ANNEXURE 11.1

Avinashilingam Institute for Home Science and Higher Education for Women

Deemed to be University Estd. u/s 3 of UGC Act 1956, Category A by MHRD (now MoE)
Re-accredited with A++ Grade by NAAC. CGPA 3.65/4, Category I by UGC
Coimbatore - 641 043, Tamil Nadu, India

Department of Mathematics
M.Sc. MATHEMATICS

Programme Outcomes:

On successful completion of this programme, the students will be able to

1. Develop an in-depth understanding of fundamental and contemporary mathematical concepts, theories, structures and methodologies.
2. Acquire strong analytical, logical and critical-thinking skills for solving complex mathematical problems.
3. Implement computational and numerical methods for real world problem-solving and apply mathematical tools in research, industry, technology-driven fields.
4. Emphasize teamwork, leadership and collaboration skills for interdisciplinary projects.
5. Promotion of mathematics for sustainable development and social welfare.
6. Establish entrepreneurial skills to apply mathematics in business, technology and innovation.

Programme Specific Outcomes:

1. Categorize the advance knowledge in Mathematics and thereby able to incorporate them in recent research areas.
2. Create mathematical models to meet the complex form of real life situations into precise form.
3. Expertise in one's profession and adapt to work in diverse fields.

Scheme of Instruction & Examinations
(For students admitted from 2025-2026 & onwards)

Part	*Subject Code*	*Name of Paper / Component*	*Hours Instruction/ week*	*Scheme of Examination*				
			T	**Duration of Exam**	**CIA**	**CE**	**Total**	**Credit**
		First Semester						
I	25MMAC01	Advanced Algebra	4	3	40	60	100	4
	25MMAC02	Real Analysis	4	3	40	60	100	4
	25MMAC03	Optimization Techniques	4	3	40	60	100	4
	25MMAC04	Advanced Graph Theory	4	3	40	60	100	4
	25MMAC05	Analytic Number Theory	4	3	40	60	100	4
II		C.S.S / Adult Education / Community Engagement and Social Responsibility	2	-	-		-	-
		Professional Development Course						
	25MMAPD1	LaTeX	4	-	-	-	-	Remarks
	25MMAPD2	Mathematical Finance	4	-	-	-	-	Remarks
		Second Semester						
I	25MMAC06	Topology - I	4	3	40	60	100	4
	25MMAC07	Measure Theory	4	3	40	60	100	4
	25MMAC08	Complex Analysis	4	3	40	60	100	4
	25MMAC09	Partial Differential Equations	4	3	40	60	100	4
	25MMAC10	Classical Dynamics	4	3	40	60	100	4
II		Inter Disciplinary Course	4	3	100	-	100	4
		Professional Certification Course	-	-	-		-	2
	25MXCSS1/ 25MXAED1/ 25MXCSR1	C.S.S / Adult Education / Community Engagement and Social Responsibility	2	2	-		-	2

	Professional Development Course							
	25MMAPD3	Numerical Analysis	4	-	-	-	-	Remarks
	Internship during Summer Vacation (1 Month)							
Third Semester								
I	25MMAC11	Topology - II	4	3	40	60	100	4
	25MMAC12	Functional Analysis	4	3	40	60	100	4
	25MMAC13	Mathematical Methods	4	3	40	60	100	4
	25MMAC14	Mathematical Statistics	4	3	40	60	100	4
	25MMAC15	Cryptography	4	3	40	60	100	4
	25MMAC16	Mini Project	1	-	100	-	100	2
	25MMAC17	Introduction to Fuzzy Sets (Self Study)	2	3	100	-	100	2
	25MMAC18	Internship	-	-	-	-	100	2
II		Multi Disciplinary Course	2	3	100	-	100	2
	Professional Development Course							
	25MMAPD4	Python Programming	5	-	-	-	-	Remarks
Fourth Semester								
I	25MMAC19	Research –Thesis/project/ patent	30	-	100	100	200	20
Total Credits								**96**
Other Courses to be Undergone by the Students								
I/II/III		**MOOC**						**2**
Total								**96+2 = 98**

Minimum 96+2 Credits to earn the degree

** Students who exit at the end of 1st year shall be awarded a **Postgraduate Diploma**.

Other Courses Offered by Mathematics Department

Part/ Sem.	Subject Code	Name of Paper/Component	Hours Instruction/ week	Scheme of Valuation			
			T	CIA	CE	Total	Credit
II / II	25MMAI01	Mathematical Techniques (Inter Disciplinary Course)	4	40	60	100	4
II / III	25MMAM01	Power Course on Quantitative Aptitude (Multi Disciplinary Course)	2	100	-	100	2
II / II	25MMAPC1	Industrial Mathematics (Professional Certification Course)	-	-	-	-	2

Advanced Algebra

Semester- I | **Hours of Instruction/week: 4**

25MMAC01 | **No. of Credits : 4**

Course Objectives:

1. To understand Galois group of a polynomial.
2. To learn the fundamentals of linear transformations.
3. To familiarize finite division rings.

Unit I **12 hrs.**

Fields: The Elements of Galois Theory - Solvability by Radicals.

Unit II **12 hrs.**

Linear Transformations: The Algebra of Linear Transformations - Characteristic Roots - Matrices.

Unit III **12 hrs.**

Linear Transformations: Canonical Forms (Triangular Form and Nilpotent Transformations).

Unit IV **12 hrs.**

Linear Transformations: Canonical Forms (Jordan Form and Rational Canonical Form).

Unit V **12 hrs.**

Selected Topics: Finite Fields - Wedderburn's Theorem on Finite Division Rings.

Total Hours: 60

Text Book:

1. I. N. Herstein (2003), ***"Topics in Algebra"***, John Wiley & sons, New York, Second Edition.

Unit	Chapter	Sections
I	5	5.6, 5.7

II	6	6.1, 6.2, 6.3
III	6	6.4, 6.5
IV	6	6.6, 6.7
V	7	7.1, 7.2

Reference Books:

1. David S Dummit(2011), "***Abstract Algebra***", John Wiley & Sons, Third Edition.
2. Joseph A. Gallian(2013), "***Contemporary Abstract Algebra***", Brooks/Cole Cengage learning, Eighth Edition.

Course Outcomes:

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

1. apply Galois Theory to determine the solvability of specific polynomial equations.
2. interpret the geometric and algebraic meaning of matrices representing linear transformations.
3. apply the triangular form and nilpotent transformations to solve problems in linear algebra.
4. compute the structure of the rational canonical form .
5. solve advanced algebraic problems involving finite fields and division rings.

CO /PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CO 1	H	H	M	L			H	M	M
CO 2	H	H	H	M		L	M	H	M
CO 3	H	H	H	M			M	M	M
CO 4	H	H	H	H	L	M	M	M	M
CO 5	H	H	H	M	L	L	M	M	M

Real Analysis

Semester - I | **Hours of Instruction/week: 4**

25MMAC02 | **No. of credits: 4**

Course Objectives:

1. To learn the concepts of Lebesgue integral.
2. To understand measurable sets on the real line.
3. To study the concept of Fourier integrals.

Unit I: **12 hrs.**

The Lebesgue Integral : Introduction - The integral of a step function - Monotonic sequences of step functions - Upper functions and their integrals - Riemann-integrable functions as examples of upper functions - The class of Lebesgue-integrable functions on a general interval.

Unit II: **12 hrs.**

The Lebesgue Integrals (cont.): Basic properties of the Lebesgue integral - Lebesgue integration and sets of measure zero - The Levi monotone convergence theorems. The Lebesgue dominated convergence theorem - Applications of Lebesgue's dominated convergence theorem - Lebesgue integrals on unbounded intervals as limits of integrals on bounded intervals.

Unit III: **12 hrs.**

The Lebesgue Integrals (cont.): Improper Riemann integrals - Measurable functions - Continuity of functions defined by Lebesgue integrals - Differentiation under the integral sign - Interchanging the order of integration - Measurable sets on the real line - The Lebesgue integral over arbitrary subsets of R.

Unit IV: **12 hrs.**

Fourier Series and Fourier Integrals: Introduction - Orthogonal systems of functions - The theorem on best approximation - The Fourier series of a function relative to an orthonormal system - Properties of the Fourier coefficients -the Riesz-Fischer theorem - The convergence and representation problems for trigonometric series - The Riemann - Lebesgue lemma - The Dirichlet integrals - An integral representation for the partial sums of a Fourier series - Riemann's localization theorem.

Unit V: **12 hrs.**

Fourier Series and Fourier Integrals (cont.): Sufficient conditions for convergence of a Fourier series at a particular point - Cesarosummability of Fourier series - Consequences of Fejer's theorem - The Weierstrass approximation theorem - Other forms of Fourier series -

The Fourier integral theorem - The exponential form of the Fourier integral theorem - Integral transforms.

Total Hours: 60

Text Book:

1. Tom. M. Apostol (2002), "***Mathematical Analysis***", Narosa Publishing House, New Delhi, Second Edition.

Unit	Chapter	Sections
I	10	10.1 to 10.6
II	10	10.7 to 10.12
III	10	10.13 to 10.19
IV	11	11.1 to 11.11
V	11	11.12 to 11.19

Reference Books:

1. Walter Rudin (1976) ,"***Principles of Mathematical Analysis***", Third Edition, Mcgraw Hill.

2. N. L. Carothers (2013),"***Real Analysis***", Cambridge University press, Indian edition.

Course Outcomes:

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

1. distinguish between the Lebesgue and Riemann integrals.
2. apply the concept of Lebesgue integral to broader class of functions.
3. demonstrate the ability to interchange the order of integration.
4. test the convergence using Riemann's localization theorem.
5. solve problems in a closed form using Fourier integrals.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CO 1	M	M	L	L			M	M	H
CO 2	H	M	M	L	L		M	M	H
CO 3	H	H	H	M	L	L	M	M	H
CO 4	H	H	M	L	L	M	M	M	H
CO 5	H	H	H	H	M	M	M	M	H

Optimization Techniques

Semester - I | **Hours of Instruction/week : 4**

25MMAC03 | **No. of credits : 4**

Course Objectives:

1. To learn Inventory Models.
2. To know the methods for obtaining optimal solutions.
3. To model any queueing situation

Unit I: **12 hrs.**

Deterministic Inventory Models : Classic EOQ model - EOQ with price breaks - Multi item EOQ with storage limitation. **Dynamic EOQ Models:** No setup model - Setup model.

Unit II: **12 hrs.**

Probabilistic Inventory Models: Continuous review models - Single period models - Multiperiod Model.

Unit III: **12 hrs.**

Simulation Modeling : Monte Carlo simulation - Types of simulation - Elements of Discrete Event simulation - Generation of random numbers - Mechanics of Discrete simulation.

Unit IV: **12 hrs.**

Classical Optimization Theory : Unconstrained problems - Constrained problems.

Unit V: **12 hrs.**

Queueing Systems : General Concepts: Introduction- Queueing processes - Transient and steady - state behavior - Limitations of the steady- state distribution. Some general relationships in Queueing theory. Birth and Death Queueing Systems- Exponential Models - The simple M/M/1 Queue.

Total Hours: 60

Text Books:

1. HamdyA.Taha (2011*), "Operations Research"*, Prentice Hall of India Private Ltd., New Delhi, Nineth Edition.
2. J.Medhi(2006), ***"Stochastic models in Queueing theory"*** ,Published by Elsevier, a division of Reed Elsevier India Pvt., Ltd., Second Edition.

Reference Books:

1. Kanti Swarup, P.K.Gupta and Man Mohan(2010),***"Operations Research"***, Sultan Chand & Sons, New Delhi, Fifteenth Edition,2010.

2. Donald Gross, Carl M. Harris.(2008), ***"Fundamentals of Queueing Theory"***, John Wiley & Sons, New Jersey.

Course Outcomes:

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

1. understand the dynamic EOQ model.
2. demonstrate probabilistic inventory models.
3. estimate the measures of performance of real systems using simulation.
4. apply Kuhn- Tucker conditions to identify stationary points of nonlinear constrained problems.
5. understand the characteristic features of queueing system.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CO 1	H	H	H	M	M	H	H	M	M
CO 2	H	H	H	M	M	H	H	M	M
CO 3	H	H	H	M	L	M	M		L
CO 4	M	L	M	L	M	M	H	M	M
CO 5	M	M	L	H	M		M		L

Advanced Graph Theory

Semester - I | **Hours of Instruction/week : 4**

25MMAC04 | **No. of Credits : 4**

Course Objectives:

1. To understand the concept of a vector space associated with the graph, its structure and properties.
2. To construct and manipulate various matrix representations of graphs.
3. To apply advanced graph coloring techniques and algorithms to solve real-world problems.

Unit I: **12 hrs.**

Vector Spaces of a Graph: Sets with one operations, Sets two with operations, Modular arithmetic and Galois fields, Vectors and vector spaces, Vector spaces associated with a graph.

Unit II: **12 hrs.**

Vector Spaces of a Graph (cont.): Basis vector of a graph, Circuit and cut-set subspaces, orthogonal vectors and spaces, Intersection and join of W and W_S.

Unit III: **12 hrs.**

Matrix Representation of Graphs: Incidence matrix, sub matrices of A(G), Circuit matrix, Fundamental circuit matrix and rank of B.

Unit IV: **12 hrs.**

Matrix Representation of Graphs (cont.): An application to a switching network, Cut-set matrix, Relationships among A_f, B_f, and C_f, Path matrix, Adjacency matrix.

Unit V: **12 hrs.**

Coloring: Chromatic number, Chromatic partitioning, Chromatic polynomial, Matchings.

Total Hours : 60

Text Book:

1. Narsingh Deo(2010), *"**Graph Theory with Applications to Engineering and Computer Science**"*, Prentice Hall of India Private limited, New Delhi.

Unit	Chapter	Sections
I	6	6.1 – 6.5
II	6	6.6 – 6.9
III	7	7.1 – 7.4
IV	7	7.5 – 7.9
V	8	8.1 – 8.4

Reference Books:

1. J.A. Bondy, U.S.R. Murthy (1986), "***Graph Theory with Applications***", Elsevier, North Holland, Newyork.
2. Ravindra B. Bapat (2014), "***Graphs and Matrices***", Springer, London.

Course Outcomes:

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

1. apply the concepts of vector spaces to graphs, including the formation of vector spaces associated with a graph.
2. analyze circuit and cut-set subspaces and understand their significance in graph theory.
3. demonstrate the use of matrices in studying graphs.
4. develop skills in working with path and adjacency matrices and understand their applications in graph theory.
5. derive and interpret the chromatic polynomial of a graph.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CO 1	H	M	M	H			M	H	H
CO 2	H	M	H	H		H	H	H	H
CO 3	H	H	H	H		H	H	H	H
CO 4	H	H	H	H		H	H	M	H
CO 5	H	H	H	H	M	H	H	H	H

Analytic Number Theory

Semester- I **Hours of Instruction/week : 4**

25MMAC05 **No. of credits : 4**

Course Objectives:

1. To understand the fundamentals of arithmetical functions.
2. To acquire knowledge on the properties and applications of congruences.
3. To learn quadratic residues and quadratic reciprocity law.

Unit I: **12 hrs.**

The fundamental theorem of Arithmetic: Introduction - Divisibility - Greatest common divisor - Prime numbers - The fundamental theorem of arithmetic - The series of reciprocals of the primes - The Euclidean algorithm - The greatest common divisor of more than two numbers.

Unit II: **12 hrs.**

Arithmetical functions and Dirichlet multiplication: Introduction - The Mobius function $\mu(n)$ - The Euler totient function $\phi(n)$ - A relation connecting ϕ and μ- A product formula for $\phi(n)$ - The Dirichlet product of arithmetical functions - Dirichlet inverses and the Mobius inversion formula - The Mangoldt function $\Lambda(n)$ – Multiplicative functions - Multiplicative functions and Dirichlet multiplication.

Unit III: **12 hrs.**

Arithmetical functions and Dirichlet multiplication(cont.): The inverse of a completely multiplicative function - Liouville's function $\lambda(n)$ - nth divisor functions $\sigma_\alpha(n)$ - Generalized convolutions - Formal power series - The Bell series of an arithmetical function - Bell series and Dirichlet multiplication.

Unit IV: **12hrs.**

Congruences: Definition - Basic properties of congruences - Residue classes and complete residue systems - Linear congruences - Reduced residue systems - The Euler Fermat theorem - Polynomial congruences modulo p - Lagrange's Theorem.

Unit V: **12 hrs.**

Quadratic Residues and the Quadratic Reciprocity law: Quadratic residues - Legendre's symbol and its properties - Evaluation of (-1/p) and (2/p) - Gauss's lemma - The quadratic reciprocity law - Applications of the reciprocity law - The Jacobi symbol.

Total Hours: 60

Text Book:

1. Tom M. Apostol (1998), ***"Introduction to Analytic Number Theory"***, Narosha Publishing House, New Delhi.

Unit	Chapter	Sections
I	1	1.1 to 1.8
II	2	2.1 to 2.10
III	2	2.11 to 2.17
IV	5	5.1 to 5.5
V	9	9.1 to 9.7

References:

1. William Stallings (2005), ***"Cryptography And Network Security"***, Prentice Hall, Addison-Wesley,USA
2. Neal Koblitz (1991), "***A Course in Number Theory and Cryptography***" Springer-Verlag, New York .

Course Outcomes:

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

1. understand the results relating prime numbers.
2. examine the behavior of arithmetical functions.
3. develop bell series and Dirichlet product for arithmetical functions.
4. apply the concepts of congruences in scientific problems.
5. use Quadratic residues and Reciprocity law in mathematical problems.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CO 1	H	H	H	M	M	H	M	M	L
CO 2	H	H	M	M	L	H	M		
CO 3	H	H	M	L	L	M	M		
CO 4	H	M	M	M	L	H	M	M	
CO 5	H	M	M	L	L	M	M	M	L

Professional Development Course

LaTeX

Semester - I **Hours of Instruction : 4**

25MMAPD1

Course Objectives:

1. To acquire the knowledge of LaTeX.
2. To learn the typing in LaTeX format.
3. To relate LaTeX format to mathematical environment.

Unit I **12 hrs.**

Introduction : Text formatting - TeX and its offspring - Basics of a LaTeX file.

Unit II **12 hrs.**

Symbols and Commands : Command names and arguments – Environments - Declarations- Lengths- Special characters- Exercises.

Unit III **12 hrs.**

Document Layout and Displayed Text: Document class - Page style - Parts of the document- Table of contents- Word division - Changing font- Centering and indenting – Lists - Generalized lists - Theorem like declarations - Tabulator stops- Boxes.

Unit IV **12 hrs.**

Creating tables and Inserting Pictures: Tables - Printing literal text - Footnotes and marginal notes - Drawing Pictures with LaTeX.

Unit V **12 hrs.**

Typing Math formulas : Mathematical environments - Main elements of math mode - Mathematical symbols - Additional elements - Fine-tuning mathematics.

Total Hours: 60

Text Book :

1. Helmut Kopka and Patrick W. Daly (2004).***"A Guide to Latex"***, Addison- Wesley Longman Limited, England, Fourth edition.

Reference Book:

1. Ms. Firuza Karmali Aibara(2019), **"A Short introduction to Latex"**, Atlantic Publishers.

Course Outcomes:

On completion of the course the students will be able to

1. use formatting commands in LaTeX.
2. write LaTeX documents containing simple mathematical equations and symbols.
3. format document layout.
4. produce tables and figures through LaTeX.
5. create document using math formulas and equations.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CO 1	H	H	H	M		M	L		M
CO 2	H	H	H	M	L	M	L	L	M
CO 3	H	H	H	M		M	L		M
CO 4	H	H	H	M	L	M	L	L	M
CO 5	H	H	H	M	L	M	L		M

Professional Development Course

Mathematical Finance

Semester - I **Hours of Instruction/week: 4**

25MMAPD2

Course Objectives:

1. To understand the concept fixed income securities
2. To acquire knowledge on interest rates, bonds and derivatives.
3. To learn the construction of best investment strategies.

Unit I: **12 hrs.**

Basic Theory of Interest and Fixed-Income Securities

Principal and interest: simple - compound and continuous - Present and future value of cash flow streams - Net present value - Internal rates of return and their comparison .

Unit II: **12 hrs.**

Principal and interest (cont.): Inflation - Annuities – Bonds - Bond prices and yields - Macaulay duration and modified duration.

Term Structure of Interest Rates and Bonds: Spot rates - forward rates and explanations of term structure - Running present value - Floatingrate bonds - Immunization, Convexity - Putable and callable bonds - Exchange-traded markets and over-the-counter markets -

Unit III: **12 hrs.**

Term Structure of Derivatives: Forward contracts - Future contracts – Options - Types of traders – Hedging – Speculation - Arbitrage.

Unit IV: **12 hrs.**

Mechanics of Options Markets: No-arbitrage principle - Short selling - Forward price for an investment asset - Types of options - Call and put options - Option positions .

Unit V: **12 hrs.**

Mechanics of Options Markets (cont.): Underlying assets - Factors affecting option prices - Upper and lower bounds for option prices - Put-call parity - Effect of dividends.

Total Hours : 60

Text Book:

1. Sheldon M. Ross (2011), ***"An Elementary Introduction to Mathematical Finance (3rd edition)"***, Cambridge University Press.

Reference Books:

1. John C. Hull & Sankarshan Basu (2018), ***"Options, Futures and Other Derivatives (10th edition)"***, Pearson Education.
2. David G. Luenberger (2013), ***"Investment Science (2nd edition)"***, Oxford University Press.

Course Outcomes:

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

1. understand financial markets and derivatives including options and futures
2. know about the concept of interest rates and bonds
3. comprehend the mechanism of trading
4. analyze call and put options
5. calculate and interpret upper and lower bounds for option prices

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CO 1	M	H	H	M	M	H	H	H	M
CO 2	M	H	H	M	M	H	H	H	M
CO 3	M	H	H	M	M	H	H	H	M
CO 4	M	M	H	M	M	H	H	H	M
CO 5	M	M	H	M	M	H	H	H	M

Topology - I

Semester - II **Hours of Instruction/week : 4**

25MMAC06 **No. of credits : 4**

Course Objectives:

1. To demonstrate the properties of topological spaces.
2. To obtain characterizations of topological concepts.
3. To acquire knowledge about connected and compact spaces.

Unit I: **12 hrs.**

Topological Spaces: Definition - Examples - Basis for a topology - The order topology - The product topology on X x Y.

Unit II: **12 hrs.**

Topological Spaces (cont.): The Subspace topology - Closed sets and limit points - Continuous functions.

Unit III: **12 hrs.**

Topological Spaces (cont.): The product topology - The metric topology

Unit IV: **12 hrs.**

Connectedness and Compactness: Connected Spaces - Connected Subspaces of the Real line - Components and Local Connectedness.

Unit V: **12 hrs.**

Connectedness and Compactness(cont.): Compact Spaces - Compact Subspaces of the Real line - Limit Point Compactness - Local Compactness.

Total Hours: 60

Text Book:

1. James R. Munkres (2014). **"Topology"**, Prentice Hall of India Private Limited, Second Edition, New Delhi.

Unit	Chapter	Sections
I	2	12,13,14,15
II	2	16,17,18
III	2	19,20,21
IV	3	23,24,25
V	3	26,27,28,29

Reference Book:

1. George F. Simmons (2006), ***"Introduction to Topology and Modern Analysis"***, TataMcGraw-Hill Publishing Company Ltd., New Delhi.

Course Outcomes:

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

1. understand the properties of various topologies on a general set.
2. construct continuous functions in topological spaces.
3. analyze the relation between metric spaces and topological spaces.
4. relate the concept of continuity to connected space.
5. demonstrate the properties of compact spaces.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CO 1	H	M	M			L	M	L	M
CO 2	H	H	M	L		L	H	M	M
CO 3	H	H	M	L	L	M	H	L	L
CO 4	H	H	M		L		H		L
CO 5	H	H	H	M	L	L	H	M	M

Measure Theory

Semester - II | **Hours of Instruction/week: 4**

25MMAC07 | **No. of credits: 4**

Course Objectives:

1. To learn the concept of Lebesgue measure
2. To understand Riemann and Lebesgue integrals
3. To acquire knowledge on Jordan decomposition

Unit I: **12 hrs.**

Measure on the real line: Lebesgue outer measure - Measurable sets – Regularity - Measurable functions - Borel and Lebesgue measurability.

Unit II: **12 hrs.**

Integration of functions of a real variable: Integration of non-negative functions - The general integral - Integration of series - Riemann and Lebesgue integrals.

Unit III: **12 hrs.**

Abstract measure spaces: Measures and outer measures - Extension of a measure - Uniqueness of the extension - Completion of a measure - Measure spaces - Integration with respect to a measure.

Unit IV: **12 hrs.**

Inequalities and the Spaces: The Spaces - Convex functions - Jensen's inequality - The inequalities of Holder and Minkowski - Completeness of $L^p(\mu)$.

Unit V: **12 hrs.**

Signed Measures and their derivatives: Signed measures and the decomposition - The Jordan decomposition - The Radon-Nikodym theorem - Some applications of the Radon-Nikodym theorem.

Total Hours: 60

Text Book:

1. G.de Barra(2003), ***"Measure Theory and Integration"***, New Age International Publishers, New Delhi.

Unit	Chapter	Sections
I	2	2.1 to 2.5
II	3	3.1 to 3.4
III	5	5.1 to 5.6

IV	6	6.1 to 6.5
V	8	8.1 to 8.4

Reference Books:

1. H. L. Royden (2005), ***"Real Analysis"***, 3rd Ed., Prentice Hall of India, New Delhi, 2005.
2. I. K. Rana (2000), ***"Measure theory and Integration"***, Second Edition, Narosa Publishing.

Course Outcomes:

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

1. compute the Lebesgue outer measure for various sets.
2. explore the properties of Riemann and Lebesgue integrals.
3. analyze the measure and outer measure.
4. recognize the completeness of L^p spaces.
5. apply the concept of Jordan decomposition and The Radon-Nikodym theorem.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CO 1	H	H	H			L	M	M	M
CO 2	H	H	H		L	M	M	M	M
CO 3	H	H	H	L		M	M	M	M
CO 4	H	H	H			L	M	M	M
CO 5	H	H	H	L	L	L	M	M	M

Complex Analysis

Semester - II | **Hours of Instruction/week : 4**

25MMAC08 | **No. of credits: 4**

Course Objectives:

1. To understand the integration of complex functions.
2. To learn the basis of complex series.
3. To study the concepts of elliptic functions.

Unit I: **12 hrs.**

Harmonic Functions: Definition and Basic Properties - The Mean - value property-Poisson's formula.

Unit II: **12 hrs.**

Power Series Expansions: Weierstrass's theorem - The Taylor Series -The Laurent series.

Unit III: **12 hrs.**

Partial Fractions and Factorization: Partial Fractions - Infinite Products-Canonical Products.

Unit IV: **12 hrs.**

Simply Periodic Functions: Representation by exponentials – The Fourier Development - Functions of finite order.

Doubly Periodic Functions: The Period module - Unimodular transformations, General properties of elliptic functions.

Unit V: **12 hrs.**

The Weierstrass Theory: The Weierstrass ρ function - The functions $\zeta(z)$ and $\sigma(z)$ - The Differential Equation.

Total Hours: 60

Text Book:

1. Lars V. Ahlfors, (1979), "***Complex Analysis***", The McGraw-Hill, New York,Third Edition.

Unit	Chapter	Sections
I	4	6.1 to 6.3
II	5	1.1 to 1.3
III	5	2.1 to 2.3
IV	7	1.1 to 1.3, 2.1, 2.2, 2.4
V	7	3.1 to 3.3

Reference Books:

1. S. Ponnusamy and H. Silverman (2006), ***"A Complex Variable with applications"***, Birkhauser, Boston.
2. Karunakaran V (2006), ***"Complex Analysis"***, Narosa Publishing House Pvt. Ltd, Second Edition, New Delhi.
3. Roopkumar R (2015), ***"Complex Analysis"***, Dorling Kinderley Pvt. Ltd, New Delhi.

Course Outcomes:

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

1. use Poisson formula and mean - value property in harmonic functions.
2. expand Taylor's series and Laurent's series for a given function.
3. convert various functions in to canonical product form.
4. identify elliptic functions.
5. apply Weierstrass functions in Brownian motion.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CO 1	H	M	H	M	L	M	H	L	M
CO 2	H	H	H	L	L		H	L	M
CO 3	H	M	H	H	M	M	H	L	M
CO 4	H	M	M	L			H	L	M
CO 5	H	H	H	H	M	H	H	L	M

Partial Differential Equations

Semester - II **Hours of Instruction/week : 4**

25MMAC09 **No. of credits: 4**

Course Objectives:

1. To classify partial differential equations.
2. To solve linear partial differential equations.
3. To evaluate physical problems using partial differentiation.

Unit I: **12 hrs.**

Partial Differential Equations of the First Order: Linear Equations of the first order-Integral Surfaces Passing through a given Curve-Surfaces Orthogonal to a given System of Surfaces- Nonlinear Partial Differential Equations of the First Order-Cauchy's Method of Characteristics.

Unit II: **12 hrs.**

Partial Differential Equations of the First Order (cont.): Compatible Systems of First order Equations – Charpit's Method- Special Types of First order Equations-Solution Satisfying given Conditions-Jacobi's Method.

Unit III: **12 hrs.**

Partial Differential Equations of the Second Order: Linear Partial Differential Equations with Constant Coefficients- Equations with Variable Coefficients- The Solution of Linear Hyperbolic Equations- Separation of variables.

Unit IV: **12 hrs.**

Laplace Equation: Families of Equipotential Surfaces- Problems with Axial Symmetry.

Unit V: **12 hrs.**

The Wave Equation: Elementary solutions of the one-dimensional wave equation – Vibrating membranes: Applications of the calculus of variations – Three dimensional problems

Total Hours : 60

Text Book:

1. Ian N. Sneddon (1988), "***Elements of Partial Differential Equations***", McGRAW- HILL Book Company, Singapore.

Unit	Chapter	Sections
I	2	2.4 to 2.8
II	2	2.9 to 2.13
III	3	3.4, 3.5, 3.8 , 3.9
IV	4	4.3 , 4.6
V	5	5.2, 5.4, 5.5

Reference Books:

1. T.Amaranath (2006), "***An Elementary Course in Partial Differential Equations***", Narosa Publishing House, New Delhi.
2. K.Sankara Rao (2010), "***Introduction to Partial Difference Equations***", Prentice Hall of India Pvt.,Ltd., Third Edition.
3. M.D.Raisinghania (2008), "***Advanced Differential Equations***", S.Chand & Company Ltd.

Course Outcomes:

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

1. solve linear and non-linear partial differential equations of first order and second order.
2. determine special types of first order equations.
3. find the solution of Hyperbolic equations.
4. apply the Dirichlet and Neumann boundary value problems in scientific fields.
5. solve various real life problems by formulating them into partial differential equations

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CO 1	H	M	M	M	L	M	M	H	M
CO 2	H	M	M	M	L	M	M	H	M
CO 3	H	H	H	M		L	M	H	M
CO 4	H	H	H	H	H	H	M	H	M
CO 5	H	M	H	H	M	H	M	H	M

Classical Dynamics

Semester - II | **Hours of Instruction/week: 4**

25MMAC10 | **No. of credits: 4**

Course Objectives:

1. To understand the concepts of Mechanical systems.
2. To learn Lagrange's and Hamiltonian equations.
3. To get knowledge of Canonical transformations.

Unit I: **12 hrs.**

Introductory concepts: Mechanical systems - Generalized co-ordinates - Constraints - Virtual work - Energy and Momentum

Unit II: **12 hrs.**

Lagrange's equations: Derivations of Lagrange's equations - Examples - Integrals of motion

Unit III: **12 hrs.**

Hamilton's equations: Hamilton's Principle - Hamilton's equations-Legendre Transformation-Modified Hamilton's principle, Principle of least action.

Unit IV: **12 hrs.**

Hamilton-Jacobi theory: Hamilton's Principal function - Hamilton - Jacobi equation – Separability-Liouville's system, Stackel's theorem.

Unit V: **12 hrs.**

Canonical Transformations: Differential forms and generating functions - Lagrange and Poisson brackets

Total Hours: 60

Text Book:

1. D.T. Greenwood (1979), ***"Classical Dynamics"***, Prentice Hall of India Pvt. Ltd., New Delhi.

Reference Book:

1. Herbert Goldstein (2002), ***"Classical Mechanics"***, Addison Wesley, Third Edition.

Course Outcomes:

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

1. identify the static and dynamic characteristics of mechanical systems.
2. analyze different systems in integrals of motion.
3. apply Lagrange's and Hamilton's equations in relevant fields.
4. utilize Hamilton-Jacobi Method in physical science.
5. explore the theory of canonical transformations and its application to dynamical theory.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CO 1	H	H	H	H	H	M	H	M	H
CO 2	H	M	H	H	H	M	H	M	H
CO 3	H	M	H	H	H	M	H	M	H
CO 4	H	M	H	H	H	M	H	M	H
CO 5	H	M	H	H	H	M	H	M	H

Professional Development Course

Numerical Analysis

Semester - II **Hours of Instructions/Week: 4**

25MMAPD3

Course Objectives:

1. To learn the methods of finding roots for Algebraic and Transcendental equations.
2. To provide efficient methods for obtaining numerical answer to solve mathematical problems.
3. To study various numerical methods for differentiation and integration.

Unit I: **12 hrs.**

Solution of Algebraic and Transcendental equations: Bisection method-Regula Falsi Method-Iteration method-Netwon Raphson Method – Generalized Newton's method, Graeffe's root squaring method.

Unit II: **12 hrs.**

Interpolation: Finite Differences -Forward differences-Backward differences-Central differences- Newton's forward and backward formulae for interpolation-Central difference interpolation formulae-Gauss's Central difference formula-Stirling's formula-Bessel's formula-Interpolation with unevenly spaced points-Lagrange's interpolation formula - Divided differences.

Unit III: **12 hrs.**

Numerical differentiation and integration: Numerical differentiation derivatives using Newton's forward and backward formula -Derivatives using Stirling's formula - Trapezoidal rule - Simpson's 1/3rd rule - 3/8 rule.

Unit IV: **12 hrs.**

Numerical solution of ordinary differential equations: The Taylor series method – Picard's method - Euler and modified Euler methods – Runge -Kutta methods - Milne's method.

Unit V :

12 hrs.

Numerical Solution of Partial Differential Equations: Introduction –Laplace's equation-Finite-difference approximations to Derivatives-Solutions to Laplace's equation by Jacobi's method, Gauss-Seidel method-Successive Over-Relaxation method-ADI method.

Total Hours: 60

Text Book:

1. S.S.Sastry (2012), ***"Introductory Methods of Numerical Analysis"***, Prentice Hall of India Learning Private Limited, 5th Edition, New Delhi.

Reference Books:

1. M.K. Jain, S.R.K. Iyengar and R.K. Jain (2012), ***"Numerical Methods for Scientific and Engineering Computation"***, New Age International (p) Limited Publishers, New Delhi, Sixth Edition.
2. Curtis. F. Gerald, Patrick & O. Wheatley (2005), ***"Applied Numerical Analysis"***, 5th Edition, Pearson Education, New Delhi.
3. P. Kandasamy, K. Thilagavathy & K. Gunavathi (2006), ***"Numerical Methods"***, S. Chand & company PVT. LTD.

Course Outcomes:

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

1. explore different methods to solve the system of equations
2. apply the knowledge of interpolation in analyzing the data.
3. utilize various types of integrals to solve many complicated problems
4. outline the methods to solve higher order differential equations
5. develop approximate solutions by simple and efficient numerical PDE methods.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CO 1	H	M	H	L	M	H	M	H	L
CO 2	M	M	H	L	H	M	M	H	M
CO 3	L	M	M	M	M	M	M	M	L
CO 4	M	M	H	L	M	H	H	M	M
CO 5	H	M	M	L	H	M	H	M	M

Topology - II

Semester -III **Hours of Instruction/week: 4**

25MMAC11 **No. of credits : 4**

Course Objectives:

1. To know the techniques of metrizability.
2. To understand compactification of topological spaces.
3. To learn convergence through countability.

Unit I : **12 hrs.**

Countability and Separation Axioms: The CountabilityAxioms – The Separation Axioms – Normal Spaces.

Unit II : **12 hrs.**

Countability and Separation Axioms Continued: The Urysohn Lemma – The UrysohnMetrization Theorem – The Tietze Extension Theorem.

Unit III : **12 hrs.**

The Tychonoff Theorem: The Tychonoff Theorem – The Stone CechCompactification.

Unit IV : **12 hrs.**

Complete Metric Spaces and Function Spaces: Complete Metric Spaces – Compactness in Metric Spaces.

Unit V : **12 hrs.**

Complete Metric Spaces and Function Spaces: Pointwise and Compact Convergence – Ascoli's Theorem.

Total Hours: 60

Text Book:

1.James R. Munkres (2014), ***"Topology"***, Prentice Hall of India Private Limited, Second Edition, New Delhi.

Unit	Chapter	Sections
I	4	30, 31, 32
II	4	33, 34, 35
III	5	37, 38
IV	7	43, 45
V	7	46, 47

Reference Book:

1. George F. Simmons (2006), ***"Introduction to Topology and Modern Analysis"***, Tata McGraw-Hill Publishing Company Ltd., New Delhi.

Course Outcomes:

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

1. categorize the separation axioms.
2. appreciate the relation between metric spaces and topological spaces.
3. prove standard theorems in topology.
4. demonstrate the concepts of complete metric spaces.
5. categorize the notion of convergence in topological spaces.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CO 1	H	M	M			L	M	L	M
CO 2	H	H	M	L		L	H	M	M
CO 3	H	H	M	L	L	M	H	L	L
CO 4	H	H	M		L		H		L
CO 5	H	H	H	M	L	L	H	M	M

Functional Analysis

Semester- III
25MMAC12

Hours of Instruction/week : 4
No. of credits : 4

Course Objectives:

1. To develop the knowledge of linear spaces.
2. To illuminate the relations between continuity and linearity.
3. To know the principles of finite dimensional linear spaces.

Unit I: **12 hrs.**

Banach Spaces : The Definition - Examples - Continuous Linear Transformations The Hahn - Banach Theorem.

Unit II: **12 hrs.**

Banach Spaces : The Natural Imbedding of N in N** - The Open Mapping Theorem - The Conjugate of an Operator.

Unit III: **12 hrs.**

Hilbert Spaces: The Definition and simple Properties - Orthogonal Complements - Orthonormal Sets.

Unit IV: **12 hrs.**

Hilbert Spaces: The conjugate Space H* - The Adjoint of an Operator – Self adjoint Operators - Normal and Unitary Operators.

Unit V: **12 hrs.**

Finite Dimensional spectral theory: Projections - The Spectral Theorem.

Total hours: 60

Text Book:

1. George F. Simmons (2006), ***"Introduction to Topology and Modern Analysis"***, Tata McGraw-Hill Publishing Company Ltd., New Delhi.

Unit	Chapter	Sections
I	9	46, 47, 48
II	9	49, 50, 51
III	10	52, 53, 54
IV	10	55, 56, 57, 58
V	10 11	59,62

Reference Book:

1. C. Goffman and G. Pedrick (1987), ***"A First Course in Functional Analysis"***, Prentice Hall of India, New Delhi.

Course Outcomes:

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

1. explain the fundamental concepts of functional analysis in applied contexts.
2. understand the properties of Banach space.
3. use the Hilbert space to construct orthonormal sets.
4. identify normal, self adjoint and unitary operators.
5. communicate the spectrum of bounded linear operator.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CO 1	H	H	H			L	H	M	L
CO 2	H	H	H	M	L	L	H	M	M
CO 3	H	H	H	M	L	M	H	M	H
CO 4	H	H	H	M	L	M	H	M	M
CO 5	H	H	H	M	L	M	H	M	M

Mathematical Methods

Semester -III

25MMAC13

Hours of Instruction/week : 4

No. of credits: 4

Course Objectives:

1. To learn the applications of Fourier transforms.
2. To understand the applications of Integral Equations.
3. To know the concepts of calculus of variations.

Unit I:

12 hrs.

Fourier Transforms : Definition - Inversion theorem - Fourier sine and cosine transform - Fourier transforms of derivatives - Fourier transforms of simple functions - Fourier transforms of rational functions.

Unit II:

12 hrs.

Applications of Fourier Transforms: Convolution integral- Convolution theorem - Parsevel's relation for Fourier transforms - Solution of PDE by Fourier transform- Laplace's equation in half plane- Laplace's equation in an infinite step- The linear diffusion equation on a semi infinitelineThe two dimensional diffusion equation.

Unit III:

12 hrs.

Integral equations: Types of integral equations - Integral equation with separable kernels - Fredholm alternative approximate method - Volterra integral equation - Classical Fredholm's theory- Fredholm's first fundamental theorem - Fredholm's second fundamental theorem - Fredholm's third fundamental theorem.

Unit IV:

12 hrs.

Applications of Integral Equations: Applications of integral equation to ordinary differential equation - Initial value problem- Boundary value problems - Singular integral equations - Abel integral equations.

Unit V:

12 hrs.

Calculus of Variations: Variation and its properties - Euler's equations - Functionals of the integral forms - Functionals dependent on higher order derivatives - Functionals dependent on the functions of several independent variables - Variational problems in parametric form.

Total Hours: 60

Text Books :

1. Ian N.Sneddon, (1974), ***"The use of Integral Transform"***, Tata McGraw Hill, New Delhi.
2. R. P. Kanwal, (1971), ***"Linear integral equations Theory and Technique"***, Academic Press, New York.
3. L. Elsgolts, (1970), ***"Differential Equations and Calculus of Variations"***, Mir Publishers, Moscow.

Reference Book:

1. W. V. Lovitt (1950), ***"Linear Integral equations"***, Dover Publications, New York.

Course Outcomes:

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

1. demonstrate first fundamental theorems of Fredholm.
2. apply Fourier transform in physical sciences.
3. evaluate integral equations of various types.
4. apply integral equations in boundary value problems.
5. identify problems in calculus of variation.

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CO 1	H	H	H	M	L	M	M	H	H
CO 2	H	H	H	M	L	M	M	H	H
CO 3	H	H	H	M	L	M	M	H	H
CO 4	H	H	H	M	L	M	M	H	H
CO 5	H	H	H	M	L	M	M	H	H

Mathematical Statistics

Semester - III

Hours of Instruction/week : 4

25MMAC14

No. of credits: 4

Course Objectives:

1. To understand the conceps of estimators and hypothesis testing.
2. To learn the concept of sampling theory.
3. To know the application of ANOVA.

Unit I:

12 hrs.

Characteristics of Estimators: Unbiasedness - Consistency - Efficient estimators - Sufficiency - Rao-Blackwell theorem.

Unit II:

12 hrs.

Methods of Estimation: Method of maximum likelihood estimation - Method of minimum variance - Method of moments - Method of Least square - Method of minimum Chi-square.

Unit III:

12 hrs.

Statistical Inference: Statistical hypothesis – Steps in solving testing of hypothesis problem – Optimum test under different situations – Neyman J. and Pearson, E.S. Lemma.

Unit IV:

12 hrs.

Sampling Theory: Simple random sampling procedure - Stratified random sampling procedure - Systematic sampling procedure.

ANOVA: Introduction - One way classification - Two way classification – Analysis of two way classified data with m-observations per cell.

Unit V:

12 hrs.

Design of Experiment: Introduction- principles of an experimental design – size of the plot - Completely Randomized Design - Randomized Block Design- Latin square design – factorial experiments.

Total Hours: 60

Text Books:

1. S.C.Gupta & V.K.Kapoor (2021), ***"Fundamentals of Mathematical Statistics"***, Sultan Chand & Sons.
2. S.C.Gupta & V.K.Kapoor(2003), ***"Fundamentals of Applied Statistics"***, Sultan Chand & Sons.

Reference Books:

1. E.G. Schilling (2005), ***"Acceptance Sampling in Quality control"***, John Wiley & Sons, New York, Second Edition.
2. V.K.Rohatgi (1988), ***"An Introduction to Probability Theory and Mathematical Statistics"***, Wiley Eastern Ltd., New Dpelhi (3rd Print).
3. M. Fisz (1963), ***"Probability Theory and Mathematical Statistics"***, John Wiley and Sons, New Delhi.

Course Outcomes:

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

1. analyze various charcteristics of estimators.
2. illustrate different methods of estimation.
3. understand and apply various concepts related to the testing of hypothesis.
4. demonstrate the concepts of sampling theory.
5. apply the concept of classification of design of experiments

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CO 1	H	H	H	M	H	H	M	H	M
CO 2	H	H	H	M	L	M	H	L	L
CO 3	H	H	H	M	M	L	M	L	M
CO 4	H	H	H	M	H	H	M	M	H
CO 5	H	H	H	M	H	M	H	M	H

Cryptography

Semester - III **Hours of Instruction/week: 4**

25MMAC15 **No. of credits: 4**

Course Objectives:

1. To know the basic algorithms that are used in cryptography.
2. To know the role of crypt analysis.
3. To know the principles of Block Cipers.

Unit I: **12 hrs.**

Introduction to Cryptography and Block Ciphers

Introduction to security attacks - services and mechanism - introduction to cryptography - Conventional Encryption: Conventional encryption model - classical encryption techniques - substitution ciphers and transposition ciphers – cryptanalysis – steganography - stream and blockciphers - Modern Block Ciphers: Block ciphers principals - Shannon's theory of confusion and diffusion - fiestal structure - data encryption standard(DES) - strength of DES - differential and linear crypt analysis of DES - block cipher modes of operations - triple DES – AES.

Unit II: **12 hrs.**

Confidentiality and Modular Arithmetic

Confidentiality using conventional encryption - traffic confidentiality - key distribution - random number generation - Introduction to graph - ring and field - prime and relative prime numbers - modular arithmetic - Fermat's and Euler's theorem - primality testing - Euclid's Algorithm - Chinese Remainder theorem - discrete algorithms.

Unit III: **12 hrs.**

Public key cryptography and Authentication requirements

Principles of public key crypto systems - RSA algorithm - security of RSA - key management – Diffle-Hellman key exchange algorithm - introductory idea of Elliptic curve cryptography – Elgamel encryption - Message Authentication and Hash Function: Authentication requirements - authentication functions - message authentication code - hash functions - birthday attacks – security of hash functions and MACS.

Unit IV: **12 hrs.**

Integrity checks and Authentication algorithms

MD5 message digest algorithm - Secure hash algorithm (SHA) Digital Signatures: Digital Signatures - authentication protocols - digital signature standards (DSS) - proof of digital signature algorithm - Authentication Applications: Kerberos and X.509 - directory authenticationservice - electronic mail security-pretty good privacy (PGP) - S/MIME.

Unit V: **12 hrs.**

IP Security and Key Management

IP Security: Architecture - Authentication header - Encapsulating security payloads - combining security associations - key management.

Total Hours: 60

Text Books:

1. William Stallings (2005), ***"Crpyptography and Network security Principles and Practices"***,Pearson/PHI.
2. Wade Trappe, Lawrence C Washington (2002), ***"Introduction to Cryptography with codingtheory"***, Pearson.

Reference Books:

1. W. Mao (2003), ***"Modern Cryptography – Theory and Practice"***, Pearson Education.
2. Charles P. Pfleeger, Shari Lawrence Pfleeger (2015), "***Security in computing***" Prentice Hall of India.

Course Outcomes:

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

1. provide security of the data over the network.
2. implement confidentiality and modular arithmetic.
3. illustrate public and private key cryptography.
4. apply authentication algorithms.
5. use IP security in networking.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CO 1	H	H	H	M	H	H	H	H	M
CO 2	H	H	H	H	H	M	H	H	M
CO 3	H	H	H	M	H	M	H	H	M
CO 4	H	H	H	H	H	H	H	H	M
CO 5	H	H	H	H	H	H	H	H	M

Introduction to Fuzzy Sets (Self Study)

Semester - III **Hours of Instruction/week: 2**

25MMAC17 **No. of credits: 2**

Course Objectives:

1. To impact knowledge on fuzzy logic principles
2. To understand the concepts of fuzzy relations and inference
3. To learn about fuzzification and defuzzification

Unit I: **6hrs.**

Fuzzy Sets: Fuzzy Sets – Basic types – Basic Concepts – ∝-cuts – Additional Properties of ∝-cuts –Extension principle for Fuzzy sets.

Unit II: **6hrs.**

Operations on Fuzzy Sets: Operations on Fuzzy sets – Types of Operations – Fuzzy complements – t -Norms-Fuzzy Unions – Combinations of operations

Unit III: **6hrs.**

Fuzzy relations Crisp relations – Fuzzy relational equations – operations on fuzzy relations – fuzzy systems – propositional logic

Unit IV: **6hrs.**

Inference: Inference – Predicate Logic – Inference in predicate logic – fuzzy logic principles – fuzzy quantifiers – fuzzy inference

Unit V: **6hrs.**

Fuzzification and Defuzzification: Fuzzy rule based systems – fuzzification and defuzzification – types.

Total Hours: 30

Text Book:

1. George J.Klir and B.Yuan (2004), ***"Fuzzy sets and Fuzzy Logic "***, Prentice Hall of India, New Delhi.

Reference Books:

1. H.J.Zimmermann (1991), ***"Fuzzy Set theory and its Applications"***, Allied Publishers limited, New Delhi.
2. N.Palaniappan(2002), ***"Fuzzy Topology"***, Alpha Science International.

Course Outcomes:

On completion of the course the students will be able to

1. develop the skill in basic understanding on fuzzy sets
2. acquire adequate knowledge on the operations on fuzzy sets.
3. understand the concept of fuzzy relations
4. analyze the mathematical problems using fuzziness
5. apply fuzzification and defuzzification in real life problems

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CO 1	H	M	H	M	H	M	H	M	H
CO 2	H	M	M	M	H	M	H	M	H
CO 3	H	L	L	L	H	H	H	M	H
CO 4	M	M	M	M	H	M	H	M	H
CO 5	M	H	M	L	L	M	H	M	H

Professional Development Course

Python Programming

Semester - III **Hours of Instruction/week : 5**

25MMAPD4

Course Objectives:

1. To introduce Python programming.
2. To learn Python coding to implement algorithms for Mathematical problems.
3. To acquire knowledge of Python coding to solve problems in Numerical Methods.

Unit I: **15 hrs.**

Introduction to Python: Basic syntax, variable types, basic operators, numbers, strings, lists, tuples, functions and input/output statements. Some simple programs to understand the relational, conditional and logical operators.Compare two numbers (less than, greater than) using if statement. Sum of natural numbers using whileloop. Finding the factors of a number using for loop; To check the given number is prime or not (use if...else statement); Find the factorial of a number (use if...if...else).; Simple programs to illustrate logical operators (and, or, not).

Unit II: **15 hrs.**

Matrices, Differential Calculus & Analytical Geometry of Three Dimensions: Python commands to reduce given matrix to echelon form and normal form with examples. Pythonprogram/command to establish the consistency or otherwise and solving system of linear equations.Python command to find the nth derivatives. Python program to find nth derivative with and withoutLeibnitz rule. Obtaining partial derivative of some standard functions Verification of Euler's theorem, itsextension and Jacobean. Python program for reduction formula with or without limits. Python programto find equation and plot sphere, cone, cylinder.

Unit III: **15 hrs.**

Roots of High-Degree Equations- Systems of Linear Equations: Introduction, Simple Iterations Method - Finite Differences Method, Gauss Elimination Method:Algorithm, Gauss Elimination Method, Jacobi's Method, Gauss-Seidel's Method.

Unit IV: **15 hrs.**

Numerical differentiation, Integration and Ordinary Differential Equations : Introduction & Euler's Method, Second Order Runge-Kutta's Method, Fourth Order Runge-Kutta'sMethod, Fourth Order Runge-Kutta's Method: Plot Numerical and Exact Solutions.

Unit V: **15 hrs.**

Two-Point Boundary Value Problems: Introduction to two-point boundary value Problems: second order differential equations - Higher order differential equations - solution of second order differential equation using Finite Difference Method.

Total Hours: 75

Text Books:

1. J. Kiusalaas(2013), ***"Numerical methods in engineering with Python 3"***, Cambridge University Press.
2. H. P. Langtangen (2016), "***Solving PDEs in Python: the FEniCS tutorial I***", Springer Open.

Reference Books:

1. Hans Fangohr (2015), ***"Introduction to Python for Computational Science and Engineering (A beginner's guide)"***, University of Southampton.
2. J. Crank, H. G. Martin, and D. M. Melluish , ***"Non-Linear Ordinary Differential Equations"***, Oxford University Press.
3. Brain Heinold (2019), "***A practical Introduction to Python Programming, Department of Mathematics and Computer Science***", Mount St. Maru's University.
4. H. P. Langtangen and Anders Logg (2017), "***Solving PDEs in Python***", Springer Open.

Course Outcomes:

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

1. get solution to their various mathematical problems quickly through Python programming.
2. implement the skill to find out the solution to dynamical systems given as differential equations.
3. solve simultaneous equations using python programming.
4. apply Python programming in solving numerical problems.
5. do computational Mathematics easily.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PSO 1	PSO 2	PSO 3
CO 1	H	M	H	M	L	M	H	M	H
CO 2	H	M	M	M	L	M	H	M	H
CO 3	H	M	M	M	L	L	H	M	H
CO 4	H	M	M	M	L	M	H	M	H
CO 5	H	L	L	L	L	H	H	M	H