Progressive Education Society's

Modern College of Arts, Science and Commerce,

Shivajinagar, Pune 5

(An Autonomous College Affiliated to Savitribai Phule Pune University)

Syllabus

M.Sc. (Mathematics)

(2019-20 Course)

(witheffectfrom 2019-20)

CIA: Continuous Internal Evaluation

Semester 1 (Part I)

Course Type	Course Code	Course / Paper Title	Hours / Week	Credit	CIA	End Sem Exam	Total
CCT-1	19ScMatP101	Real Analysis	5	4	40	60	100
CCT-2	19ScMatP102	Advanced Calculus	5	4	40	60	100
CCT-3	19ScMatP103	Group Theory	5	4	40	60	100
CCT-4	19ScMatP104	Numerical Analysis	5	4	40	60	100
Elective – I (Any one of the following two)							
DSEP-1	19ScMatP105	Ordinary Differential Equations	5	4	40	60	100
	19ScMatP106	Graph Theory					
Extra Credit Courses							
AECCT-1	19CpCysP101	Cyber Security-I	1	1	-	-	25
AECCT-2	19CpHrtP102	Human Rights-I	1	1	-	-	25
	Total		**27**	**22**			

Semester 2 (Part I)

Course Type	Course Code	Course / Paper Title	Hours / Week	Credit	CIA	End Sem Exam	Total
CCT-5	19ScMatP201	Complex Analysis	5	4	40	60	100
CCT-6	19ScMatP202	General Topology	5	4	40	60	100
CCT-7	19ScMatP203	Ring Theory	5	4	40	60	100
CCT-8	19ScMatP204	Linear Algebra	5	4	40	60	100
Elective – II (Any one of the following two)							
DSEP-2	19ScMatP205	Partial Differential Equations	5	4	40	60	100
	19ScMatP206	Integral Equations and Transforms					
Extra Credit Courses							
AECCT-3	19CpCysP201	Cyber Security-II	1	1	-	-	25
AECCT-4	19CpHrtP202	Human Rights-II	1	1	-	-	25
	Total		**27**	**22**			

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Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune - 5

First Year of M.Sc. (Mathematics) (2019 Course)

Course Code: 19ScMatP101
Course Name: Real Analysis

Teaching Scheme: TH: 4 Hours/Week **Credit: 04**

Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisites:

- Measure theory on real numbers, Exterior measure, Lebesgue measure, Measurable sets.

Course Objectives: To study

- Measure theory on a set
- Cantor Set
- Lebesgue integration theory
- Differentiation of functions on R^n

Course Outcomes:

On completion of the course, student will be able to–

- Find exterior measure and Lebesgue measure
- Check measurability of sets
- Find differentiation and integration of functions on R^n

Course Contents:

Chapter 1	Measure Theory	16 TH + 4 TUT
	• Exterior measure • Measurable sets • Cantor set • Lebesgue measure • Measurable functions	
Chapter 2	Integration Theory	16 TH + 4 TUT
	• The Lebesgue integral • Basic properties and convergence theorems • The space L^1 of integrable functions • Fubini's theorem.	
Chapter 3	Differentiation and Integration	15 TH + 4 TUT
	• Differentiation of the integral • Good Kernels and approximation to the identity	

	• Differentiation of functions on R^n	
Guidance/Discussion on course specific experiential learning through field work		1 TH
	TOTAL	60 = 48 TH + 12 TUT

Reference Books:

1. Real Analysis by Elias M. Stein and RamiShakharchi, Princeton University Press, 2005.

2. Real Analysis by H. Royden, Prentice Hall (Fourth edition), 2010.

3. Principles of Mathematical Analysis by W. R

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Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune - 5

First Year of M.Sc. (Mathematics) (2019 Course)

Course Code: 19ScMatP102
Course Name: Advanced Calculus

Teaching Scheme: TH: 4 Hours/Week **Credit: 04**

Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisites:
Derivative, Integration, Scalar field, Vector field,

Course Objectives: To study

- Derivative of scalar and vector field
- First and second fundamental theorems of calculus for line integrals
- Double integrals and Green's theorem
- Stokes' theorem and Divergence theorem
- Inverse function theorem and Implicit function theorem

Course Outcomes:
On completion of the course, student will be able to–

- Find area of the surface using double integration
- Find volume of the surface using double integration
- Find curl and divergence of a vector field
- Find directional derivative and gradient of a scalar field

Course Contents:

Chapter 1	Differential Calculus of Scalar and Vector Fields	11 TH + 3 TUT
	• Derivative of scalar field with respect to a vector • Directional derivative • Gradient of scalar field • Derivative of a vector field • Matrix form of chain rule • Inverse function theorem • Implicit function theorem	
Chapter 2	Line Integrals	12 TH + 3 TUT
	• Path and line integrals • Work as a line integral • Independence of path	

	• The first and second fundamental theorem of calculus • Necessary condition for a vector field to be a gradient	
Chapter 3	Multiple Integrals	12 TH + 3 TUT
	• Double integrals • Applications to area and volume • Green's theorem in the plane • Change of variables in a double integral • Transformation formula • Change of variables in an n-fold integral	
Chapter 4	Surface Integrals	12 TH + 3 TUT
	• The fundamental vector product • Area of a parametric surface • Surface integrals • The theorem of Stokes • The curl and divergence of a vector field • Gauss divergence theorem • Applications of the divergence theorem	
Guidance/Discussion on course specific experiential learning through field work		1 TH
	TOTAL	60= 48TH + 12 TUT

Reference Books:

1. Calculus Vol.II by T.M. Apostol, Wiley Student Edition (Second Edition), 2002.

2. Principles of Mathematical Analysis by W. Rudin, McGraw Hill, 1964.

3. Mathematical Analysis by S.C. Malik and Savita Arora, New Age International Private Limited (Fifth Edition), 2017.

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First Year of M.Sc. (Mathematics) (2019 Course)

Course Code: 19ScMatP103
Course Name: Group Theory

Teaching Scheme: TH: 4 Hours/Week **Credit: 04**

Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisites:

- Definition and examples of groups.
- Types of groups.

Course Objectives:-To Study

- Groups and subgroups.
- Symmetries of square.
- Cyclic groups, Permutation groups, Normal subgroups and Quotient groups.
- Homomorphism and Isomorphism between groups.

Course Outcomes:

On completion of the course, student will be able to–

- Find number of groups up to isomorphism.
- Find homomorphism and isomorphism between groups.
- Identify symmetries in the object.

Course Contents:

Chapter 1	Groups and Subgroups	9 TH +2 TUT
	• Groups • Group of matrices • Symmetries of a square, The dihedral groups, The rotation group of a cube • Elementary properties of groups • Subgroups • Subgroup tests	
Chapter 2	Cyclic Groups	8TH +2TUT
	• Cyclic groups • Properties of cyclic groups • Classification of subgroups of cyclic groups	
Chapter 3	Permutation Groups	8TH + 2 TUT
	• Permutation groups	

	• Properties of permutation groups • Cycle notation	
Chapter 4	Group Homomorphism and Isomorphism	8TH + 2 TUT
	• Homomorphism and Isomorphism of Groups • Properties of homomorphism, isomorphism and automorphism • The first isomorphism theorem • Cosets and Lagranges theorem • Cayley's theorem	
Chapter 5	External and Internal Direct Products	8 TH +2 TUT
	• External direct product, Internal direct product • Properties of external direct product and internal direct product • Normal subgroups and Factor groups • Applications of Factor groups • The fundamental theorem of finite abelian group	
Chapter 6	Sylow Theorems	6TH +2 TUT
	• Conjugacy classes • The class equation • Probability that two elements commute • The Sylow theorems • Application of the Sylow theorems	
Guidance/Discussion on course specific experiential learning through field work		1 TH
	TOTAL	60=48 TH + 12 TUT

Reference Books:

1. Contemporary Abstract Algebra by Joseph Gallian, Richard Stratton (Seventh edition),2010.
2. Topics in Algebra by I.N.Herstein, John Wiley and Sons(Second edition), 1975.
3. Abstract Algebra by Dummit and Foote, John Wiley and Sons(Third edition), 2003.
4. A First Course in Abstract Algebra by John B. Fraleigh, Pearson Education, 2003.

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Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune - 5

First Year of M.Sc. (Mathematics) (2019 Course)

Course Code: 19ScMatP104
Course Name: Numerical Analysis

Teaching Scheme: TH: 4 Hours/Week **Credit: 04**

Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisites:
Roots of equation, System of linear and nonlinear equations, Integration and Differentiation, Eigenvalues and eigenvectors, First order and first-degree differential equation

Course Objectives: To study
- Methods of finding real roots
- Numerical methods for finding solution of system of linear and nonlinear equations
- Methods of obtaining eigenvalues and eigenvectors of matrices numerically
- Numerical differentiation and integration

Course Outcomes:
On completion of the course, student will be able to–
- Find real roots of algebraic and transcendental equations
- Understand numerical methods to solve system of linear and nonlinear equations
- Find eigenvalues and eigenvectors of matrices numerically
- Find differentiation and integration numerically
- Understand method to solve differential equations

Course Contents:

Chapter 1	Root Finding Methods	8 TH + 2 TUT
	• Convergence • Fixed point iteration scheme • Newton's method • Secant method • Accelerating convergence	
Chapter 2	System of Equations	11 TH + 3 TUT

	• Formation of system of equations • Gaussian elimination method • Pivoting strategies • Error estimates and condition number • LU decomposition • Direct factorization • Iterative techniques for linear systems • Nonlinear system of equations	
Chapter 3	Eigenvalues and Eigenvectors	9 TH + 2 TUT
	• The power method • The inverse power method • Reduction to symmetric tridiagonal form • Eigenvalues of symmetric tridiagonal matrices	
Chapter 4	Differentiation and Integration	10 TH + 3 TUT
	• Numerical differentiation using Lagrange's interpolating polynomial • Numerical integration • Newton's- Cotes quadrature • Composite Newton's-Cotes quadrature	
Chapter 5	Initial Value Problems of Ordinary Differential Equation	9 TH + 2 TUT
	• Euler's Method • Runge-Kutta Methods • Multistep Methods • Convergence and stability analysis	
Guidance/Discussion on course specific experiential learning through field work		1 TH
	TOTAL	60 = 48 TH + 12 TUT

Reference Books:

1. A friendly introduction to Numerical Analysis byBrian Bradie, Prentice Hall ,2007.

2. An introduction to Numerical Analysis by K. E. Atkinson, John Wiley and Sons (Second edition), 1978.

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Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune - 5

First Year of M.Sc. (Mathematics) (2019 Course)

Course Code: 19ScMatP105
Course Name: Ordinary Differential Equations

Teaching Scheme: TH: 4 Hours/Week **Credit: 04**

Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisites:
Derivative, Integration, Homogeneous differential equations of first order, Exact differential equations, Integrating factors.

Course Objectives: To study

- Second order linear differential equations
- Qualitative properties of solutions
- Power series solutions of first and second order linear differential equations
- System of first order and first degree differential equations
- Non linear differential equations
- Existence and uniqueness of solutions of differential equations

Course Outcomes:
On completion of the course, student will be able to–

- Find general solutions of homogeneous and non- homogeneous differential equations
- Find normal form of differential equations
- Find solutions of differential equations using power series
- Find critical points of differential equations and check for stability of differential equations.

Course Contents:

Chapter 1	Second order linear equations	8 TH + 2 TUT
	• The general solution of homogeneous equation • The use of known solution to find another • Homogeneous equations with constant coefficients • The method of undermined coefficients • The method of variation of parameters	
Chapter 2	Qualitative properties of solutions	8 TH + 2 TUT
	• Sturm separation theorem • Normal form • Standard form	

	• Sturm's comparison theorem	
Chapter 3	Power series solutions	7 TH + 2 TUT
	• Review of power series • Series solutions of first order equations • Second order linear equations • Ordinary points and regular singular points • Indicial equations • Gauss hypergeometric equations • The point at infinity	
Chapter 4	Systems of first order equations	8 TH + 2 TUT
	• General remarks on systems • Linear systems • Homogeneous linear systems with constant coefficients • Non linear systems • Volterra's Prey-Predator equations	
Chapter 5	Non-linear equations	8 TH + 2 TUT
	• Autonomous systems • Critical points • Stability • Liapunov's direct method • Nonlinear mechanics • Conservative systems	
Chapter 6	The existence and uniqueness of solutions	8 TH + 2 TUT
	• The method of successive approximations • Picard's Theorem • Systems • The second order linear equations	
Guidance/Discussion on course specific experiential learning through field work		1 TH
	TOTAL	60=48 TH + 12TUT

Reference Books:

1. Differential equations with applications and historical notes by G. F. Simmons, Mc-Graw Hill (Second edition), 2003.

2. An introduction to differential equations and their applications by Stanley J. Farlow, Mc-Graw Hill, 1994.

3. Ordinary and partial differential equations by M. D. Raisinghania, S. Chand and Co. (18^{th} Edition), 1976.

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Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune - 5

First Year of M.Sc. (Mathematics) (2019 Course)

Course Code: 19ScMatP106
Course Name: Graph Theory

Teaching Scheme: TH: 4 Hours/Week **Credit: 04**

Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisites:

- Graphs.
- Types of graphs.

Course Objectives: To Study

- Various types of graphs such as Eulerian graphs, Hamiltonion graphs, etc.
- Trees, Planarity and duality of graphs, Colouring of graphs.
- Digraphs, Tournaments.

Course Outcomes:

On completion of the course, student will be able to–

- Apply Euler's formula for planar graphs.
- Understand Eulerian digraphs and tournaments.
- Understand applications of Hall'stheorem.

Course Contents:

Chapter 1	Definitions and examples	10 TH + 3 TUT
	• Introduction • Examples of graphs • Embedding of graphs • Eulerian graphs • Hamiltonian graphs	
Chapter 2	Trees, planarity and duality	12 TH +3 TUT
	• Definition and elementary properties of trees • The enumeration of trees • Planar graphs • Euler's formula for plane graphs • Graphs on other surfaces • Dual graphs • Infinite graphs	

Chapter 3	The colouring of graphs	10 TH +2 TUT
	• The chromatic number • The proof of Brook's theorem • The colouring of maps • Edge-colouring • Chromatic polynomial	
Chapter 4	Digraphs	6 TH +2 TUT
	• Digraphs • Eulerian digraphs and tournaments • Markov chains	
Chapter 5	Matching, marriage and Menger's theorem	9 TH +2 TUT
	• Hall's marriage theorem • Transversal theory • Applications of Hall's theorem • Menger's theorem • Network flows	
Guidance/Discussion on course specific experiential learning through field work		1 TH
	TOTAL	60=48 TH + 12TUT

Reference Books:

1. Introduction to graph theory by R. J. Wilson, Pearson (Third edition), 2003.
2. A first look at Graph Theory by John Clarke and D. A. Holton, Allied Publisher, 1991.
3. Graph Theory by Harary, Narosa Publishers, 1989.

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Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune - 5

First Year of M.Sc. (Mathematics) (2019 Course)

Course Code: 19ScMatP201
Course Name: Complex Analysis

Teaching Scheme: TH: 4 Hours/Week **Credit: 04**

Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisites: Basic concepts of complex numbers.

Course objectives: To Study

- Cauchy's theorem
- Meromorphic functions
- Bilinear Transformation

Course Outcomes:

On completion of the course, student will be able to–

- Find integral value of meromorphic functions
- Find radius of convergence, poles and residues
- Find mapping between two complex functions

Course Contents:

Chapter 1	Preliminaries to complex numbers	11 TH + 3 TUT
	• Complex number and the complex plane • Basic properties • Convergence • Sets in the complex plane • Functions on the complex plane • Continuous functions • Holomorphic functions • Power series • Integration along curves	
Chapter 2	Cauchy's theorem and its applications	14 TH + 4 TUT
	• Goursat's theorem • Local existance of primitives and Cauchy's theorem in a disk • Evaluation of some integrals • Further applications • Morera's theorem • Sequences of holomorphic functions	

	• Holomorphic functions defined in terms of integral • Schwartz reflection principle • Runge's approximation theorem.	
Chapter 3	Moromorphicfunctions and the logarithm	14 TH + 3 TUT
	• Zeros and poles • The residue formula and its examples • Singularities and meromorphic functions • The argument principle and applications • Homotopies and simply connected domain • The complex logarithm • Fourier series and harmonic functions	
Chapter 4	Bilinear transformation and mappings	8 TH + 2TUT
	• Basic mappings • Linear fractional transformations	
Guidance/Discussion on course specific experiential learning through field work		1 TH
	TOTAL	60= 48 TH + 12 TUT

Reference Books:

1. Complex Analysis by E.Stein and R.Shakharchi, Princeton University Press, 2003.

2. Foundations of Complex Analysis by S. Ponnusamy, Alpha Science International Ltd. (Second Edition), 2005.

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Modern College of Arts, Science and Commerce (Autonomous), Shivajinagar, Pune - 5

First Year of M.Sc. (Mathematics) (2019 Course)

Course Code: 19ScMatP202
Course Name: General Topology

Teaching Scheme: TH: 4 Hours/Week **Credit: 04**

Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisites: Set theory, Metric spaces

Course Objectives: To study

- Countable and uncountable sets
- Basis and types of topology
- Connectedness and compactness
- Countability and separation axiom
- Tychonoff theorem

Course Outcomes:

On completion of the course, student will be able to–

- Check countability of a set
- Compare the topologies
- Check continuity of a function
- Check connectedness and compactness of spaces
- Find limit points and closure of a set
- Check normality and regularity of spaces

Course Contents:

Chapter 1	Countable and uncountable sets	8 TH + 2TUT
	• Infinite sets, • The axiom of choice • Continuum hypothesis • Well-ordered sets • The maximum principle	
Chapter 2	Topological spaces and continuous functions	8 TH + 2TUT

	• Basis of topology • Order topology • Continuous functions • Product topology • Metric topology • Quotient topology	
Chapter 3	Connectedness and compactness	11 TH + 3TUT
	• Connected spaces • Components and local connectedness • Compact spaces • Limit point compactness • Local compactness • One-point compactness	
Chapter 4	Countability and separation axioms	12 TH + 3TUT
	• The countability axiom • Separation axiom • Normal spaces • The Urysohn lemma • The Urysohnmetrization theorem • The Tietze extension theorem	
Chapter 5	Tychonoffspaces	8 TH+ 2TUT
	• Tychonoff theorem • Completely regular spaces	
Guidance/Discussion on course specific experiential learning through field work		1 TH
	TOTAL	60 = 48TH + 12TUT

Reference Books:

1. Topology: A first course by J. R. Munkres, Pearson (Second edition), 1999.

2. Topology by J. Dugundji, Allyn and Bacon, Boston, 1966.

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First Year of M.Sc. (Mathematics) (2019 Course)

Course Code: 19ScMatP203
Course Name: Ring Theory

Teaching Scheme: TH: 4 Hours/Week **Credit: 04**

Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisites:

- Definition and examples of rings
- Vector spaces

Course Objectives: To Study

- Various types of rings such as polynomial ring, Boolean ring, etc.
- Integral domains, Fields, Principal ideal domains, Unique factorization domains and Modules

Course Outcomes:

On completion of the course, student will be able to–

- Find number of rings, subrings, ideals, integral domains, fields up to isomorphism.
- Check reduciabilty and irreduciability of polynomials
- Find homomorphism and isomorphism between rings
- Identify modules

Course Contents:

Chapter 1	Rings	10 TH +3 TUT
	• Rings, Opposite rings, Integral Domains, Fields • Ring of matrices, Boolean rings. • Polynomial rings: Power series rings, Laurent series rings	
Chapter 2	Ideals	12 TH +3 TUT
	• Ideals • Maximal ideal, Minimal ideal, Prime ideal, Principal ideal • Relation between ideals, Integral domains and fields	
Chapter 3	Homomorphism and isomorphism of rings	7 TH +2 TUT
	• Homomorphism and isomorphism of rings • Properties of homomorphism and	

	isomorphism • Fundamental theorems • Endomorphism rings • Fields of fractions • Prime fields	
Chapter 4	Integral domains	8 TH +2 TUT
	• Euclidean domains • Principal ideal domains • Unique factorization domains • Polynomial rings that are U.F.D.'s • Irreducibility Criteria	
Chapter 5	Modules	10 TH +2 TUT
	• Modules and submodule • Quotient modules • Free modules • Module homomorphism • Tortion free modules	
specific experiential learning through field work	Guidance/Discussion on course	1 TH
	TOTAL	60=48 TH + 12TUT

Reference Books:

4. Rings and Modules by C. Musili, Narosa Publishing House(Second edition),2001.
5. Abstract Algebra by Dummit and Foote, John Wiley and Sons(Third edition), 2003.
6. Basic Abstract Algebra by Jain and Bhattacharya, Cambridge University Press (Second edition), 2003.

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First Year of M.Sc. (Mathematics) (2019 Course)

Course Code: 19ScMatP204
Course Name: Linear Algebra

Teaching Scheme: TH: 4 Hours/Week **Credit: 04**

Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisites: Matrix, Vector spaces, Basis and dimension, Linear transform, Inner product.

Course Objectives: To study

- Basis and dimension of vector spaces
- Matrix of linear transforms
- The reduction of matrices to triangular and canonical forms
- Metric vector spaces

Course Outcomes:

On completion of the course, student will be able to–

- Find basis and dimension of vector spaces
- Find matrix of linear transform
- Reduce matrix to triangular form
- Reduce matrix to Jordan canonical form
- Find matrix of bilinear, quadratic and Hermitian form

Course Contents:

Chapter 1	Vector spaces	12 TH + 3 TUT
	• Definitions and examples • Subspaces • Basis and dimension	
Chapter 2	Linear mapping and matrices	12 TH + 3 TUT
	• Linear mapping • Quotient spaces • Vector spaces of linear mapping • Linear mapping and matrices • Change of basis • Rank of linear mapping • Decomposition of vector space	
Chapter 3	Reduction of matrices to canonical forms	12 TH + 3 TUT

	• Eigenvectors and eigenvalues • Triangularization of a matrix • Jordan canonical form	
Chapter 4	Metric vector spaces	11 TH + 3 TUT
	• Bilinear forms • Symmetric bilinear forms • Quadratic forms • Hermitian forms • Euclidean vector space • Canonical representation of unitary operator • Euclidean spaces	
Guidance/Discussion on course specific experiential learning Throughfield work		1 TH
	TOTAL	60 = 48 TH + 12 TUT

Reference Books:

1. First Course in Linear Algebra by P. B. Bhattacharya, S. R. Nagpaul, S. K. Jain, New Age International Pvt. Ltd., 2012.

2. University algebra by N. S. Gopalakrishnan, New Age International Pvt. Ltd., 2018.

3. Linear Algebra by VikasBist and Vivek Sahai, Narosa Publishing House, 2001.

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First Year of M.Sc. (Mathematics) (2019 Course)

Course Code: 19ScMatP205
Course Name: Partial Differential Equations

Teaching Scheme: TH: 4 Hours/Week **Credit: 04**

Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisites: Continuity, Integration, Partial derivative, Curves and surfaces, Solution of systems of differential equations

Course Objectives: To study

- First and second order linear partial differential equations
- Heat and wave equations
- Boundary value problems
- Heat conduction problems

Course Outcomes:

On completion of the course, student will be able to–

- Solve first and second order linear partial differential equations using various methods
- Solve boundary value problems

Course Contents:

Chapter 1	First order partial differential equations	16 TH + 4 TUT
	• Classification of integrals • Linear equations of first order • Pfaffian differential equations • Compatible systems • Charpit's method • Jacobi's method • Integral surfaces through a given curve • Quasi linear equation • Nonlinear first order P.D.E.	
Chapter 2	Second order partial differential equations	31 TH + 8 TUT
	• Classification of second order partial differential equations • One dimensional wave equation • Laplace equation • Boundary value problems	

	• The Cauchy problem • Dirichlet and Neumann problem • Harnack's theorem • Heat conduction problem • Duhamel's principle • Classification in the case of n-variables • Families of equipotential surfaces • Kelvin's inversion theorem	
Guidance/Discussion on course specific experiential learning through field work		1 TH
	TOTAL	60 = 48 TH + 12 TUT

Reference Books:

1. An elementary course in Partial Differential Equations by T. Amaranth, Narosa Publishing House (Second edition), 2008.

2. Elements of Partial Differential Equations by I. N. Sneddon, Mc-Graw Hill book company, 2006.

3. Ordinary and partial differential equations by M. D. Raisinghania, S. Chand and Co. (Eighteenth Edition), 1976.

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First Year of M.Sc. (Mathematics) (2019 Course)

Course Code: 19ScMat206
Course Name: Integral Equation and Transforms

Teaching Scheme: TH: 4 Hours/Week **Credit: 04**

Examination Scheme: CIA: 50 Marks **End-Sem: 50 Marks**

Prerequisites:

Integration, Differentiation, Ordinary differential equations, Initial value problems.

Course Objectives: To study

- Classification of integral equations.
- Methods to solve Fredholm integral equations.
- Methods to solve Volterra integral equations.
- Methods to solve singular integral equations.
- Methods to solve non-linear integral equations.
- Methods to obtain Fourier and Laplace transforms.

Course Outcomes:

On completion of the course, student will be able to–

- Classify integral equations.
- Solve Fredholm integral equations.
- Solve Volterra integral equations.
- Solve singular integral equations.
- Solve non-linear integral equations.
- Obtain Fourier and Laplace transforms.
- Solve differential and integral equations using Fourier and Laplace transforms.

Course Contents:

Chapter 1	Classification of linear integral equations	6 TH + 1 TUT
	• Fredholmintegral equations • Volterra integral equations • Integro-differential equations • Singular integral equations • Converting Volterra integral equation to ordinary differential equation • Conversion of initial value problem to Volterra integral equation • Conversion of BVP to Fredholm	

	equation	
Chapter 2	Fredholm integral equations	6 TH + 2TUT
	• Decomposition method • Modified decomposition method • Direct computation method • Successive approximation method • Successive substitution method • Homogeneous Fredholm integral equations • Comparison between alternative methods	
Chapter 3	Volterra integral equations	6 TH + 2 TUT
	• Decomposition method • Modified decomposition method • Series solution method • Converting Volterra integral equation to initial value problem • Successive approximation method • Successive substitution method • Comparison between alternative methods	
Chapter 4	Integro-differential equations	6 TH + 1 TUT
	• Introduction • Direct computation method • Decomposition method • Converting to Fredholm integral equation • Volterra integro-differential equations series solution method • Conversion to initial value problem	
Chapter 5	Singular integral equations	5 TH+ 1 TUT
	• Abel problem • Generalized Abel integral equation • Weakly-singular Volterra equations	
Chapter 6	Nonlinear integral equations	6 TH+ 1 TUT
	• Nonlinear Fredholm integral equations • Direct computation method • Decomposition method • Nonlinear Volterra integral equation • Series solution method • Decomposition method • Existence and uniqueness of solutions using fixed point theorem in case of linear and nonlinear Volterra and Fredholm integral equations	
Chapter 7	Fourier transforms	6 TH+ 2 TUT

	• Definition, Properties and evaluation of Fourier and inverse Fourier transforms of functions • Convolution theorem for Fourier transforms • Sine and cosine Fourier transforms • Solving differential equations and integral equations using Fourier transforms	
Chapter 8	Laplace transforms	6 TH+ 2 TUT
	• Definition, Properties and evaluation of Laplace transforms. • Convolution theorem for Laplace transforms • Solving differential equation and integral equation using Laplace transforms.	
Guidance/Discussion on course specific experiential learning through field work		1 TH
	TOTAL	60= 48TH + 12TUT

Reference Books:

1. A First course in integral equations by A.M. Wazwaz, World Scientific, 1997.

2. Introduction to Integral Equations with Applications by A.J. Jerri, Wiley Interscience (Second edition), New York,1999.