 1435**

**TIME : 3 Hours** **MAX.MARKS :75**

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**Unit I: Graphs and Degrees:**

Connected graphs-Common classes of graphs-Degree of vertex- Regular graphs-Degree sequences.

**Unit II: Trees and Connectivity:**

Bridges-Trees-T he minimum spanning tree problem- Cut-vertices-Blocks- Connectivity.

**Unit III: Matching, Factorization and Planarity:**

Matching- Factorization- Decompositions and graceful labelings- Planar graphs- Embedding of graphs on surfaces.

**Unit IV: Coloring:**

The four color problem-vertex coloring-Edge coloring-The Heawood map coloring theorem-Local coloring.

**Unit V: Distance and Domination:**

The center of a graph- Distant vertices- Detour and directed distance-The domination number of a graph.

**Text Book:**

An Introduction to Graph Theory by Gary Chartrand and Ping Zhang, 4th edition, TATA McGRAW-Hill (Reprint 2008).

**Chapters:** 1(1.2, 1.3), 2(2.1, 2.2, 2.3), 4(4.1, 4.2, 4.3), 5(5.1, 5.2, 5.3), 8(8.1, 8.2, 8.3), 9(9.1, 9.2), 10(10.1, 10.2, 10.3, 10.4, 10.5), 12(12.1, 12.2, 12.4), 13(13.1 only).

**Reference Books:**

1. Graph Theory by F. Harary, Addison Wesley, 1969.
2. Graph Theory with Applications by J.A. Bondy and U.S.R. Murty, Elsevier Science Ltd/North-Holland (June 1976).

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# THE MADURA COLLEGE (Autonomous), MADURAI – 625 011

**(AFFILIATED TO MADURAI KAMARAJ UNIVERSITY)**

**RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC**

**PROGRAMME: M.Sc., Mathematics** **COURSE CODE : 4PGM2(2015 on & Upto 2014)**

**COURSE TITLE : Functional Analysis** **QN.NO : 1437**

**TIME : 3 Hours** **MAX.MARKS :75**

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**Unit I: Preliminaries:**

Relations on a Set - Linear Spaces and Linear Maps - Metric Spaces and continuous functions.

**Unit II: Fundamentals of Normed Spaces:**

Normed Spaces - Continuity of Linear Maps - Hahn-Banach Theorems - Banach Spaces.

**Unit III: Bounded linear Maps on Banach Spaces:**

Uniform Boundedness Principle - Closed Graph and Open Mapping Theorems - Bounded Inverse Theorem.

**Unit IV: Geometry of Hilbert Spaces:**

Inner Product Spaces - Orthonormal Sets.

**Unit V: Bounded Operators on Hilbert Spaces:**

Bounded Operators and Adjoints - Normal, Unitary and Self-Adjoint Operators.

**Text Book:**

Functional Analysis – Balmohan V. Limaye – Revised 2nd Edition 2008, New Age International Publishers.

Chapter: 1(Sec.1-3), 2(Sec. 5 – 8), 3(Sec. 9-11), 4(Sec. 21 & 22), 5(Sec. 25 & 26).

**Reference Books**:

1. Introduction to topology and modern analysis by G. F. Simons, Tata McGraw – Hill International Edition (2004).

2. Functional analysis by K. Chandrasekhara Rao Second Edition 2006, Narosa Publishing House.

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**(AFFILIATED TO MADURAI KAMARAJ UNIVERSITY)**

**RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC**

**PROGRAMME: M.Sc., Mathematics** **COURSE CODE : 4PGM3(2015 On)**

**COURSE TITLE : Advanced Statistics** **QN.NO : 1439**

**TIME : 3 Hours** **MAX.MARKS :75**

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**Unit I: Statistical Tests:**

Chi Square Tests- the distribution of certain quadratic forms- a test of equality of several means- Non central $\chi^2$ and Non central F- the analysis of variance- Regression problem- Test of Stochastic independence.

**Unit II: Nonparametric Methods:**

Confidence interval for distribution Quantiles- Tolerance limits for distribution- The sign test- Test of Wilcoxon- the equality of two distributions- The Mann-Whitney Wilcoxon test- Distribution under alternative hypothesis- Linear rank statistics.

**Unit III: Sufficient Statistics:**

Sufficient Statistics for Parameter- Rao-Blackwell theorem- Completeness and uniqueness- The exponential class of probability- Density function- Functions of parameter- The case of several parameters.

**Unit IV: Statistical Inference:**

The Rao-Cramer inequality- The sequential probability ratio test multiple comprehension- Classification- Sufficiency, Completeness and Stochastic independence- Robust independence.

**Unit V: Normal Distribution Theory:**

The Multivariate normal distributions- Distributions of certain quadratic forms- Independence of certain quadratic forms.

**Text Book:**

Introduction to Mathematical Statistics Robert V. Hogg, Alex T. Craig, 4th Edition, Macmillan Publishing Co. Inc (1970).
Chapters: 8, 9, 10, 11, 12.

**Reference Books**:

1. Statistical Methods by S. P. Gupta Revised Edition 2011, S.Chand Publishing.
2. Fundamentals of Mathematical Statistics by S.C. Gupta, V.K. Kapur, Reprint 2000, Sultan Chand & Sons.

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# THE MADURA COLLEGE (Autonomous), MADURAI – 625 011

**(AFFILIATED TO MADURAI KAMARAJ UNIVERSITY)**

**RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC**

**PROGRAMME: M.Sc., Mathematics** **COURSE CODE : 4PGM4(2015 On & Upto 2014)**

**COURSE TITLE : Stochastic Processes** **QN.NO : 1441**

**TIME : 3 Hours** **MAX.MARKS :75**

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**Unit I: Differential Difference Equations:**

Introduction - Important properties of Laplace transforms – differential equation – differential difference equations – matrix analysis.

**Unit II: Probability Distributions:**

Generating functions – Laplace transforms – Laplace transform of a probability distribution of a random variable – Classification of distributions.

**Unit III: Stochastic Process:**

Introduction – Specification of Stochastic Process – Stationary Process – Martingales.

**Unit IV: Markov Chain:**

Definitions and examples – higher transition probabilities – generalization of independent Bernoulli trails – Classification of states and chains – Determination Higher Transition Probabilities – Stability of Markov System – Graph Theoretic Approach.

**Unit V: Markov Process with Discrete State Space:**

Poisson Process – Poisson process and Related Distribution – Generalization of Poisson Process – Birth and Death process.

**Text Book:**

Stochastic Processes by J. Medhi, 2nd Edition, Reprint 2008, New age international Publisher (1984).
Chapters: 1(sec.1.1 - 1.4), 2(sec. 2.1 - 2.4), 3(sec.3.1 - 3.4), 4(sec. 4.1 - 4.4) and Appendix A (A1-A4).

**Reference Books:**

1. Probability random variable and stochastic processes by A. Papoulis, Tata McGraw – Hill (1991).
2. Stochastic processes by S. K. Srinivasan, K.M. Mehata, 2nd Edition, Tata McGraw – Hill (1978).

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# THE MADURA COLLEGE (Autonomous), MADURAI – 625 011

**(AFFILIATED TO MADURAI KAMARAJ UNIVERSITY)**

**RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC**

**PROGRAMME: M.Sc., Mathematics** **COURSE CODE : 4PGM5(2015 On) / 3PGM5(B) (2011 – 14)**

**COURSE TITLE : Programming with JAVA** **QN.NO : 1443**

**TIME : 3 Hours** **MAX.MARKS :75**

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**Unit I: Java evolution:**

Java history – java features – java and internet - java environment. Overview of java language: java program structure – java statements – Implementry java program – java virtual machine – command line arguments.

**Unit II: Java fundamentals:**

Constants, variables and data types – operations and expressions – decision making and branching – decision making and looping.

**Unit III: Classes, objects and methods:**

Defining a class, adding variables – adding methods – constructors – method overloading inheritance – overriding methods, arrays, strings and vectors – creating arrays – strings – vectors – wrapper classes.

**Unit IV: Interfaces:**

Defining interfaces – external interfaces – implementing interfaces, packages: creating packages – using a package – adding a class to a package. Multithreaded programming – creating threads – extending the thread – stopping and blocking a thread –life cycle of a thread.

**Unit V: Applet programming :**

Applet life cycle – creating an executable applet – applet tag – running the applet – more about applet tag – passing parameters to applets – graphics programming – the graphics class – lines and rectangles – circle and ellipses drawing arc polygons.

**Text Book:**

Programming with JAVA – A primer by E. Balagurusamy, 2nd edition 2001, Tata McGraw – Hill Publication.

Chapters: 2(2.1,2.2,2.4,2.6,2.9), 3(3.5,3.7,3.8,3.9,3.10),4(4.2-4.4),5(5.2-5.9),6(6.2-6.8), 7(7.2-7.4),8(8.2-8.6,8.11,8.12),9(9.2-9.7),10(10.2-10.4),11(11.5-11.8),12(12.2-12.5), 14(14.5-14.12),15(15.2-15.6).

**References Books:**

1. JAVA 2: The complete reference by Patrick Naughton, Herbert Schildt, 3rd edition, Obsborne Publishing(1997).

2. Programming with JAVA 2 by C. Xavier, 2nd Reprint 2003, Scitech Publication.

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# THE MADURA COLLEGE (Autonomous), MADURAI – 625 011

**(AFFILIATED TO MADURAI KAMARAJ UNIVERSITY)**

**RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC**

**PROGRAMME : M.Sc., Mathematics** **COURSE CODE : 21P1MMC1**

**COURSE TITLE : Real Analysis I** **QN.NO : 12401**

**TIME : 3 Hours** **MAX.MARKS :75**

**Objective:**

1. To acquire idea to know real number system and numerical sequence and series.
2. To understand the concepts of continuity and Differentiation.
3. To impart the knowledge of Sequence and series of functions

| Unit | Description | Hours | K-level | CLO |
|---|---|---|---|---|
| I | **The Real and Complex number system:** Introduction-Ordered sets-Fields-The Real fields-The extended Real number system.**Basic Topology:**Finite, countable and uncountable sets-Metric spaces-Compact sets-Perfect sets-Connected sets.. | 18 | Up to K3 | CLO1 |
| II | **Numerical Sequences and series:** Convergent sequence-subsequence-Cauchy sequence- Upper and Lower limits-Some special sequences-series-series of nonnegative terms-The Number e-The root and ratio test-Power series-summation of parts-Absolute convergence-Addition and multiplication of series- Rearrangements. | 18 | Up to K3 | CLO2 |
| III | **Continuity:** Limits of functions- Continuity functions- Continuity and compactness-Continuity and connectedness- Discontinuities-Monotonic functions- Infinite limits and limits at infinity. | 18 | Up to K3 | CLO3 |
| IV | **Differentiation:** The derivative of a real function-Mean value theorems-The continuity of derivatives- L'Hospital rule-Derivatives of Higher order- Taylor's theorem- Differentiation of vector-valued functions. | 18 | Up to K4 | CLO4 |
| V | **Sequence and series of functions:** Discussion of main problems-uniform convergence-uniform convergence and continuity- uniform convergence and integration- uniform convergence and differentiation-Equicontinuous families of functions- The stone-weierstrass theorem. | 18 | Up to K5 | CLO5 |

**Book for study:**

1. Walter Rudin, Principles of Mathematical Analysis, Tata McGraw- Hill, New York, 1988.
   **Chapters: 1,2,3,4,5,7**

**Books for Reference:**

1. Tom M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, 1997.
2. H. L. Royden, Real Analysis, Third Edition, Macmillan Publishing Company, New Delhi, 1988.

**Web Resources:**

https://nptel.ac.in/courses/111/106/111106053/#
https://ocw.mit.edu/courses/mathematics/18-100c-real-analysis-fall-2012/
http://www.math.louisville.edu/~lee/RealAnalysis/

**Rationale and activities having direct bearing on Nature of the course:**

Real analysis is an area of analysis that studies concepts such as sequences and their limits, continuity, differentiation, integration and sequences of functions. By definition, real analysis focuses on the real numbers, often including positive and negative infinity to form the extended real line. Various ideas from real analysis can be generalized from the real line to broader or more abstract contexts.

This course impart theoretical knowledge & Problem Solving Skills to the students and is crafted to help the students to knowing the best techniques in a given theory. Theoretical learning gives the guidance to the mind and mind guides our body to convert that theoretical learning into practical performance.Theoretical knowledge explains the why factor at the back of any situation and technique of working.

**Pedagogy :**

Chalk and Talk, Seminar, Quiz, Problem Solving, Tutorial, Group Discussion, PPT.

**Course Learning Outcomes:**

On the successful completion of the course, Students will be able to

| Number | Course Learning outcome | Knowledge level |
|---|---|---|
| CLO1 | Remembering the basic concepts of real field and basic topology | Up to K3 |
| CLO2 | Understand the idea of numerical sequence& series | Up to K3 |
| CLO3 | Understand the concept of limit and continuity with various conditions | Up to K3 |
| CLO4 | Identifying the concept of derivatives and its properties | Up to K4 |
| CLO5 | Analyzing the concept of convergence with various conditions | Up to K5 |

K1- Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – solving problems
K4- Examining, analyzing, presentation and make inference with evidences.
K5- Evaluating

**Mapping of Course Outcomes (CLOs) with Program Outcomes (POs)**

| CLOs/POs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CLO1** | 2 | 3 | 2 | 1 | 3 |
| **CLO2** | 2 | 3 | 2 | 1 | 3 |
| **CLO3** | 2 | 3 | 2 | 1 | 3 |
| **CLO4** | 2 | 3 | 2 | 1 | 3 |
| **CLO5** | 2 | 3 | 2 | 1 | 3 |

1. Weakly 2. Medium 3. Strongly

**P.T.O.**

**Blue Print**

**Mapping with Course Outcomes (CLOs)**

| Units | CLOs | K-level | Section A | | Section B | | Section C (Either/or Choice) | Section D (Open Choice) |
|---|---|---|---|---|---|---|---|---|
| | | | MCQs | | Short Answers | | | |
| | | | No. Of Questions | K-Level | No. of Questions | K-Level | | |
| 1 | CLO 1 | Up to K 3 | 2 | K1 & K1 | 1 | K1 | 2(K1 & K1) | 1(K2) |
| 2 | CLO 2 | Up to K 3 | 2 | K2& K2 | 1 | K1 | 2(K2& K2) | 1(K3) |
| 3 | CLO 3 | Up to K 3 | 2 | K3& K3 | 1 | K2 | 2(K3 & K3) | 1(K3) |
| 4 | CLO 4 | Up to K 4 | 2 | K3& K3 | 1 | K2 | 2(K4& K4) | 1(K4) |
| 5 | CLO 5 | Up to K 4 | 2 | K4& K4 | 1 | K3 | 2(K4 & K4) | 1(K4) |
| No. of Questions to be asked | | | 10 | | 5 | | 10 | 5 |
| No. of Questions to be answered | | | 10 | | 5 | | 5 | 3 |
| Marks for each question | | | 1 | | 2 | | 5 | 10 |
| Total Marks for each Section | | | 10 | | 10 | | 25 | 30 |

K1- Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – solving problems
K4- Examining, analyzing, presentation and make inference with evidences.

**Distribution of section wise marks with K levels**

| K Levels | Section A (No choice) | Section B (No choice) | Section C (Either/ or) | Section D (Open choice) | Total marks | % of marks without choice | Consolidated |
|---|---|---|---|---|---|---|---|
| K1 | 2 | 4 | 10 | - | 16 | 13.33 | |
| K2 | 2 | 4 | 10 | 10 | 26 | 21.67 | 35% |
| K3 | 4 | 2 | 10 | 20 | 36 | 30.00 | 30% |
| K4 | 2 | | 20 | 20 | 42 | 35.00 | 35% |
| Total marks | 10 | 10 | 50 | 50 | 120 | 100 | 100% |

**Blue Print for CIA-I**
**Mapping with Course Learning Outcomes (CLOs)**

| SL. No | CLOs | K-level | Section A | | Section B (Either/or Choice) | Section C (Open Choice) |
|---|---|---|---|---|---|---|
| | | | Short Answers | | | |
| | | | No. of Questions | K-Level | | |
| 1 | CLO 1 | Up to K 3 | 2 | K2,K2 | 2(K2 &K2) | 2(K2,K3) |
| 2 | CLO 2 | Up to K 3 | 3 | K2,K3,K3 | 2(K3 &K3) | 1(K3) |

| | | | | |
|---|---|---|---|---|
| No. of Questions to be asked | 5 | | 4 | 3 |
| No. of Questions to be answered | 5 | | 2 | 2 |
| Marks for each question | 2 | | 5 | 10 |
| Total Marks for each Section | 10 | | 10 | 20 |

**Distribution of section wise marks with K levels**

| K Levels | Section A (No choice) | Section B (Either/ or) | Section C (Open choice) | Total marks | % of marks without choice | Consolidated |
|---|---|---|---|---|---|---|
| K1 | - | - | - | - | - | - |
| K2 | 6 | 10 | 10 | 26 | 43.33 | 43% |
| K3 | 4 | 10 | 20 | 34 | 56.67 | 57% |
| K4 | - | - | - | - | | |
| Total marks | 10 | 20 | 30 | 60 | 100.00 | 100% |

**Blue Print for CIA-II**
**Mapping with Course Learning Outcomes (CLOs)**

| SL.No | CLOs | K-level | Section A | | Section B (Either/or Choice) | Section C (Open Choice) |
|---|---|---|---|---|---|---|
| | | | Short Answers | | | |
| | | | No. of Questions | K-Level | | |
| 1 | CLO 3 | Up to K 3 | 2 | K2,K2 | 2(K3 &K3) | 2(K3,K3) |
| 2 | CLO 4 | Up to K 4 | 3 | K2,K3,K3 | 2(K4 &K4) | 1(K4) |
| No. of Questions to be asked | | | 5 | | 4 | 3 |
| No. of Questions to be answered | | | 5 | | 2 | 2 |
| Marks for each question | | | 2 | | 5 | 10 |
| Total Marks for each Section | | | 10 | | 10 | 20 |

K1- Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – solving problems
K4- Examining, analyzing, presentation and make inference with evidences.

**Distribution of section wise marks with K levels**

| K Levels | Section A (No choice) | Section B (Either/ or) | Section C (Open choice) | Total marks | % of marks without choice | Consolidated |
|---|---|---|---|---|---|---|
| K1 | - | - | - | - | - | |
| K2 | 6 | | - | 6 | 10.00 | 10% |
| K3 | 4 | 10 | 20 | 34 | 56.67 | 57% |
| K4 | - | 10 | 10 | 20 | 33.33 | 33% |
| Total marks | 10 | 20 | 30 | 60 | 100.00 | 100% |

**Blue Print for Assignment**

**Mapping with Course Learning Outcomes (CLOs)**

| SL. No | CLOs | K-Level | Component | Marks |
|---|---|---|---|---|
| 1 | CLO 5 | K5 | Assignment | 5 |

K5 – Evaluating.

**Lecture Plan**

| Units | Description | Hours | Pedagogy |
|---|---|---|---|
| I | Introduction-Ordered sets | 3 | Chalk and Talk |
| | Fields, The Real fields | 3 | Chalk and Talk |
| | The extended Real number system | 3 | Chalk and Talk |
| | Finite, countable and uncountable sets | 3 | Chalk and Talk |
| | Metric spaces | 3 | Chalk and Talk&Seminar |
| | Compact sets-Perfect sets, Connected sets. | 3 | Chalk and Talk & Group Discussion |
| II | Convergent sequence | 3 | Chalk and Talk |
| | subsequence-Cauchy sequence- | 3 | Chalk and Talk |
| | Upper and Lower limits-Some special sequences | 3 | Chalk and Talk |
| | series of nonnegative terms-The Number e | 2 | Chalk and Talk |
| | The root and ratio test-Power series | 3 | Chalk and Talk |
| | summation of parts-Absolute convergence | 2 | Chalk and Talk &Seminar |
| | Addition and multiplication of series-Rearrangements. | 2 | Chalk and Talk& Group Discussion |
| III | Limits of functions, Continuity functions | 3 | Chalk and Talk |
| | Continuity and compactness | 3 | Chalk and Talk |
| | Continuity and connectedness | 3 | Chalk and Talk |
| | Discontinuities | 3 | Chalk and Talk |
| | Monotonic functions | 3 | Chalk and Talk &Seminar |
| | Infinite limits and limits at infinity. | 3 | Chalk and Talk& Group Discussion |
| IV | The derivative of a real function | 3 | Chalk and Talk |
| | Mean value theorems | 3 | Chalk and Talk& |
| | The continuity of derivatives | 3 | Chalk and Talk & Group Discussion |
| | L'Hospital rule-Derivatives of Higher order | 3 | |
| | Taylor's theorem | 3 | |
| | Differentiation of vector valued functions. | 3 | |
| V | Discussion of main problems-uniform convergence | 3 | Chalk and Talk |
| | uniform convergence and continuity | 3 | Chalk and Talk & |
| | uniform convergence and integration | 3 | Chalk and Talk |
| | uniform convergence and differentiation | 3 | Chalk and Talk |
| | Equicontinuous families of functions | 3 | Chalk and Talk &Seminar |
| | The stone-weierstrass theorem. | 3 | Chalk and Talk & Group Discussion |
| **Total Hours** | | **90** | |

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# THE MADURA COLLEGE (Autonomous), MADURAI – 625 011

**(AFFILIATED TO MADURAI KAMARAJ UNIVERSITY)**

**RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC**

**PROGRAMME : M.Sc., Mathematics** **COURSE CODE : 21P1MMC2**

**COURSE TITLE : Abstract Algebra** **QN.NO : 12402**

**TIME : 3 Hours** **MAX.MARKS :75**

**OBJECTIVES:**

The objective of this course is to introduce the basic ideas of counting principle, Sylow subgroups, finite abelian groups, field theory and Galois Theory and to see its application to the solvability of polynomial equations by radicals.

| Unit | Description | Hours | K-level | CLO |
|---|---|---|---|---|
| I | **Sylow's Theorem**: Another Counting Principle – 1st, 2nd and 3rd parts of Sylow's Theorems – double coset – the normalizer of a group. | 15 | Up to K2 | CLO1 |
| II | **Finite Abelian Groups:**External and Internal direct Products – structure theorem for finite abelian groups – non isomorphic abelian groups - polynomial rings. | 17 | Up to K3 | CLO2 |
| III | **Splitting Field :**Polynomials over rational fields – the Eisenstein criterion - extension fields – roots of polynomials – splitting fields. | 15 | Up to K4 | CLO3 |
| IV | **Galois Theory:**More about roots – simple extension – separable extension – fixed fields – symmetric rational functions – normal extension - Galois group – fundamental theorem of Galois theory. | 16 | Up to K4 | CLO4 |
| V | **Solvability by radicals:**Solvable group – the commutator subgroup – Solvability by radicals - finite fields-Wedderburn Theorem. | 12 | Up to K5 | CLO5 |

**BOOK FOR STUDY:**

1. I.N. Herstein, Topics in Algebra, 2nd Edition, John Wiley and Sons, New York, 1975.

| UNIT | CHAPTER(S) | SECTIONS |
|---|---|---|
| I | 2 | 2.11 & 2.12 |
| II | 2 & 3 | 2.13, 2.14, 3.9 |
| III | 3 & 5 | 3.10, 5.1, 5.3 |
| IV | 5 | 5.5 & 5.6 |
| V | 5 & 7 | 5.7, 7.1 |

**BOOKS FOR REFERENCES:**


1. S. Lang, "Algebra", 3rd Edition, Addison-Wesley, Mass, 1993.
2. John B. Fraleigh, "A First Course in Abstract Algebra", Addison Wesley, Mass, 1982.
3. Joseph A. Gallian,"Contemporary Abstract Algebra"-9th edition,*2016.*


**WEB RESOURCES:**

1. http://math.uchicago.edu/~may/REU2016/REUPapers/Idelhaj.pdf
2. http://torus.math.uiuc.edu/jms/m317/handouts/finabel.pdf
3. https://orion.math.iastate.edu/tathagat/teaching/18_math302/302notes-week15.pdf
4. https://nrich.maths.org/1422
5. http://www.math.brown.edu/dabramov/MA/f1314/251/Zijian-notes.pdf

**RATIONALE AND ACTIVITIES HAVING DIRECT BEARING ON NATURE OF COURSE:**

Algebra helps to develop your critical thinking, Knowledge to find number of Sylow subgroups, Algebraic structures with their associated homomorphisms, form mathematical categories and given polynomial is solvable by radicals or not.

**PEDAGOGY:**
Lecture, Seminar, Quiz, Problem Solving, Tutorial, Group Discussion and Power point presentation.

**COURSE LEARNING OUTCOMES:**

On the successful completion of the course, students will be able to

| Number | Course Outcome | Knowledge level |
|---|---|---|
| CLO 1 | Recall the concepts of counting priciple, Normalizer group and understand the parts of sylows theorems | Up to K2 |
| CLO 2 | Understand the different kinds of ideas about finite abelian groups and theorems about polynomial rings | Up to K3 |
| CLO 3 | Examine splitting field in rational fields, extension fields, splitting fields and understand about Eisenstein criterion | Up to K4 |
| CLO 4 | Use the concept of Galois theory and able to apply it in several extension fields. | Up to K4 |
| CLO 5 | Examine whether the polynomial is solvable in radicals and learn about Wedderburn theorem. | Up to K5 |

K1 - Remembering and recalling facts with specific answers
K2 - Basic understanding of facts and stating main ideas with general answers
K3 - Application oriented - Solving Problems
K4 - Examining, analyzing, presentation and make inferences with evidences
K5 – Evaluate the mistakes in answers

**Mapping with Courses Learning Outcomes (CLOs)**

| CLO/ PO | PO | | | | |
|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 |
| CLO 1 | 3 | 2 | 2 | 2 | 1 |
| CLO 2 | 3 | 2 | 2 | - | 1 |
| CLO 3 | 3 | 2 | 3 | - | 2 |
| CLO 4 | 3 | 2 | - | - | 2 |
| CLO 5 | 3 | - | - | 2 | 3 |

3 – Advance Application 2 - Intermediate Level 1- Basic Level

**BLUE PRINT – External Exam**

| S. No. | CLOs | K Level | Section A | | Section B | | Section C (Either/or Choice) | Section D (Open Choice) |
|---|---|---|---|---|---|---|---|---|
| | | | MCQs | | Short Answers | | | |
| | | | No. of questions | K Level | No. of questions | K level | | |
| 1 | CLO 1 | Up to K2 | 2 | K1 & K1 | 1 | K1 | 2(K1 & K1) | 1(K2) |
| 2 | CLO 2 | Up to K3 | 2 | K2 & K3 | 1 | K1 | 2(K2 & K2) | 1(K3) |
| 3 | CLO 3 | Up to K4 | 2 | K2 & K3 | 1 | K2 | 2(K3 & K3) | 1(K3) |
| 4 | CLO 4 | Up to K4 | 2 | K3 & K4 | 1 | K2 | 2(K4 & K4) | 1(K4) |
| 5 | CLO 5 | Up to K5 | 2 | K3 & K4 | 1 | K3 | 2(K4 & K4) | 1(K4/K5) |
| No. of Questions to be asked | | | 10 | | 5 | | 10 | 5 |
| No. of Questions to be answered | | | 10 | | 5 | | 5 | 3 |
| Marks for each question | | | 1 | | 2 | | 5 | 10 |
| Total Marks for each Section | | | 10 | | 10 | | 25 | 30 |

K1 - Remembering and recalling facts with specific answers
K2 - Basic understanding of facts and stating main ideas with general answers
K3 - Application oriented - Solving Problems
K4 - Examining, analyzing, presentation and make inferences with evidences
K5 - Evaluate the mistakes in answers

**Distribution of section wise marks with K levels.**

| K Levels | Section A (No choice) | Section B (No choice) | Section C (Either/ or) | Section D (Open choice) | Total marks | % of marks without choice | Consolidated |
|---|---|---|---|---|---|---|---|
| K1 | 2 | 4 | 10 | - | 16 | 13.33 | 35% |
| K2 | 2 | 4 | 10 | 10 | 26 | 21.67 | |
| K3 | 4 | 2 | 10 | 20 | 36 | 30 | 30% |
| K4 | 2 | - | 20 | 10 | 32 | 26.67 | 27% |
| K5 | | | - | 10 | 10 | 8.33 | 8% |
| Total marks | 10 | 10 | 50 | 50 | 120 | 100 | 100% |

**BLUE PRINT – CIA - I**

| Sl.No | CLOs | K Level | Section A | | Section B (Either/or Choice) | Section C (Open Choice) |
|---|---|---|---|---|---|---|
| | | | Short Answers | | | |
| | | | No. of Questions | K Level | | |
| 1 | CLO 1 | Up to K2 | 2 | K1, K2 | 2(K1 & K1) | 1(K2) |
| 2 | CLO 2 | Up to K3 | 3 | K1, K1, K2 | 2(K2 & K2) | 2(K3, K3) |
| No. of Questions to be asked | | | 5 | | 4 | 3 |
| No. of Questions to be answered | | | 5 | | 2 | 2 |
| Marks for each question | | | 2 | | 5 | 10 |
| Total Marks for each Section | | | 10 | | 10 | 20 |

**Distribution of Section-wise Marks with K levels**

| K Levels | Section A (No choice) | Section B (Either/ or) | Section C (Open choice) | Total marks | % of marks without choice | Consolidated |
|---|---|---|---|---|---|---|
| K1 | 6 | 10 | - | 16 | 26.67 | 67 |
| K2 | 4 | 10 | 10 | 24 | 40 | |
| K3 | - | - | 20 | 20 | 33.33 | 33% |
| K4 | - | - | - | - | - | - |
| K5 | - | - | - | - | - | - |

**BLUE PRINT – CIA - II**

| Sl.No | CLOs | K level | Section A | | Section B (Either/or Choice) | Section C (Open Choice) |
|---|---|---|---|---|---|---|
| | | | Short Answers | | | |
| | | | No. of Questions | K-Level | | |
| 1 | CLO 3 | Up to K4 | 2 | K2,K2 | 2(K2 & K2) | 2(K3&K4) |
| 2 | CLO 4 | Up to K4 | 3 | K2,K3,K3 | 2(K3 & K3) | 1(K3) |
| No. of Questions to be asked | | | 5 | | 4 | 3 |
| No. of Questions to be answered | | | 5 | | 2 | 2 |
| Marks for each question | | | 2 | | 5 | 10 |
| Total Marks for each Section | | | 10 | | 10 | 20 |

**Distribution of Section-wise Marks with K levels**

| Levels | Section A (No choice) | Section B (Either/ or) | Section C (Open choice) | Total marks | % of marks without choice | Consolidated |
|---|---|---|---|---|---|---|
| K1 | - | - | - | - | - | 30% |
| K2 | 8 | 10 | - | 18 | 30 | |
| K3 | 2 | 10 | 20 | 32 | 53.33 | 53% |
| K4 | - | - | 10 | 10 | 16.67 | 17% |
| K5 | | - | - | - | - | - |
| Total Marks | 6 | 20 | 30 | 60 | 100 | 100% |

**LESSON PLAN**

| Unit | Description | Hours | Mode |
|---|---|---|---|
| I | Another Counting Principle – 1st, 2nd and 3rd parts of Sylow's Theorems | 8 | Lecture, Quiz |
| | Double coset – the normalizer of a group. | 7 | Problem Solving |
| II | External and Internal direct Products – structure theorem for finite abelian groups | 8 | Lecture, Quiz |
| | Non isomorphic abelian groups - polynomial rings. | 9 | Quiz |
| III | Polynomials over rational fields – the Eisenstein criterion | 7 | PPT, Lecture |
| | extension fields – roots of polynomials – splitting fields | 8 | |
| IV | More about roots – simple extension – separable extension | 5 | Lecture, Tutorial |
| | fixed fields – symmetric rational functions – normal extension | 6 | Lecture, Tutorial |
| | Galois group – fundamental theorem of Galois theory | 5 | Tutorial |
| V | Solvable group – the commutator subgroup – Solvability by radicals | 6 | PPT, Lecture |
| | Finite fields- Wedderburn Theorem. | 6 | Lecture |
| **Total Hours** | | **75** | |

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# THE MADURA COLLEGE (Autonomous), MADURAI – 625 011

**(AFFILIATED TO MADURAI KAMARAJ UNIVERSITY)**

**RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC**

**PROGRAMME : M.Sc., Mathematics** **COURSE CODE : 21P1MMC3**

**COURSE TITLE : Topology** **QN.NO : 12403**

**TIME : 3 Hours** **MAX.MARKS :75**

**Course Objectives:**

The objective of the course is

- To impart knowledge on topological spaces and their properties such as compactness, connectedness, metrizability, countablity & separation axioms etc.,
- To demonstrate construction of new topological spaces out of given ones by means of operations like union, intersection and finite & infinite Cartesian product
- To analyze the structure of topological spaces applying continuous functions and homeomorphisms

**Course content:**

| Unit | Description | Hours | K-level | CLO(s) |
|---|---|---|---|---|
| I | **TOPOLOGICAL SPACES AND CONTINUOUS FUNCTIONS:** Types of Topological Spaces and Examples - Basis for a topology - The order topology -The product topology on X x Y - The subspace topology - Closed sets and limits points - Continuous functions | 12 | K3 | 1 |
| II | **PRODUCT TOPOLOGY & CONNECTEDNESS:**The Product Topology - The metric topology - Sequence lemma- Uniform limit theorem- Connected spaces - Connected subspaces of thereal line - Components and Local connectedness | 12 | K4 | 2 |
| III | **COMPACTNESS & COMPLETE METRIC SPACES**: Compact topological spaces - Compact subspaces of the real line – Limit Point Compactness – complete metric spaces – compactness in metric spaces. | 12 | K4 | 3 |
| IV | **COUNTABILITY & SEPERATION AXIOMS:** First and Second countable spaces - Lindeloff and Separable Spaces - Countability axioms - The separation axioms - Normal spaces - TheUrysohn lemma | 12 | K4 | 4 |
| V | **URYSOHN, TYCHONOFF THEOREMS AND COMPACTIFICATION:** The UrysohnMetrization Theorem - Tietze Extension Theorem-The Tychonofftheorem – Stone Cechcompactification | 12 | K2 | 5 |

**Book for Study:**

- Topology (Second Edition), JamesR.Munkres, Prentice – Hall of India, Private Ltd, New Delhi (2014).
  **Unit –I:**Sections 12 to 18 of Chapter 2
  **Unit –II:** Sections 19 to 21 of Chapter 2 - Sections 23 to 25 of Chapter 3
  **Unit –III:**Sections 26 to 28 of Chapter 3 - Sections 43 and 45 of Chapter 7
  **Unit –IV:** Sections 30 to 33 of Chapter 4
  **Unit –V:** Sections 34 and 35 of Chapter 4 - Sections 37 and 38 of Chapter 5

**Books for References:**


1. Introduction to Topology and Modern Analysis, G.F.Simmons, TataMcGraw-Hill Edition, New Delhi (2004).
2. Introduction to Topology (3rd Edition), Bert Mendelson, Dover Publications, New York (1990).
3. Principles of Topology, Fred H.Croom,Dover Publications, New York, (2016).
4. Theory and Problems of General Topology, Seymour Lipschutz, McGraw-Hill Edition,New Delhi (2006).
5. Introduction to Topology, Colin Adams and Robert Franzosa, Pearson Publications, New Delhi (2009).

**Web Resources:**

1. https://ocw.mit.edu/courses/mathematics/18-901-introduction-to-topology-fall-2004/index.htm
2. https://www.topologywithouttears.net/topbook.pdf
3. https://www.math.colostate.edu/~renzo/teaching/Topology10/Notes.pdf
4. https://www.youtube.com/playlist?list=PLpG_ISEhQ6z0Q5MaIvdn5tBJFWfp9fZtQ
5. https://freevideolectures.com/course/3528/topology

**Pedagogy**

Chalk and Talk, PPT, Quiz, Group discussion, Seminar, Interaction, Tutorial sessions

**Course learning Outcomes**

On the successful completion of the course, students will be able to

| CLO # | Description | K- level |
|---|---|---|
| CLO 1 | Verify whether or not a given set together with a collection of its subsets a topological space, to construct the topologies generated by bases and sub-bases, to determine the closure and interior of a set, to find the product of two topological spaces, identify continuous functions | K3 |
| CLO 2 | Compare the box and the product topologies, to recognize metrizable spaces, toidentify connected topological spaces, to construct new connected spaces out of given ones, to find out connected subspaces of the real line | K4 |
| CLO 3 | Determine the compactness of a topological space, to find out compact subspaces of the real line | K4 |
| CLO 4 | Recognize various types of topological spaces such as first &second countable, Lindeloff, Hausdorff based on the countability and separation axioms | K4 |
| CLO 5 | Prove certain named theorems on separation and compactness | K2 |

**Mapping with CLOs with POs**

| # | PO -1 | PO -2 | PO -3 | PO -4 | PO -5 | PO -6 | PO -7 |
|---|---|---|---|---|---|---|---|
| **CLO -1** | - | - | 2 | 1 | 3 | - | - |
| **CLO -2** | - | 1 | 2 | 2 | 3 | - | - |
| **CLO -3** | - | 1 | 2 | 2 | 3 | 2 | - |
| **CLO -4** | - | 2 | 3 | 2 | 3 | 2 | - |
| **CLO -5** | - | 2 | 3 | 2 | 3 | 2 | - |

*Advance application– 3* *Intermediate level–2* *Basic level–1*

**Learning Outcome Based Education (LOBE) & Assessment**
**Summative Examination – Blue Print**
**Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)**

| Units | CLOs | K- Level | Section A | | Section B | | Section C (Either/or Choice) | Section D (Open Choice) |
|---|---|---|---|---|---|---|---|---|
| | | | MCQs | | Short Answers | | | |
| | | | No. of Questions | K- Level | No. of Questions | K- Level | | |
| 1 | CLO 1 | Up to K3 | 2 | K2 / K3 | 1 | K1 | 2 (K1/K1) | 1 (K3) |
| 2 | CLO 2 | Up to K4 | 2 | K2 / K3 | 1 | K2 | 2 (K3/K3) | 1 (K4) |
| 3 | CLO 3 | Up to K4 | 2 | K3 / K4 | 1 | K2 | 2 (K4/K4) | 1 (K3) |
| 4 | CLO 4 | Up to K4 | 2 | K3 / K4 | 1 | K3 | 2 (K4/K4) | 1 (K4) |
| 5 | CLO 5 | Up to K2 | 2 | K1 / K1 | 1 | K1 | 2 (K2/K2) | 1 (K2) |
| No. of Questions to be asked | | | 10 | | | 5 | 10 | 5 |
| No. of Questions to be answered | | | 10 | | | 5 | 5 | 3 |
| Marks for each question | | | 1 | | | 2 | 5 | 10 |
| Total Marks for each section | | | 10 | | | 10 | 25 | 30 |

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences

## Distribution of Section-wise Marks with K levels

| K Levels | Section A MCQs | Section B (Short Answers) | Section C (Either/ or) | Section D (Open choice) | Total marks | % of marks without choice | Consoli-dated |
|---|---|---|---|---|---|---|---|
| K1 | 2 | 4 | 10 | - | 16 | 13.33 | 35% |
| K2 | 2 | 4 | 10 | 10 | 26 | 21.67 | |
| K3 | 4 | 2 | 10 | 20 | 36 | 30 | 30% |
| K4 | 2 | - | 20 | 20 | 42 | 35 | 35% |
| Total marks | 10 | 10 | 50 | 50 | 120 | 100 | 100% |

## CIA I – Blue Print
## Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

| Units | CLOs | K- Level | Section A | | Section B | | Section C | |
|---|---|---|---|---|---|---|---|---|
| | | | Short Answers | | (Either/or Choice) | | (Open Choice) | |
| | | | No. of Questions | K-Level | No. of Questions | K-Level | No. of Questions | K- Level |
| 1 | CLO 1 | Up to K3 | 1 | K2 | 2 | K3 | 1 | K2 |
| | | | 1 | K3 | | | 1 | K3 |
| 2 | CLO 2 | Up to K4 | 2 | K2 | 2 | K4 | 1 | K4 |
| | | | 1 | K3 | | | | |
| No. of Questions to be asked | | | 5 | | 4 | | 3 | |
| No. of Questions to be answered | | | 5 | | 2 | | 2 | |
| Marks for each question | | | 2 | | 5 | | 10 | |
| Total Marks for each section | | | 10 | | 10 | | 20 | |

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences

## CIA II – Blue Print
## Articulation Mapping-K Levels with Courses Learning Outcomes (CLOs)

| Units | CLOs | K- Level | Section A | | Section B | | Section C | |
|---|---|---|---|---|---|---|---|---|
| | | | Short Answers | | (Either/or Choice) | | (Open Choice) | |
| | | | No. of Questions | K-Level | No. of Questions | K-Level | No. of Questions | K-Level |
| 1 | CLO 4 | Up to K4 | 3 | K3 | 2 | K4 | 1 | K3 |
| | | | | | | | 1 | K4 |
| 2 | CLO 5 | Up to K2 | 1 | K2 | 2 | K2 | 1 | K2 |
| | | | 1 | K3 | | | | |
| No. of Questions to be asked | | | 5 | | 4 | | 3 | |
| No. of Questions to be answered | | | 5 | | 2 | | 2 | |
| Marks for each question | | | 2 | | 5 | | 10 | |
| Total Marks for each section | | | 10 | | 10 | | 20 | |

K1- Remembering and recalling facts with specific answers
K2- Basic understanding of facts and stating main ideas with general answers
K3- Application oriented- Solving Problems
K4- Examining, analyzing, presentation and make inferences with evidences

## COURSE PLAN

| UNIT | Topics to be covered | Hour(s) | Pedagogy |
|---|---|---|---|
| I | Topological spaces – introduction – definition and Examples - Types of Topological Spaces | 2 | Chalk and talk, PPT, Interaction, e-Quiz and Group Discussion |
| | Basis and subbasis for a topology – topology generated by bases and subbases | 2 | |
| | The order topology | 1 | |
| | The product topology on X x Y - The subspace topology | 2 | |
| | Closed sets and limits points | 2 | |
| | Continuous functions | 2 | |
| | Tutorial | 1 | |
| II | The Product Topology – Definition of Box topology and product topology | 1 | Chalk and talk, PPT, Interaction, Group Discussion and Assignment |
| | Comparison of Box topology and product topology and related theorems | 1 | |
| | Metric topology: Metrizable space – standard bounded metric, Euclidean metric and square metric | 1 | |
| | Topologies generated by square and Euclidean metrics | 1 | |
| | Uniform topology | 1 | |
| | Sequence lemma-Uniform limit theorem | 1 | |
| | Connected topological spaces – definition and example – construction of new connected spaces from the given ones | 1 | |
| | Connected subspaces of the real line | 2 | |
| | Components and Local connectedness | 2 | |
| | Tutorial | 1 | |
| III | Compact topological spaces – definition and examples –properties | 2 | Chalk and talk, PPT, Interaction, Assignment and Seminar |
| | Finite product of compact topological spaces – tube Lemma – finite intersection property | 2 | |
| | Compact subspaces of the real line – Extreme value theorem – Lebesgue number Lemma –Uniform continuity theorem | 2 | |
| | Limit Point Compactness | 1 | |
| | Complete metric spaces | 2 | |
| | Compactness in metric spaces. | 2 | |
| | Tutorial | 1 | |
| IV | The countability axioms - First and Second countable spaces | 2 | Chalk and talk, PPT, Interaction and e-Quiz |
| | Lindeloff and Separable Spaces | 2 | |
| | The separation axioms – Hausdroff, Regular and Norma spaces | 2 | |
| | Properties of Normal spaces | 2 | |
| | The Urysohn lemma – Completely regular spaces | 3 | |
| | Tutorial | 1 | |
| V | The Urysohn Metrization Theorem | 2 | Chalk and talk and Interaction |
| | Tietze Extension Theorem | 3 | |
| | The Tychonoff Theorem | 2 | |
| | Compactification – definition and examples | 2 | |
| | Stone Cech compactification | 2 | |
| | Tutorial | 1 | |
| **Total Hours** | | **60** | |

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# THE MADURA COLLEGE (Autonomous), MADURAI – 625 011

**(AFFILIATED TO MADURAI KAMARAJ UNIVERSITY)**

**RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC**

**PROGRAMME : M.Sc., Mathematics** **COURSE CODE : 21P1MMC4**

**COURSE TITLE : Ordinary Differential Equations** **QN.NO : 12404**

**TIME : 3 Hours** **MAX.MARKS :75**

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**Course Objectives:**

1. Develop strong background on finding solutions to linear differential equations with constant and variable coefficients and also with singular points.
2. Study the existence and uniqueness of the solutions of first order differential equations.
3. To solve the second order and *n-th* order Initial value problems.
4. Introduce the students to the technique of solving various problems of engineering and science.
5. Study the concepts relating to the order and linearity of ODEs, analytic and computational solution methods for ODEs .

**Course content**

| Unit | Description | Hours | K-level | CLOs |
|---|---|---|---|---|
| I | **Linear Homogeneous Equations with Constant Coefficients** Introduction – Second order homogeneous equations – Initial value problem for second order equations – Linear dependence and independence – A formula for Wronskian. | 18 | K2 | 1 |
| II | **Linear Non-Homogeneous Equations with Constant Coefficients** The Non-Homogeneous equations of order two – Homogeneous and Non-Homogeneous equations of order *n* – Initial value problems for *n-th* order equations – Annihilator method to solve Non-Homogeneous equations. | 18 | K3 | 2 |
| III | **Linear Equations with Variable Coefficients** Initial value problem – Existence and Uniqueness theorem – The Wronskian and Linear independence – Reduction of the order of a Homogeneous equation – The Non-Homogeneous equation – Homogeneous equations with analytic coefficients – The Legendre equations. | 18 | K4 | 3 |
| IV | **Linear Equations with Regular Singular Points** The Euler equations – Second order equations with Regular singular points – Exceptional cases – The Bessel equation – The Bessel equation continued. | 18 | K4 | 4 |
| V | **Existence and Uniqueness of Solutions to First Order Equations** Equations with variable separated – Exact equations – The metho successive approximation – The Lipschitz condition – Convergenc successive approximation – Non-local existence of solutions Approximations to and uniqueness of solutions. | 18 | K5 | 5 |

**Book for Study:**

1. Earl A. Coddington, An Introduction to Ordinary Differential Equations – Prentice – Hall of India Private Limited, New Delhi, 2008.

**Books for References:**

1. Williams E. Boyce and Richard C. Diprima, Elementary Differential Equations and Boundary Value Problems, 10th edition, John Wiley and Sons, New York, 2012.
2. M. D., Raisinghania, Advanced Differential Equaitons, S. Chand & Company Limited, New Delhi, 2012.
3. George F. Simmons, Differential Equations with Application and Historical Notes, Tata McGraw Hill, New Delhi, 1974.
4. B. Rai, D. P. Choudhury and H. I. Freedman, A Course in Ordinary Differential Equations, Narosh Publishing House, Private Limited, New Delhi, 2012.
5. Ravi. P. Agarwal and Ramesh C. Gupta, Essentials of Ordinary Differential Equations, McGraw Hill, New York, 1991.

**Web Resources:**

1. http://eqworld.ipmnet.ru/en/solutions/ode.htm
2. https://www.khanacademy.org/math/differential-equations
3. https://mathinsight.org/ordinary_differential_equation_introduction
4. https://tutorial.math.lamar.edu/Classes/DE/DE.aspx

5. https://www.emathhelp.net/calculators/differential-equations/differential-equation- calculator/
6. https://www.wolframalpha.com/examples/mathematics/differential-equations/

**Rationale and activities having direct bearing on Nature of Course**

Knowledge and Skill

Ordinary differential equations have wide applications in various science disciplines. It is practically important for science students able to model physical problems using mathematical equations, then solve these equations so that the behaviour of the systems concerned can be studied.

**Pedagogy:**

Lecture, Seminar, Quiz, Problem Solving, Tutorial, Group Discussion, PPT.

**Course Learning Outcomes:**

On the successful completion of the course, Students will be able to

| Number | Course Learning outcome | Knowledge level |
|---|---|---|
| CLO1 | Knowing the basic concepts Linearly Independent and dependent functions for solving Linear differential equations. | K2 |
| CLO2 | Acquire understanding of Homogeneous and Non-Homogeneous of second and higher order ODE's and solves them. | K3 |
| CLO3 | Solve problems using methods of undetermined coefficients, reduction of the order of equation and able to pertain Legendre equations. | K4 |
| CLO4 | Able to analyze problems in linear second order differential equations and able to pertain Bessel functions. | K4 |
| CLO5 | Know about exact differential equations and existence, uniqueness and continuity of solutions of first order ODE's, | K5 |

K1- Remembering and recalling facts with specific answers
K2 –Basic understanding of facts and stating main ideas with general answers
K3 –Application oriented – solving problems
K4- Examining, analyzing, presentation and make inference with evidences.
K5 - Evaluating the ode problems

**Mapping of Course Outcomes (CLOs) with Program Outcomes(POs)**

| CLOs/Pos | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| CLO1 | 3 | 2 | 3 | 3 | 3 |
| CLO2 | 3 | 2 | 3 | 3 | 3 |
| CLO3 | 3 | 3 | 3 | 3 | 3 |
| CLO4 | 3 | 3 | 3 | 3 | 3 |
| CLO5 | 2 | 2 | 2 | 3 | 2 |

1. Basic level 2. Intermediate level 3. Advance level

**External Blue Print**
**Mapping with Course Learning Outcomes (CLOs)**

| SL.No | CLOs | K-level | Section A | | Section B | | Section C (Either/or Choice) | Section D (Open Choice) |
|---|---|---|---|---|---|---|---|---|
| | | | MCQs | | Short Answers | | | |
| | | | No. of Questions | K-Level | No. of Questions | K-Level | | |
| 1 | CLO 1 | Up to K 2 | 2 | K1 & K1 | 1 | K1 | 2(K1& K1) | 1(K2) |
| 2 | CLO 2 | Up to K 3 | 2 | K2& K3 | 1 | K1 | 2(K2 & K2) | 1(K3) |
| 3 | CLO 3 | Up to K 4 | 2 | K2 & K3 | 1 | K2 | 2(K3 & K3) | 1(K3) |
| 4 | CLO 4 | Up to K 4 | 2 | K3 & K4 | 1 | K2 | 2(K4& K4) | 1(K4) |
| 5 | CLO 5 | Up to K5 | 2 | K3& K4 | 1 | K3 | 2(K4& K4) | 1(K5) |
| No. of Questions to be asked | | | 10 | | 5 | | 10 | 5 |
| No. of Questions to be answered | | | 10 | | 5 | | 5 | 3 |
| Marks for each question | | | 1 | | 2 | | 5 | 10 |
| Total Marks for each Section | | | 10 | | 10 | | 25 | 30 |

K1- Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – solving problems
K4- Examining, analyzing, presentation and make inference with evidences.
K5 - Evaluating the ode problems

**Distribution of section wise marks with K levels**

| K Levels | Section A (No choice) | Section B (No choice) | Section C (Either/ or) | Section D (Open choice) | Total marks | % of marks without choice | Consolidated |
|---|---|---|---|---|---|---|---|
| K1 | 2 | 4 | 10 | - | 16 | 13.33 | 35% |
| K2 | 2 | 4 | 10 | 10 | 26 | 21.67 | |
| K3 | 4 | 2 | 10 | 20 | 36 | 30 | 30% |
| K4 | 2 | - | 20 | 10 | 32 | 26.67 | 26.67% |
| K5 | - | - | - | 10 | 10 | 8.33 | 8.33% |
| Total marks | 10 | 10 | 50 | 50 | 120 | 100 | 100% |

**Blue Print for CIA-I**

| Sl. No. | CLOs | K-level | Section A | | Section B (Either/or Choice) | Section C (Open Choice) |
|---|---|---|---|---|---|---|
| | | | Short Answers | | | |
| | | | No. of Questions | K-Level | | |
| 1 | CLO 1 | Up to K 3 | 2 | K2 & K3 | 2(K3& K3) | 2(K2, K3) |
| 2 | CLO 2 | Up to K4 | 3 | K2, K2, K3 | 2(K4&K4) | 1(K3/ K4) |
| No. of Questions to be asked | | | 5 | | 4 | 3 |
| No. of Questions to be answered | | | 5 | | 2 | 2 |
| Marks for each question | | | 2 | | 5 | 10 |
| Total Marks for each Section | | | 10 | | 10 | 20 |

K1- Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – solving problems
K4- Examining, analyzing, presentation and make inference with evidences.
K5 - Evaluating the ode problems

**Distribution of section wise marks with K levels**

| K Levels | Section A (No choice) | Section B (Either/ or Choice) | Section C (Open Choice) | Total marks | % of marks without choice | Consolidated |
|---|---|---|---|---|---|---|
| K1 | - | - | - | - | - | - |
| K2 | 3 | - | 1 | 16 | 26.67 | 26.67% |
| K3 | 2 | 2 | 1 | 24 | 40 | 40% |
| K4 | - | 2 | 1 | 20 | 33.33 | 33.33% |
| Total marks | 10 | 20 | 30 | 60 | 100.00 | 100% |

**Blue Print for CIA-II**
**Mapping with Course Learning Outcomes (CLOs)**

| SL. No | CLOs | K-level | Section A | | Section B (Either/or Choice) | Section C (Open Choice) |
|---|---|---|---|---|---|---|
| | | | Short Answers | | | |
| | | | No. of Questions | K-Level | | |
| 1 | CLO 3 | Up to K 3 | 2 | K2 & K3 | 2 (K3& K3) | 2(K2, K3) |
| 2 | CLO 4 | Up to K4 | 3 | K2,K2, K3 | 2 (K4&K4) | 1(K3/ K4) |
| No. of Questions to be asked | | | 5 | | 4 | 3 |
| No. of Questions to be answered | | | 5 | | 2 | 2 |
| Marks for each question | | | 2 | | 5 | 10 |
| Total Marks for each Section | | | 10 | | 10 | 20 |

K1- Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – solving problems
K4- Examining, analyzing, presentation and make inference with evidences.
K5 - Evaluating the ode problems

**Distribution of section wise marks with K levels**

| K Levels | Section A (No choice) | Section B (Either/ or Choice) | Section C (Open Choice) | Total marks | % of marks without choice | Consolidated |
|---|---|---|---|---|---|---|
| K1 | - | - | - | - | - | - |
| K2 | 3 | - | 1 | 16 | 26.67 | 26.67% |
| K3 | 2 | 2 | 1 | 24 | 40 | 40% |
| K4 | - | 2 | 1 | 20 | 33.33 | 33.33% |
| Total marks | 10 | 20 | 30 | 60 | 100.00 | 100% |

**Lesson Plan**

| Units | Description | Hours | Pedagogy |
|---|---|---|---|
| I | Introduction | 2 | Lecture |
| | Second order homogeneous equations | 3 | Lecture |
| | Initial value problem for send order equations | 3 | Lecture & PPT |
| | Linear dependence and independence | 3 | Lecture |
| | Problems on Linear dependence and independence | 3 | Lecture |
| | A formula for Wronskian | 4 | Lecture& Group Discussion |
| II | The Non-Homogeneous equations of order two | 3 | Lecture |
| | Homogeneous equations of order n | 3 | Lecture& Seminar |
| | Non-Homogeneous equation of order n | 3 | Lecture |
| | Initial value problems for *n-th* order equations | 3 | Lecture & PPT |
| | Annihilator method | 3 | Lecture |
| | Annihilator method to solve Non-Homogeneous | 3 | Lecture& Seminar |
| III | Initial value problem | 3 | Lecture |
| | Existence and Uniqueness theorem | 3 | Lecture & PPT |
| | The Wronskian and Linear independence | 3 | Lecture |
| | Reduction of the order of a Homogeneous equation | 3 | Lecture |
| | Reduction of the order of a Homogeneous equation | 3 | Lecture & Seminar |
| | Homogeneous equations with analytic coefficients | 3 | Lecture & Group Discussion |
| | The Legendre equations. | 3 | |
| IV | The Euler equations | 4 | Lecture |
| | Second order equations with Regular singular points | 4 | Lecture |
| | Exceptional cases | 3 | Lecture & Seminar |
| | The Bessel equation | 4 | Lecture |
| | The Bessel equation continued. | 4 | Lecture & PPT |
| V | Equations with variable separated | 2 | Lecture |
| | Exact equations | 3 | Lecture & Seminar |
| | The method of successive approximation | 2 | Lecture |
| | The Lipschitz condition | 3 | Lecture & PPT |
| | Convergence of successive approximation | 3 | Assignment |
| | Non-local existence of solutions. | 2 | Lecture & Group Discussion |
| | Approximations to and uniqueness of solutions. | 3 | Lecture |
| **Total Hours** | | **90** | |

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# THE MADURA COLLEGE (Autonomous), MADURAI – 625 011

**(AFFILIATED TO MADURAI KAMARAJ UNIVERSITY)**

**RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC**

**PROGRAMME : M.Sc., Mathematics** **COURSE CODE : 21P1MME1**

**COURSE TITLE : Number Theory and Cryptography** **QN.NO : 12405**

**TIME : 3 Hours** **MAX.MARKS :75**

**Course Objectives:**

1. To understand the fundamental number theoretical algorithms and techniques.
2. Able to identify number theoretical functions and study their properties.
3. To learn and analyze certain types of Diophantine equations.
4. To apply the number theoretic concepts in modern cryptography.

| Unit | Description | Hours | K-level | CLO |
|---|---|---|---|---|
| I | Divisibility – Division algorithm – GCD – Euclidean algorithm – LCM — Congruence's – Euler's Theorem – Fermat's theorem – Wilson's theorem – Solutions of congruence's – The Chinese Remainder Theorem | 27 | Up to K3 | CLO1 |
| II | Quadratic residues – Lemma of Gauss – Gaussian reciprocity law – cobi symbol. | 17 | Up to K4 | CLO2 |
| III | Arithmetic functions – The Moebius Inversion formula – Multiplication of arithmetic functions. | 16 | Up to K2 | CLO3 |
| IV | Diophantine Equation – The linear equation – Pythagorean Triangle - The equation $x^2 + y^2 = z^2$ – The equation $x^4 + y^4 = z^2$ – sum of four and five squares. | 15 | Up to K4 | CLO4 |
| V | Discrete logarithm – Principles of public key – Cryptosystem – RSA algorithm – Elliptic curve cryptography. | 15 | Up to K3 | CLO5 |

**Books for Study:**

1. An introduction to the theory of numbers by Ivan Niven and Herbert +
   **Chapters: 1(1.2), 2(2.1-2.3), 3(3.1- 3.3), 4(4.2, 4.3, 4.4*), 5(5.1, 5.3, 5.6*).**
   ***Chapter: 4(4.4), 5(5.6)** is presented in 3rd edition 1972.Cryptography and Network Security

2. Principles and Practice by William Stallings, Prentice Hall, Fifth Edition, New Delhi, 2011.
   **Chapter: 8(8.5), 9(9.1-9.2), 10(10.4)**

**Books for Reference:**

1. Tom Apostol, Introduction to Analytic Number theory, Narosa Publications, New Delhi
   Neal Koblitz, A Course in Number Theory and Cryptography, Springer-Verlag, New York,1987.
2. David M.Burton, Elementary Number Theory, Wm.C.Brown Publishers, Dubuque, Iowa, 1989.

**Web Resources:**

1. https://nptel.ac.in/courses/106/103/106103015/
2. https://onlinecourses.nptel.ac.in/noc20_ma42/preview

**Rationale and activities having direct bearing on nature of course:**

Understanding of the course helps to encrypt and decrypt messages using basic concept of number theory, and to break the code using RSA carelessly.

**Pedagogy :**

Chalk and Talk, Problem Solving, Tutorial, Group Discussion, Quiz, Seminar.

**Course Learning Outcomes**

On the successful completion of the course, students will be able to

| Number | Course outcome | knowledge level |
|---|---|---|
| CLO1 | Understand the concept of divisibility and congruence. | Up to K3 |
| CLO2 | Learn the idea of Quadratic residues and reciprocity. | Up to K4 |
| CLO3 | Solve the number theoretical functions . | Up to K2 |
| CLO4 | Identify and solve Diophantine equations. | Up to K4 |
| CLO5 | Implement number theoretical concepts in cryptography. | Up to K3 |

K1- Recall, K2 – Understanding, K3 – Applying, K4- analyzing

| | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | 2 | 1 | 3 | 2 | 3 |
| **CO2** | 1 | - | 3 | 2 | 1 |
| **CO3** | 1 | 1 | 3 | 2 | 2 |
| **CO4** | - | - | 3 | 2 | 3 |
| **CO5** | 2 | 2 | 3 | 2 | 3 |

1. Basic level 2. Intermediate level 3. Advance level

| Units | CLOs | K-level | Section A | | Section B | | Section C | Section D |
|---|---|---|---|---|---|---|---|---|
| | | | MCQs | | Short Answers | | | |
| | | | No. of Questions | K-Level | No. of Questions | K-Level | (Either/or Choice) | (Open Choice) |
| 1 | CLO 1 | Up to K3 | 2 | K2 & K3 | 1 | K1 | 2(K2 & K2) | 1(K3) |
| 2 | CLO 2 | Up to K4 | 2 | K3 & K4 | 1 | K3 | 2(K4 & K4) | 1(K4) |
| 3 | CLO 3 | Up to K2 | 2 | K1 & K1 | 1 | K1 | 2(K1 & K1) | 1(K2) |
| 4 | CLO 4 | Up to K4 | 2 | K3 & K4 | 1 | K2 | 2(K4 & K4) | 1(K4) |
| 5 | CLO 5 | Up to K3 | 2 | K2 & K3 | 1 | K2 | 2(K3 & K3) | 1(K3) |
| No. of Questions to be asked | | | 10 | | 5 | | 10 | 5 |
| No. of Questions to be answered | | | 10 | | 5 | | 5 | 3 |
| Marks for each question | | | 1 | | 2 | | 5 | 10 |
| Total Marks for each Section | | | 10 | | 10 | | 25 | 30 |

**BLUE PRINT – External Examination**
**Articulation Mapping K-level with Course Learning Outcomes (CLOs)**

**Distribution of Section-wise Marks with K levels**
**The Components of assessment**

| K Levels | Section A (No choice) | Section B (No choice) | Section C (Either/ or) | Section D (Open choice) | Total marks | % of marks without choice | Consolidated |
|---|---|---|---|---|---|---|---|
| K1 | 2 | 4 | 10 | - | 16 | 13.33 | 35% |
| K2 | 2 | 4 | 10 | 10 | 26 | 21.67 | |
| K3 | 4 | 2 | 10 | 20 | 36 | 30.00 | 30% |
| K4 | 2 | - | 20 | 20 | 42 | 35.00 | 35% |
| Total marks | 10 | 10 | 50 | 50 | 120 | 100 | 100% |

| S.No | CLO | Test Component | Marks | K Level |
|---|---|---|---|---|
| 1 | 5 | Assignment | 5 Marks | K3 |
| 2 | 5 | Seminar | 5 Marks | K2 |
| 3 | 5 | Quiz | 5 Marks | K2 |

**BLUE PRINT – CIA - 1**
**Articulation Mapping K-level with Course Learning Outcomes (CLOs)**

| S.No. | CLOs | K-level | Section A | | Section B | Section C |
|---|---|---|---|---|---|---|
| | | | Short Answers | | | |
| | | | No. of Questions | K-Level | (Either/or Choice) | (Open Choice) |
| 1 | CLO 1 | Up to K3 | 3 | K2,K2,K3 | 2(K2 & K2) | 2(K3, K3) |
| 2 | CLO 2 | Up to K4 | 2 | K2, K3 | 2(K4 & K4) | 1(K4) |
| No. of Questions to be asked | | | 5 | | 4 | 3 |
| No. of Questions to be answered | | | 5 | | 2 | 2 |
| Marks for each question | | | 2 | | 5 | 10 |

| | | | | |
|---|---|---|---|---|
| Total Marks for each Section | 10 | | 10 | 20 |

**Distribution of Section-wise Marks with K levels**

| K Levels | Section A (No choice) | Section B (Either/ or) | Section C (Open choice) | Total marks | % of marks without choice | Consolidated |
|---|---|---|---|---|---|---|
| K2 | 6 | 10 | - | 16 | 26.67 | 27% |
| K3 | 4 | - | 20 | 24 | 40.00 | 40% |
| K4 | - | 10 | 10 | 20 | 33.33 | 33% |
| Total marks | 10 | 20 | 30 | 60 | 100 | 100% |

**BLUE PRINT – CIA -2**

**Articulation Mapping K-level with Course Learning Outcomes (CLOs)**

| S.No. | CLOs | K-level | Section B | | Section C | Section D |
|---|---|---|---|---|---|---|
| | | | Short Answers | | | |
| | | | No. of Questions | K-Level | (Either/or Choice) | (Open Choice) |
| 1 | CLO 3 | Up to K2 | 3 | K1,K1,K2 | 2(K2 & K2) | 1(K2) |
| 2 | CLO 4 | Up to K4 | 2 | K2, K3 | 2(K3 & K3) | 2(K3,K4) |
| No. of Questions to be asked | | | 5 | | 4 | 3 |
| No. of Questions to be answered | | | 5 | | 2 | 2 |
| Marks for each question | | | 2 | | 5 | 10 |
| Total Marks for each Section | | | 10 | | 10 | 20 |

**Distribution of Section-wise Marks with K levels**

| K Levels | Section A (No choice) | Section B (Either/ or) | Section C (Open choice) | Total marks | % of marks without choice | Consolidated |
|---|---|---|---|---|---|---|
| K1 | 4 | - | - | 4 | 06.67 | 46.67% |
| K2 | 4 | 10 | 10 | 24 | 40.00 | |
| K3 | 2 | 10 | 10 | 22 | 36.67 | 36.67% |
| K4 | - | - | 10 | 10 | 16.67 | 16.67% |
| Total marks | 10 | 20 | 30 | 60 | 100 | 100% |

**Lesson Plan**

| UNIT | DESCRIPTION | HOURS | PEDAGOGY |
|---|---|---|---|
| I | Divisibility - Division algorithm | 4 | Chalk and Talk, Problem Solving, Tutorial |
| | GCD, Euclidean algorithm | 4 | |
| | LCM and Properties | 5 | |
| | Congruence's - Euler's Theorem | 4 | |
| | Fermat's theorem – Wilson's theorem | 5 | |
| | Solutions of congruence's – The Chinese Remainder Theorem | 5 | |
| II | Quadratic residues – Lemma of Gauss | 8 | Chalk and Talk, Problem Solving, Tutorial |
| | Gaussian reciprocity law – Jacobi symbol. | 9 | |
| III | Arithmetic functions | 6 | Chalk and Talk, Problem Solving, quiz |
| | The Moebius Inversion formula | 4 | |
| | Multiplication of arithmetic functions. | 6 | |
| IV | Diophantine Equation – The linear equation – Pythagorean Triangle | 6 | Problem Solving, Seminar |
| | The equation $x^2 + y^2 = z^2$ | 3 | |
| | The equation $x^4 + y^4 = z^2$. | 3 | |
| | sum of four and five squares | 3 | |
| V | Discrete logarithm– Principles of public key | 6 | Chalk and Talk, Problem Solving |
| | Cryptosystem – RSA algorithm | 5 | |
| | Elliptic curve cryptography. | 4 | |
| | **Total Hours** | **90** | |

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# THE MADURA COLLEGE (Autonomous), MADURAI – 625 011

**(AFFILIATED TO MADURAI KAMARAJ UNIVERSITY)**

**RE-ACCREDITED (3rd Cycle) WITH "A" GRADE BY NAAC**

**PROGRAMME : M.Sc., Mathematics** **COURSE CODE : 21P1MNM1**

**COURSE TITLE : Quantitative Aptitude for Competitive Examinations** **QN.NO : 12406**

**TIME : 3 Hours** **MAX.MARKS :75**

**Course Objectives:**

1. To learn simplest tricks to find percentage, profit, loss, permutation, combination and probability.
2. To apply numerical techniques in solving quantitative aptitude.
3. To understand the shortcuts for the competitive exams.

| Unit | Description | Hours | K-level | CLO |
|---|---|---|---|---|
| I | **Problems on Numbers**: Introduction – important facts on sum, difference, product of two numbers, average, ratio, fraction – some other related problems – **Problems on Ages:** present ages – age ratio – some related problems. | 6 | K2 | CLO1 |
| II | **Percentage:** Introduction – important facts and formulae – results on populations – results on depreciation – difference percentage – some other related problems – Profit and Loss: calculate cost price and selling price – calculate profit% and loss% – Problems. | 6 | K2 | CLO2 |
| III | **Time and work:** Important ideas and formulae – days and hours calculations for workers works separately or together – problems – **Problems on train:** calculate train speed and distance – time to pass a pole or station of train of 'L' meter – speed of two train travel in same and opposite direction – Problems. | 6 | K2 | CLO3 |
| IV | **Calendar:** odd days – leap year – ordinary year – counting of odd days – day of the week – related to odd days – problems – **Clocks:** Important facts – too fast and too slow – related problems. | 6 | K2 | CLO4 |
| V | **Permutations and Combinations:** factorial notation – permutations – combinations – solved examples – **Probability:** random experiment – sample space – event – probability of occurrence of outcomes and event – results on probability – solved examples. | 6 | K2 | CLO5 |

**Book for Study:**

1. Dr. R. S. Aggarwal, Quantitative Aptitude for competitive examinations (Fully Solved), 2011 Revised Edition, S. Chand & Company Ltd.
   **Sections:** - 7, 8, 10, 11, 15, 18, 27, 28, 30 31.

**Books for Reference:**

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, 2020 Seventh Edition, McGraw Hill Publisher.
2. Dinesh Khattar, Quantitative Aptitude for Competitive Examinations, 2019 Fourth Edition, Pearson India Publisher.

**Web Resources:**

1.https://www.youtube.com/playlist?list=PLXjJ5c4vskp6yidDJs-NttEQwng8tu6Lo
2.https://www.careerbless.com/aptitude/qa/home.php
3.https://youtu.be/mLD41elDRTE

**Rationale and activities having direct bearing on nature of course:**

Thinking critically and applying basic mathematics skills to solve problems on numbers, ages, trains, time & work, calendar, clocks, probability and etc.,and developing proficiency in numerical and quantitative reasoning.

**Activities having direct bearing on Employability:**

This course imparts problem solving skills in the students and is crafted to help the students in identifying the best solution for a given problem. This course helps in strengthen the students in their "Aptitude knowledge" with the essentials short cut techniques.

**Pedagogy:**

Chalk and Talk, Seminar, Quiz, Problem solving and Tutorials.

## COURSE LEARNING OUTCOMES

| Number | Course outcome | knowledge level |
|---|---|---|
| **CLO1** | Learn mathematical tricks to solve the problems on numbers and ages | K2 |
| **CLO2** | Learn shortcuts in finding profit percentage and loss percentage | K2 |
| **CLO3** | Understand the idea of solving problems on time & work and trains | K2 |
| **CLO4** | Acquire the knowledge in calendar and clock problems | K2 |
| **CLO5** | Solve the problems on probability, permutation and combination | K2 |

**Mapping of Course Learning Outcomes (CLOs) with Program Outcomes (POs) and Program Specified Outcomes (PSOs)**

| CLO\ PO | PO | | | | |
|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 |
| **CLO1** | 3 | 1 | - | 3 | - |
| **CLO2** | 3 | 1 | - | 3 | - |
| **CLO3** | 3 | 1 | - | 3 | - |
| **CLO4** | 3 | 1 | - | 3 | - |
| **CLO5** | 3 | 1 | - | 3 | - |

3- Advance Application 2- Intermediate Level 1- Basic Level

## Blue Print – External Exam

**Articulation Mapping K-level with Course Learning Outcomes (CLOs)**

| Sl. No | CLOs | K. Level | Section A Short Answers | Section B (Either/or Choice) | Section C (Open Choice) |
|---|---|---|---|---|---|
| 1 | CLO1 | Up to K2 | 1( K1) | 2 (K2 & K2) | 1 (K1) |
| 2 | CLO2 | Up to K2 | 1( K1) | 2 (K2 & K2) | 1 (K1) |
| 3 | CLO3 | Up to K2 | 1( K1) | 2 (K2 & K2) | 1 (K1) |
| 4 | CLO4 | Up to K2 | 1( K1) | 2 (K2 & K2) | 1 (K1) |
| 5 | CLO5 | Up to K2 | 1( K1) | 2 (K2 & K2) | 1 (K1) |
| No. of Questions to be asked | | | 5 | 10 | 5 |
| No. of Questions to be answered | | | 5 | 5 | 3 |
| Marks for each question | | | 2 | 7 | 10 |
| Total Marks for each Section | | | 10 | 35 | 30 |

## Distribution of Section-wise Marks with K levels

**The Components of assessment**

| K Levels | Section A (No choice) | Section B (Either/ or) | Section C (Open choice) | Total marks | % of marks without choice | Consolidated |
|---|---|---|---|---|---|---|
| K1 | 10 | - | 50 | 60 | 46.15 | 46% |
| K2 | - | 70 | | 70 | 53.85 | 54% |
| Total marks | 10 | 70 | 50 | 130 | 100.00 | 100% |

| S.No | CLO | Test Component | Marks | K Level |
|---|---|---|---|---|
| 1 | 5 | Assignment | 5 Marks | K2 |
| 2 | 5 | Seminar | 5 Marks | K1 |
| 3 | 5 | Quiz | 5 Marks | K2 |

## Blue Print – CIA – I

**Articulation Mapping K-level with Course Learning Outcomes (CLOs)**

| Sl. No | CLOs | K. Level | Section A (Short Answers ) | Section B (Either/or Choice) | Section C (Open Choice) |
|---|---|---|---|---|---|
| 1 | CLO1 | Up to K2 | 3 (K1) | 2(K2 & K2) | 2(K1&K1) |
| 2 | CLO2 | Up to K2 | 2(K1) | 2(K2 & K2) | 1(K1) |
| No. of Questions to be asked | | | 5 | 4 | 3 |
| No. of Questions to be answered | | | 5 | 2 | 2 |

| | | | |
|---|---|---|---|
| Marks for each question | 2 | 5 | 10 |
| Total Marks for each Section | 10 | 10 | 20 |

**Distribution of Section-wise Marks with K levels**

| K Levels | Section A (Short Answers) | Section B (Either/ or) | Section C (Open choice) | Total marks | % of marks without choice | Consolidated |
|---|---|---|---|---|---|---|
| K1 | 10 | - | 30 | 40 | 66.67 | 67% |
| K2 | - | 20 | - | 20 | 33.33 | 33% |
| Total marks | 10 | 20 | 30 | 60 | 100 | 100% |

**Blue Print – CIA – II**

**Articulation Mapping K-level with Course Learning Outcomes (CLOs)**

| Sl. No | CLOs | K. Level | Section A (Short Answers) | Section B (Either/or Choice) | Section C (Open Choice) |
|---|---|---|---|---|---|
| 1 | CLO3 | Up to K2 | 3(K1) | 2(K2 & K2) | 2(K1&K1) |
| 2 | CLO4 | Up to K2 | 2(K1) | 2(K2 & K2) | 1(K1) |
| No. of Questions to be asked | | | 5 | 4 | 3 |
| No. of Questions to be answered | | | 5 | 2 | 2 |
| Marks for each question | | | 2 | 5 | 10 |
| Total Marks for each Section | | | 10 | 10 | 20 |

**Distribution of Section-wise Marks with K levels**

| K Levels | Section A (Short Answers) | Section B (Either/ or) | Section C (Open choice) | Total marks | % of marks without choice | Consolidated |
|---|---|---|---|---|---|---|
| K1 | 10 | - | 30 | 40 | 66.67 | 67% |
| K2 | - | 20 | - | 20 | 33.33 | 33% |
| Total marks | 10 | 20 | 30 | 60 | 100.00 | 100% |

**LESSON PLAN**

| UNIT | DESCRIPTION | Hours | MODE |
|---|---|---|---|
| I | Problems on Numbers: Introduction - important facts on sum, difference, product of two numbers, average, ratio, fraction | 6 | Chalk and Talk |
| | some related problems | | Problem Solving |
| | Problems on Ages: present ages – age ratio - some related problems . | | Tutorial |
| II | Percentage: Introduction – important facts and formulae – – | 6 | Chalk and Talk |
| | results on populations – results on depreciation – difference percentage – some other related problems. | | Problem Solving |
| | Profit and Loss: calculate cost price and selling price – calculate profit% and loss% – Example Problems. | | Problem Solving |
| III | Time and work: Important ideas and formulae | 6 | Chalk and Talk |
| | days and hours calculations for workers works separately or together – problems | | Problem Solving |
| | Problems on train: calculate train speed and distance | | Chalk and Talk |
| | time to pass a pole or station of train of 'L' meter – speed of two train travel in same and opposite direction – Problems. | | Problem Solving |
| IV | Calendar, odd days, Example problems. | 6 | Chalk and Talk |
| | Leap year, Ordinary year, Example problems. | | Seminar |
| | Clocks, The fast and Two slow, Example problems. | | Problem Solving |
| V | Factorial Notation, Example problems. | 6 | Chalk and Talk |
| | Permutation and Combination, Example problems. | | Seminar |
| | Probability, Experiment, Random experiment, example problems. | | Problem Solving |
| | Sample Space, Event, Probability occurrence of an event, Example problems. | | Tutorial |
| **TOTAL HOURS** | | **30** | |

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