Yogi Divine Society inspired,
Sarvodaya Kelavani Samaj managed

Shree Manibhai Virani and Smt. Navalben Virani Science College, Rajkot.
Autonomous

(Affiliated to Saurashtra University, Rajkot)

Re-Accredited at 'A' Level by NAAC
STAR college Scheme & Status by MST-DBT
UGC- College with Potential for Excellence (CPE)
UGC-DDU KAUSHAL Kendra
GAAA – Highest Grade A-1 by KCG, Government of Gujarat
GPCB-Government of Gujarat approved Environment Audit Center
UGC-Autonomous College

DEPARTMENT OF MATHEMATICS

M.Sc. Mathematics

Enclosure –IB

Shree Manibhai Virani and Smt. Navalben Virani Science College, Rajkot
Autonomous
(Affiliated to Saurashtra University, Rajkot)

Department of Mathematics
M.Sc. MATHEMATICS

Regulations for Students Admitted From A.Y. 2016-2017 & Onwards

ELIGIBILITY
Candidates for the programme of **MASTER OF SCIENCE (MATHEMATICS)** shall be admitted as per the norms prescribed by the Saurashtra University, Rajkot and State Government. All admissions are provisional and subject to the approval of Saurashtra University.

DURATION OF THE PROGRAMME:
The M.Sc. program is full time curriculum run for two years spread over 4 semesters with two semesters in one academic year. There shall not be less than 90 working days for each semester. Examination shall be conducted as continuous internal assessment (CIA) as well as semester end examination (SEE).

EVALUATION

The evaluation shall generally comprise of Continuous Internal Evaluation (CIE) and Semester End Examination (SEE) with percentage weightage as specified below, unless specified otherwise in the Scheme of Instruction and Examinations.

Theory Courses		***Practical Courses***	
Continuous Internal Evaluation (CIE)	30%	Continuous Internal Evaluation (CIE)	40%
Semester End Examination (SEE)	70%	Semester End Examination (SEE)	60%

For the purpose of computation of credits the following mechanism is adopted:

a) 1 hour instruction of Theory = 1 Credit
b) 1 hour instruction of Tutorial = 1 Credit
c) 2-3 hours instructions of Practical = 1 Credit

ISSUE OF MARK-SHEET AND DEGREE CERTIFICATE

The college shall publish the result after evaluation and with the recommendations of Result Passing Board at the end of each semester. On approval/ratification of the results by the Academic Council, the candidate will be recommended to Saurashtra University for the award of the degree on completion of all the courses and components of the curriculum.

Enclosure –IIB

Shree Manibhai Virani and Smt. Navalben Virani Science College, Rajkot (Autonomous)
Affiliated to Saurashtra University, Rajkot
Department of Mathematics
M. Sc. MATHEMATICS

SCHEME OF INSTRUCTION AND EXAMINATIONS
For Students Admitted from A.Y. 2016-2017 & Onwards

OBJECTIVES OF THE PROGRAMME:

The curriculum is framed to accomplish the following program objectives which students shall accomplish by the end of their post graduation study:

Students under M.Sc. Mathematics programme should have acquired the following knowledge and skills:

1. Research Skills

a) A basic understanding of methods and the subject matter of mathematical sciences (including analysis, algebra, applied mathematics, topology and geometry).
b) The ability to read, understand and write research papers.
c) The habit to read mathematical texts independently.
d) Comprehension of the general framework of mathematical research; an understanding of the role of axioms, assumptions, theorems, proofs, and conjectures

2. Computational skills

a) Proficiency in basic computational methods including pure and applied branches of mathematics.
b) Facility with computer-aided computations.

3. Analytical skills

a) An understanding of the basic rules of logic and proficiency in using them.
b) The ability to give counter examples to prove or disprove the derived/ existing results.
c) The ability to distinguish a coherent argument from a fallacious one.
d) The ability to derive general principles from examples.
e) The ability to formulate mathematical conjectures and to test them.
f) The ability to complete mathematical proofs.

4. Practical problem solving and mathematical modeling skills

a) The ability to relate mathematical concepts to problems arising in other disciplines.
b) The ability to represent problems and ideas precisely in mathematical terms.
c) The ability to identify facts and techniques relevant to a given problem, and proficiency in using them to solve the problem.

5. Communication skills

a) The ability to clearly present mathematical concepts, statements, and arguments both in written and oral form.
b) Knowledge of standard mathematical terminology and notation and the ability to use them properly

SCHEME OF INSTRUCTION AND EXAMINATIONS
FOR STUDENTS ADMITTED FROM A.Y. 2016-2017 & ONWARDS

Semester - I							
Course Code	**Course**	**Hrs of Inst/ week**	**Exam Duration (Hrs)**	**Max Marks**			**Credit**
				CIA	**SEE**	**Total**	
Part –I							
16PMTCC01	**Core 1:** Algebra – I	4	3	30	70	100	4
16PMTCC02	**Core 2:** Topology – I	4	3	30	70	100	4
16PMTCC03	**Core 3:** Functions of Several Variables	4	3	30	70	100	4
16PMTCC04	**Core 4:** Theory of Differential Equations	4	3	30	70	100	4
16PMTDC01/ 16PMTDC02	**Discipline Specific Elective -ID -- I:** Classical Mechanics–I/ Fuzzy Mathematics	4	3	30	70	100	4
16PMTCC05	Comprehensive Viva	4	-	-	100	100	4
		24				**600**	**24**
Part III							
16PVE01	Value Education	1		Remarks			1
Total		**25**					**25**

Semester – II							
Course Code	**Course**	**Hrs of Inst/ week**	**Exam Duration (Hrs)**	**Max Marks**			**Credit**
				CIA	**SEE**	**Total**	
Part I							
16PMTCC06	**Core 5:** Algebra – II	4	3	30	70	100	4
16PMTCC07	**Core 6**: Topology – II	4	3	30	70	100	4
16PMTCC08	**Core 7**: Real Analysis	4	3	30	70	100	4
16PMTCC09	**Core 8**: Theory of Partial Differential Equations	4	3	30	70	100	4
16PMTDC03/ 16PMTDC04	**Discipline Specific Elective - ID - II:** Classical Mechanics – II / Mathematical Methods	4	3	30	70	100	4
16PMTCC10	Comprehensive Viva	-	-	-	100	100	2
16PMTCC11	**Practical :** Introduction to Latex	4	3	60	40	100	2
Total		**24**				**700**	**24**

Semester - III							
Course Code	**Course**	**Hrs of Inst**	**Exam Duration (Hrs)**	**Max Marks**			**Credit**
				CIA	**SEE**	**Total**	
Part I							
16PMTCC12	**Core 9:** Complex Analysis	4	3	30	70	100	4
16PMTCC13	**Core 10**: Number Theory – I	4	3	30	70	100	4
16PMTCC14	**Core 11**: Discrete Mathematics	4	3	30	70	100	4
16PMTCC15	**Core 12**: Linear Algebra	4	3	30	70	100	4
16PMTDC05/ 16PMTDC06	**Discipline Specific Elective - ID - III:** Financial Mathematics **OR** Cryptography	4	3	30	70	100	4
16PMTCC16	**Practical** (Programming of Numerical Methods in Scilab)	8	3	100	-	100	3
Total		**28**				**600**	**23**

Semester – IV							
Course Code	**Course**	**Hrs of Inst**	**Exam Duration (Hrs)**	**Max Marks**			**Credit**
				CIA	**SEE**	**Total**	
Part – I							
16PMTCC17	**Core13:** Functional Analysis	4	3	30	70	100	4
16PMTCC18	**Core 14:** Number Theory – II	4	3	30	70	100	4
16PMTCC19	**Core 15:** Graph Theory	4	3	30	70	100	4
16PMTCC20	**Core 16:** Differential Geometry	4	3	30	70	100	4
16PMTDC07/ 16PMTDC08	**Discipline Specific Elective - ID - IV:** Mathematical Statistics **OR** Operation Research	4	3	30	70	100	4
16PMTCC21	Comprehensive Viva	8	3		100	100	2
Part – II							
16PMTCE01	Writing Summery of a Research Paper	-	-	50	-	50	1
16PMTCE02	Field Visit	-	-	50	-	50	1
Total		**28**				**700**	**24**
TOTAL OF ALL SEMESTERS						**2600**	**96**

TOTAL MARKS AND CREDIT DISTRIBUTION

S.NO	PART	Total Marks	Total Credits
1.	**PART I:** Core, Discipline Specific Elective Courses	2500	93
2.	**PART II :** Competency Enhancement Courses	100	2
3.	**PART III:** Value Education	Remarks	1
	TOTAL	**2600**	**96**

- **Part- I: CORE, DSE CORE**

CORE COURSES (Theory)

S.No	Semester	Course Code	Course
1.	I	16PMTCC01	Algebra – I
2.		16PMTCC02	Topology – I
3.		16PMTCC03	Functions of Several Variables
4.		16PMTCC04	Theory of Differential Equations
5.		16PMTCC05	Comprehensive Viva
6.	II	16PMTCC06	Algebra – II
7.		16PMTCC07	Topology – II
8.		16PMTCC08	Real Analysis
9		16PMTCC09	Theory of Partial Differential Equations
10		16PMTCC10	Comprehensive Viva
11	III	16PMTCC12	Complex Analysis
12.		16PMTCC13	Number Theory – I
13.		16PMTCC14	Discrete Mathematics
14		16PMTCC15	Linear Algebra
15	IV	16PMTCC17	Functional Analysis
16		16PMTCC18	Number Theory – II
17		16PMTCC19	Graph Theory
18		16PMTCC20	Differential Geometry
19		16PMTCC21	Comprehensive Viva

CORE COURSES (Practical)

S.No	Semester	Course Code	Course
1.	**I**	-	-
2.	**II**	16PMTCC11	**Practical :** Introduction to Latex
3.	**III**	16PMTCC16	**Practical** (Programming of Numerical Methods in Scilab)
4.	**IV**	-	-

- **OTHER CORE COURSES**

S.No.	Semester	Course Code	Course
1.	**-**	**-**	-

- **DSE CORE COURSE (Theory & Practical)**
  Students are required to opt for any one of the courses offered in each semester respectively.

S.No	Semester	Theory	
		Course Code	**Course**
1.	I	**16PMTDC01**	Classical Mechanics - I
		16PMTDC02	Fuzzy Mathematics
2.	II	**16PMTDC03**	Classical Mechanics - II
		16PMTDC04	Mathematical Methods
3	III	**16PMTDC05**	Financial Mathematics
		16PMTDC06	Cryptography
4.	IV	**16PMTDC07**	Mathematical Statistics
		16PMTDC08	Operation Research

- **Part- II COMPETENCY ENHANCEMENT COURSES**

S.No	Semester	Course Code	Course
1.	**I**	-	-
2.	**II**	-	-
3.	**III**	-	-
4.	**IV**	**16PMTCE01**	Writing Summery of a Research Paper
5		**16PMTCE02**	Field Visit

- **Part III** VALUE EDUCATION

S.No	Semester	Course Code	Course
1.	**I**	16PVE01	Value Education

Semester – I			
16PMTCC01	**Core 1:** Algebra – I	**4hrs/wk**	**4 Credits**

Objectives:

Upon completion of the course students will be able to

1. Understand basic principles of algebraic structures like groups, fields rings and division rings.
2. Recognize and understand the concept of Ideals.
3. Recognize and understand the concepts of Euclidean domains, Unique factorization domains, polynomial rings as well as Einstein irreducibility criterion.

Unit 1 Basic concepts of group theory **(10hrs)**

- Group
- Abelian group
- Cyclic group
- Normal subgroup

Unit 2 Homomorphism of Groups **(10hrs)**

- Quotient group
- Permutation group
- Group isomorphism and their properties
- Cayley's theorem, Automorphisms of groups

Unit 3 Direct Products **(10hrs)**

- Direct Products
- Finitely Generated Abelian Groups
- Invariants of a finite Abelian Groups
- Sylow Theorems

Unit 4 Quick look at basic ring theory **(9hrs)**

- Euclidean ring
- Quotient ring and zero divisors
- Ideals and ideal rings
- Principal ideal
- Maximal ideal and prime ideal
- Homomorphisms of ideals
- Sum and Direct Sum of Ideals
- Nilpotent and Nil Ideals

Unit 5 Euclidean domains **(9hrs)**

- Euclidean domains
- Principal Ideal Domains

- Unique Factorization Domains
- Polynomial Rings over UFD
- Polynomial rings over rational field
- Irreducible polynomials
- Einstein irreducibility criterion

Reference Books:

1. P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul, Basic Abstract Algebra**,** Second Edition, Cambridge University Press, 1995.
2. M. Artin, Algebra, Prentice-Hall of India Private Ltd., New Delhi, 1994.
3. J. A. Gallian, Contemporary Abstract Algebra, Fourth Edition, Narosa Publishing House, New Delhi, 1999.
4. N. S. Gopalakrishnan, University Algebra, New Age International Private Ltd. Publishers, New Delhi, Sixth Reprint, 1998.
5. I. N. Herstein, Topics in Algebra, Second Edition, Wiley Pub. , New York, 1975.

Semester – I			
16PMTCC02	**Core 2:** Topology – I	**4hrs/wk**	**4 Credits**

Objectives:

Upon completion of the course students will be able to

1. Recognize and interpret the topological structures and their characterizations.
2. Identify and understand the subspace topology and product topology.
3. Identify and classify the type of topology including quotient topology and metric topology.
4. Understand and differentiate the hierarchy of the topological spaces and their characterizations.

Unit 1 Topological spaces **(10hrs)**

- Relations and well ordered set
- Topological spaces
- Basis for a Topology

Unit 2 The Subspace Topology **(10hrs)**

- The Subspace Topology
- Order Topology

Unit 3 Product Topology **(10hrs)**

- Product Topology and related concepts
- Closed sets and limit points

Unit 4 Continuity **(9hrs)**

- Continuous functions
- Metric Topology
- Quotient Topology

Unit 5 Hierarchy in topological spaces **(9hrs)**

- T_1- spaces
- Hausdorff spaces
- Regular spaces and Normal spaces
- Urysohn's Lemma and Tietze extension theorem

Reference Books:-

1. Munkres J., Topology: A first course, Prentice-Hall of India Pvt. Ltd, New Delhi.
2. Simmons G. F., Introduction to Topology and Modern Analysis, McGraw Hill Company, Tokyo.
3. Willards S., General Topology, Addition-Wesley, Reading, 1970.

Semester – I			
16PMTCC03	**Core 3:** Functions of Several Variables	**4hrs/wk**	**4 Credits**

Objectives:

Upon completion of the course students will be able to

1. Identify and define functions of the form $T: R^n \to R^m$
2. Introduce the concepts including limit, continuity for the functions of several variables.
3. Understand and criticize the concepts of partial derivative of first and higher order for functions of several variables.
4. Recognize and understand the concepts of tensor algebra on finite dimensional vector spaces, alternating and symmetric tensors, wedge products, vector fields and forms as well as their basic properties.

Unit 1 Euclidean Space and its basic properties **(10hrs)**

- Euclidean Space R^n and its basic properties
- Functions From: $R^n \to R^m$
- Limit, Continuity and Oscillation
- Relation between Linear Transformation $T: R^n \to R^m$ and m * n Matrices

Unit 2 Differentiation **(10hrs)**

- Differentiations and their Basic Prosperities
- Chain Rule and Jacobian Matrix

Unit 3 Partial Differentiation **(10hrs)**

- Partial Derivatives and its Relation with Jacobian Matrix
- Partial Derivatives of Higher Order

Unit 4 Partial Derivative and Continuity **(9hrs)**

- Young's Theorem, and Schwarz's Theorem
- Directional Derivative its Basic Properties its Relation with Derivative
- Partial Derivative and Continuity

Unit 5 Tensor algebra on Finite Dimensional Vector Space **(9hrs)**

- Tensor algebra on Finite Dimensional Vector Space
- Alternating and Symmetric Tensors
- Wedge Product and Relation Among Them
- Vector Fields and Forms, their Basic Properties

Reference Books:-

1. M. Spivak, Calculus on Manifolds, W.E. Benjamin Inc., 1965.
2. W. Rudin, Principles of Mathematical Analysis, (Third Edition), Tata McGraw-Hill Publ. Co., New Delhi, 1983.
3. S. R. Ghorpade and B. V. Limaye, A Course in Multivariable Calculus and Analysis, Springer, 2010

Semester – I			
16PMTCC04	**Core 4:** Theory of Differential Equations	**4hrs/wk**	**4 Credits**

Objectives:

Upon completion of the course students will be able to

1. Understand the meaning of Ordinary Differential Equations.
2. Understand and solve Partial differential equation.
3. Identify and solve Gauss hyper geometric equation.
4. Understand, identify and solve Cauchy Problem including Charpit's and Jacobi's method.

Unit 1 Review of Simultaneous Ordinary Differential Equations (10hrs)

- Review of Simultaneous Ordinary Differential Equations of First Order
- Second order differential equations: the method of variation of parameters
- Ordinary and singular points, series solution
- Fresenius method: solution in series near regular singular point, point at infinity

Unit 2 Some special kind of equations (10hrs)

- Legendre equation
- Legendre polynomial and its properties
- Bessel's equation
- Bessel's function of first and second kind and their properties

Unit 3 Partial differential equations (10hrs)

- Partial differential equation
- Partial differential equation of first order
- Compatible system of first order partial differential equations
- Picard's Method of successive Approximations

Unit 4 Gauss hyper geometric equations (9hrs)

- Gauss hyper geometric equation
- Gauss hyper geometric function and its properties

Unit-5 Solution of partial differential equations (9hrs)

- Charpit's and Jacobi's method
- Cauchy Problem

Reference Books:-

1. G. F. Simmons, Differential equations with applications and historical notes, McGraw-Hill International Editions, second edition.
2. Amarnath, T., Elementary Course in Partial Differential Equations, Narosa Publ. House, New Delhi, 1997.
3. Sneddon, I. N., Elements of Partial Differential Equations, McGraw-Hill Publ. Co., 1957.
4. Rabenstein, A. L., Introduction to Ordinary Differential Equations, Academic Press.
5. Raisinghania, M. D. Advanced Differential Equations, S. Chand \& Co., 1995.
6. Grewal, B.S. and Grewal, J.S., Higher Engineering Mathematics, (36th Edition), Khanna Publ., New Delhi, 2000.

7. Somasundaram, D., Ordinary Differential Equations: A First Course, Narosa Publ. House, New Delhi, 2002.
8. William E. Boyce, Richard C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 10th Edition.

Semester – I			
16PMTDC01	**DISCIPLINE SPECIFIC ELECTIVE - ID - I :** Classical Mechanics - I	**4hrs/wk**	**4 Credits**

Objectives:

Upon completion of the course students will be able to

1. Understand and describe elementary principles of motion.
2. Understand and criticize equations of motion and classify the dynamical systems.
3. Derive and utilize Lagrange's equation of motions.
4. Identify, understatnd and solve two body central force problem.

Unit 1 Survey of elementary principles (10hrs)

- Conservation theorem for linear momentum and angular momentum for a particle
- Conservation theorem for linear momentum and angular momentum for a system of particles
- Classification of dynamical system

Unit 2 D'Almbert's principle and Lagrange's equation of motions (10hrs)

- Constraints.
- Virtual displacement and principle of virtual work.
- Generalized force in holonomic system
- Mathematical expression for principle of virtual work
- D'Almbert's principle
- Lagrange's equation for holonomic system
- Lagrange's equation for conservative non-holonomic system
- Problems on above topics

Unit 3 Variational principle and Lagrange's equations (10hrs)

- Variational principle
- Calculus of variations
- Hamilton's principle
- Derivation of Hamilton's principle from Lagrange's equation
- Derivation of Lagrange's equations from Hamilton's principle
- Cyclic co-ordinates
- Conservation theorems
- Problems on above topics

Unit 4 Two Body Central force problem (9hrs)

- Reduction to equivalent one body problem
- The equations of motion and first integrals
- The equivalent one dimensional problem and classification of orbits
- The inverse square law of force

Unit 5 Equations of Motion and Rigid bodies **(9 Hrs)**

- Independent co-ordinates of rigid bodies
- Generalized co-ordinates of a rigid bodies
- Euler angles and Cayley-Klein parameters and related quantities
- Components of angular velocity along the body set of axes
- Euler's theorem on the motion of a rigid body, rate of change of a vector
- The coriolis force
- Euler's equations of motion for a rigid body
- Finite rotations
- Infinitesimal rotations

Reference Books:-

1. H. Goldstein, Classical Mechanics, 2nd Edition, Narosa Publishing House
2. C. R. Mondal, Classical Mechanics, Prentice Hall of India Pvt. Ltd.

Semester – I			
16PMTDC02	**DISCIPLINE SPECIFIC ELECTIVE - ID - I** Fuzzy Mathematics	**4hrs/wk**	**4 Credits**

Objectives:

Upon completion of the course students will be able to

1. Recognize and understand concepts of fuzzy sets and their types.
2. Understand and utilize operations on fuzzy sets.
3. Identify, understand and solve fuzzy relation equations.

Unit 1 Fuzzy sets **(10hrs)**

- Fuzzy sets – and their basic types
- Basic concepts , α-cuts ,Additional properties of α-cuts
- Extension principle for Fuzzy sets

Unit 2 **Operations on Fuzzy sets** **(10hrs)**

- Operations on Fuzzy sets and Types of operations
- Fuzzy complements
- t-Norms
- Fuzzy Unions
- Combinations of operations

Unit 3 Fuzzy Arithmetic **(10hrs)**

- Fuzzy numbers
- Arithmetic operations on intervals
- Arithmetic operations on Fuzzy numbers

Unit 4 Fuzzy relations **(9hrs)**

- Binary fuzzy relations
- Fuzzy equivalence relations
- Fuzzy compatibility relations
- Fuzzy ordering relations
- Fuzzy morphisms

Unit 5 Fuzzy Relation Equations **(9hrs)**

- Fuzzy Relation Equations General discussion
- Problem partitioning, Solution method
- Fuzzy Relation Equations based on Sup-i Compositions – Fuzzy Relation Equations based on inf-ωi Compositions

Reference Books:

1. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic, Prentice Hall of India, New Delhi, 2004.
2. H.J. Zimmermann, Fuzzy Set Theory and its Applications, Allied Publishers Limited, New Delhi, 1991.
3. G. J. Klir and B. Yuan, Fuzzy Sets and Fuzzy Logic, Prentice Hall of India, New Delhi, 1995.

Semester – II			
16PMTCC06	**Core 5:** Algebra – II	**4hrs/wk**	**4 Credits**

Objectives:

Upon completion of the course students will be able to

1. List and understand advance concepts of Algebra.
2. Identify, define and perform operations on modules.
3. Define and verify automorphisms and homomorphism of modules.

Unit 1 Division ring and Field **(10hrs)**

- Division ring and Field
- Extension fields
- Algebraic and transcendental extensions

Unit 2 Exetensions **(10hrs)**

- Splitting fields
- Normal extensions
- Multiple roots
- Finite fields
- Separable extensions

Unit 3 Automorphism fixed fields **(10hrs)**

- Automorphism fixed fields
- Galois extension
- Fundamental theorem of Galois Theory
- Fundamental theorem of Algebra

Unit 4 Modules **(9hrs)**

- Modules (Definitions and examples)
- Submodules and Operation on modules

Unit 5 Homomorphism of Modules **(9hrs)**

- Homomorphisms of modules and quotient modules
- Completely reducible module
- Finitely generated modules

Reference Books:

1. P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul, Basic Abstract Algebra**,** Second Edition, Cambridge University Press, 1995.
2. M. Artin, Algebra, Prentice-Hall of India Private Ltd., New Delhi, 1994.
3. J. A. Gallian, Contemporary Abstract Algebra, Fourth Edition, Narosa Publishing House, New Delhi, 1999.
4. N. S. Gopalakrishnan, University Algebra, New Age International Private Ltd. Publishers, New Delhi, Sixth Reprint, 1998.
5. I. N. Herstein, Topics in Algebra, Second Edition, Wiley Pub. , New York, 1975.

Semester – II			
16PMTCC07	**Core 6**: Topology – II	**4hrs/wk**	**4 Credits**

Objectives:

Upon completion of the course students will be able to

1. Understand, define and verify connectedness of topological spaces.
2. Understand, define and verify nets and filters.
3. State and prove the Tychonoff's theorem.
4. List, compare and classify the separation axioms of topological spaces.
5. Understand, define and verify concept of compact spaces.

Unit 1 Connected Spaces **(10hrs)**

- Connected spaces
- Components
- Path components

Unit 2 Nets and Filters **(10hrs)**

- Nets and Filters
- Tychonoff's theorem

Unit 3 Product and quotient topologies **(10hrs)**

- The product and quotient topologies
- Separation properties in products and quotient spaces

Unit 4 Compact spaces **(9hrs)**

- Compact spaces
- Product and quotient of compact spaces

Unit 5 Locally compactness **(9hrs)**

- Limit point and Compactness
- Locally compactness

Reference Books:-

1. Munkres J., Topology: A first course, Prentice Hall of India Pvt. Ltd, New Delhi.
2. Kelly J. L., General Topology, Van Nostrand Reinhold Company, 1965.
3. Willards S., General Topology, Addition-Wesley, Reading, 1970.

Semester – II			
16PMTCC08	**Core 7**: Real Analysis	**4hrs/wk**	**4 Credits**

Objectives:

Upon completion of the course students will be able to

1. Understand, define algebra of sets.
2. Define and understand measurable sets and various types of measures.
3. Define, understand and utilize the concept of differentiation of monotone functions and absolute continuity.
4. State and prove theorems including Holder's inequality and Minkowski's inequality.

Unit 1 Algebra of Sets **(10hrs)**

- Algebra of sets, σ-algebra of sets
- Borel sets
- Lebesgue outer measure
- Measurable sets
- Lebesgue measure

Unit 2 Nonmeasurable Set **(10hrs)**

- A nonmeasurable set
- Measurable Functions
- Littlewood's three principles

Unit 3 Riemann integral **(10hrs)**

- Riemann integral
- The Lebesgue integral of a bounded function over a set of finite measure
- The integral of a nonnegative function
- The general Lebesgue integral
- Convergence in measure

Unit 4 Differentiation of monotone functions **(9hrs)**

- Differentiation of monotone functions
- Functions of bounded variation
- Differentiation of an integral
- Absolute continuity

Unit 5 lL^p spaces **(9hrs)**

- lL^p spaces
- The Holder's inequality
- The Minkowski's inequality
- Convergence and completeness

Reference Books:-

1. H. L. Royden, Real Analysis, Third Edition, PHI Learning Private Limited (2009) New Delhi.
2. N. L. Carothers, Real Analysis, Cambridge University Press (2000).
3. G de Barra, Measure Theory and Integration, Wiley Eastern Limited, First Wiley Eastern Reprint (1987).
4. V. Karunakaran, Real Analysis, Pearson (2012).
5. S. K. Berberian, Fundamentals of Real Analysis, Universitext, Springer (1999).
6. I. K. Rana, An introduction to Measure and Integration, Narosa Publishing House, New Delhi.

Semester – II			
16PMTCC09	**Core 8**: Theory of Partial Differential Equations	**4hrs/wk**	**4 Credits**

Objectives:

Upon completion of the course students will be able to

1. Identify and understand the higher order partial differential equations.
2. Understand and utilize the methods to solve the given partial differential equations
3. Understand and solve the given Boundary value problems and Equipotential surfaces.

Unit 1 Second order partial differential equations **(10hrs)**

- Origin of second order partial differential equations
- Linear second order partial differential equations with constant coefficients
- Solutions for f(x; y) to be polynomial
- Exponential, sin/cos functions
- General method for homogeneous equations

Unit 2 Classification of second ordered partial differential equations **(10hrs)**

- Classification of second ordered partial differential equations
- Canonical form

Unit 3 Non-linear second order partial differential equations **(10hrs)**

- Non-linear second order partial differential equations
- solution by Monge's method
- Special case and general case

Unit 4 Second order partial differential equations with variable coefficients **(9hrs)**

- Second order partial differential equations with variable coefficients
- Method of changing variables for special type of equations
- Separation of variable Method
- Solution of three special equations –Laplace
- Wave and diffusion equation
- Solution of these equations in different coordinate systems

Unit 5 Boundary value problems **(9hrs)**

- Boundary value problems
- Dirichlet boundary value problems
- Neumann boundary value problems
- Maximum and minimum principles
- Harnack's theorem
- Green's functions
- Equipotential surfaces

Reference Books:-

1. Amarnath, T., Elementary Course in Partial Differential Equations, Narosa Publ. House, New Delhi, 1997.
2. Sneddon, I. N., Elements of Partial Differential Equations, McGraw- Hill Publ. Co., 1957
3. Grewal, B. S. and Grewal, J. S., Higher Engineering Mathematics, (36th Edition), Khanna Publ. New Delhi, 2000.
4. Raisinghania, M. D. Advanced Differential Equations, S. Chand & Co., 1995.
5. Phoolan Prasad and Ravindran, R., Partial Differential Equations, Wiley Eastern.

Semester – II			
16PMTDC03	**Elective- II** Classical Mechanics - II	**4hrs/wk**	**4 Credits**

Objectives:

Upon completion of the course students will be able to

1. Understand, define and verify Rigid Body Equations of Motion.
2. Understand and compare theory of relativity in classical mechanics.
3. Derive the Hamilton's equation of motion.
4. Understand and utilize the Canonical transformations and Generating functions.

Unit 1 The Rigid Body Equations of Motion **(10hrs)**

- Angular momentum and kinetic energy of motion about a point
- The inertia tensor and moment of inertia
- The heavy symmetrical top with one point fixed

Unit 2 Special Relativity in Classical Mechanics **(10hrs)**

- The basic program of special relativity
- The Lorentz transformations
- Lorentz transformations in real four dimensional spaces
- Further descriptions of the Lorentz transformation

Unit 3 Covariant four – dimensional formulations **(10hrs)**

- Covariant four – dimensional formulations
- The force and energy equations in relativistic mechanics

Unit 4 Hamilton's equation of Motion **(9hrs)**

- Derivation of Hamilton's equation of motion
- Routh's procedure
- Derivation of Hamilton's equation from Hamilton's Principle
- Principle of least action
- Problem related to above topics

Unit 5 Canonical transformations and Generating functions **(9hrs)**

- Poisson's brackets and their properties
- Hamilton-Jacobi theory
- Problem related to above topics

Reference Books:-

1. H. Goldstein, Classical Mechanics, 2nd Edition, Narosa Publishing House
2. C. R. Mondal, Classical Mechanics, Prentice Hall of India Pvt. Ltd.

Semester – II			
16PMTDC04	**Elective- II** Mathematical Methods	**4hrs/wk**	**4 Credits**

Objectives:

Upon completion of the course students will be able to

1. Understand, define and utilize Fourier series and Summation of infinite series.
2. Understand, define and utilize Laplace transform, Inverse Laplace transform, Convolution theorem, Apply these concept to solve the ordinary differential equations.
3. Understand and utilize Green's function and its applications, Gram-Schmidt orthonormalization method to Legendre polynomials, Hermite polynomials, Jacobi polynomials, Z-transform.

Unit 1 Fourier series and applications **(10hrs)**

- Fourier series and applications to boundary value problems
- Summation of infinite series.

Unit 2 Fourier integral representation and applications **(10hrs)**

- Fourier integral representation and applications
- Fourier transforms
- Computations of Fourier transforms of functions
- Properties of Fourier transforms

Unit 3 Convolution and Fourier transform **(10hrs)**

- Convolution and Fourier transform
- Applications to the boundary value problems involving Heat equation
- Wave equation and Laplace equations

Unit 4 Laplace transform **(9hrs)**

- Laplace transform
- Laplace transforms of some functions
- Properties of Laplace transform
- Inverse transform
- Convolution theorem
- Applications to solutions of ordinary differential equations
- Applications to the solutions of diffusion equation and wave equation

Unit 5 Green's function and its applications **(9hrs)**

- Green's function and its applications
- Gram-Schmidt orthonormalization method to Legendre polynomials
- Hermite polynomials
- Jacobi polynomials
- Z-transform

Reference Books:-

1. Shankar Rao, Introduction to Partial Differential Equations.
2. Courant and Hilbert; Mathematical Methods.
3. N. Sneddon; Special Functions of Mathematical Physics and Chemistry.
4. L.A. Pipes, Applied Mathematics for Engineers and Physicists.
5. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 2004
6. M. D. Raisinghania Advanced Differential Equations.

Semester – II			
16PMTCC11	**Practical :** Introduction to Latex	**4 hrs/wk**	**2 Credits**

Objectives:

Upon completion of the course students will be able to

1. Understand the purpose and nature of LaTeX.
2. Understand how LaTeX differs from a word processor.
3. Install and utilize LaTeX and its related components successfully on personal computer.
4. Create document using LaTeX including the features like line break, fonts size, page breaks.
5. Utilize LaTeX and its templates to compose Mathematical documents, presentations, and reports.
6. Identify, remember and effectively utilize symbols useful for mathematical type setting.
7. Create complete document including title page, index, chapters, tables graphics and bibliography

Introduction to LaTeX

Unit – 1:Historyand Basics of LaTex.

- History of LaTeX, How to install LaTeX,
- Basic Structure of LaTeX Document, Layout Design,
- Advantages and Disadvantages,
- Input file structures, Document class, Page Style, Packages.

Unit – 2:Simple documents and type setting

- Typesetting of Text, Structure of Document,
- Line Break and Page Break,
- Fonts and Size,
- Different Environments,
- Cross references,
- Footnotes, Fancy header.

Unit – 3:Mathematical Type sttting

- Typesetting Mathematics, single equation,
- Mathematical Formulas, multiline single equation, multiple equations,
- array and matrix, command for mathematical symbols,
- theorem and lemmas.

Unit – 4:Use of Graphicx and tables.

- Graphicx package,
- tabular environment,
- bibliography.

Unit – 5:Presentation using LaTeX.

- Preparing presentation using LaTeX.

Text book:

1. Tobias Oetiker, Hubert Partl, Irene Hyna and Elisabeth Schlegl, The Not So Short Introduction to LaTeX 2ε, www.ctan.org.

Reference books:

1. George Grätzer (2007), *More Math into LaTeX*, 4th edition, Springer.
2. Michael Doob, *A Gentle Introduction to TeX, www.ctan.org.*
3. F. Mittelbach and M Goossens with Braams, Carlisle, and Rowley, *The LaTeX Companion, second edition,* Addison-Wesley Professional, 2004.

Practical

1. Basic Introduction to LaTeX, Structure of LaTeX document, First document produced using LaTeX.
2. Use of different fonts, size, apply page break and line break, use command for making text bold, italic, emphasis, underline.
3. Document structure using /chapter, /section, /subsection, cross referencing using /label and /ref command, Footnote and use of fancy header package.
4. Equation environment, single equation, multi line single equation, multi equations, mathematical symbols.
5. How to write array and matrix in LaTeX.
6. Writing theorem and lemma using LaTeX.
7. Preparing Tables using LaTeX, Use of Graphicx package in LaTeX.
8. How to write bibliography using LaTeX.
9. Preparing a basic beamer presentation
10. Preparing beamer presentation using overlay, color, slide transaction, use of different themes, use of graphics.