Course Name : Master of Science
Discipline : Mathematics
CHOICE BASED CREDIT SYSTEM
Rules and regulations, Course Scheme and Scheme of Examinations
(For those who join in June 2024 and later)

COURSE OBJECTIVES:

The syllabus for M.Sc. Mathematics degree under semester system has been designed on the basis of Choice Based Credit System, (CBCS) which will help the students to go adequate knowledge in Mathematics to do Research in Mathematics in any reputed institutions as well as give enough background to prepare for various National level tests conducted by Tamil Nadu Government, UGC-CSIR, NBHM etc.

To enable the students to understand various applications of Mathematics in Real life as well as in any other allied subjects like Physics, Chemistry etc.

ELIGIBILITY FOR ADMISSION:

Candidate should have passed the B.Sc. / B.Sc. (CA) Degree Examination with mathematics as Major subject conducted by various Universities and colleges accepted by the Syndicate.

DURATION OF THE COURSE: Two Years

COURSE SCHEME:

I year M.Sc. MATHEMATICS

Semester	Part	Subject Name	Hours	Credit	Int + Ext =Total	Local	Regional	National	Global	Professional Ethics	Gender	Human Values	Environment & Sustainability	Employability	Entrepreneurship	Skill Development	Subject Code	Revised / New / No Change / Interchanged & Percentage of Revision
I	Core 1	**Abstract Algebra-I**	6	5	25+75=100	✔	✔	✔	✔					✔	✔	✔	**P24MAC11**	**New**
	Core 2	**Real Analysis - I**	6	4	25+75=100	✔	✔	✔	✔					✔	✔	✔	**P24MAC12**	**New**
	Core 3	Ordinary Differential Equations	6	4	25+75=100	✔	✔	✔	✔					✔	✔	✔	P23MAC13	No Change

	Core 4	**Probability and Statistics**	6	4	25+75=100	✔	✔	✔	✔					✔	✔	✔	**P24MAC14**	**New**
	Elective 1	**a) Differential Geometry** **b) Mathematical Python**	6	5	25+75=100	✔	✔	✔	✔					✔	✔	✔	**P24MAE11/** **P24MAE12**	**New** **New**
	Total		**30**	**22**														
II	Core 5	**Abstract Algebra – II**	6	5	25+75=100	✔	✔	✔	✔					✔	✔	✔	**P24MAC21**	**New**
	Core 6	**Real Analysis - II**	5	4	25+75=100	✔	✔	✔	✔					✔	✔	✔	**P24MAC22**	**New**
	Core 7	**Topology**	5	4	25+75=100	✔	✔	✔	✔					✔	✔	✔	**P24MAC23**	**New**
	Core 8	**Advanced Graph Theory**	5	4	25+75=100	✔	✔	✔	✔					✔	✔	✔	**P24MAC24**	**New**
	Core 9	Partial Differential Equations	5	4	25+75=100	✔	✔	✔	✔					✔	✔	✔	P23MAC25	No Change
	NME	Industrial Statistics	4	4	25+75=100	✔	✔	✔	✔					✔	✔	✔	P23MAN21	No Change
	Total		**30**	**25**														

TENTATIVE SYLLABUS STRUCTURE

Semester	Part	Subject	Hours	Credit	Int +Ext = 100	Subject Code	Courses having focus on employability/ entrepreneurship/ skill development
III	Core 10	Field Theory	6	5	40+60=100		employability/ entrepreneurship/ skill development
	Core 11	Complex Analysis	6	4	40+60=100		employability/ entrepreneurship/ skill development
	Core 12	Numerical Methods	6	4	40+60=100		employability/ entrepreneurship/ skill development
	Core 13	Measure Theory	6	4	40+60=100		employability/ entrepreneurship/ skill development
	Elective 2	a)Integral Equations b) Classical Mechanics c) Number Theory and Cryptography	6	5	40+60=100		employability/ entrepreneurship/ skill development
IV	Core 14	Optimization Techniques	6	4	40+60=100		employability/ entrepreneurship/ skill development
	Core 15	Functional Analysis	6	4	40+60=100		employability/ entrepreneurship/ skill development
	Core 16	Combinatorics	6	4	40+60=100		employability/ entrepreneurship/ skill development
		PROJECT	6	4	50+50=100		employability/ entrepreneurship/ skill development
	Elective 3	a)Applications of Graph Theory b)Advanced Topology c)Stochastic Processes	6	5	40+60=100		employability/ entrepreneurship/ skill development

SEMESTER I
Core 1

Course Title: Abstract Algebra – I	**Total Hours: 90** **Contact Hours per Week :6**
Course Code: P24MAC11	**Total Credits: 5**

Objective(s):

- To study in detail how to apply the Abstract structures to a concrete realization.

Course Outcomes
On completing this course, students can/are

Cos	CO Statements
CO1:	Learn the concept of group theory.
CO2:	Construct new groups from some groups already on hand.
CO3:	Learn the symmetry to analyse the object using group theoretic methods.
CO4:	Know about the concept of group, the algebraic structure such as rings, fields and vector spaces.
CO5:	Use group theory as a powerful tool research in robotics, computer vision, computer graphics and medical image analysis.

Unit I **[18 Hours]**
Group - Cayley's theorem - Permutation groups - Another counting principle.
Unit II **[18 Hours]**
Sylow's theorem - Direct products - Finite abelian groups.
Unit III **[18 Hours]**
Euclidean Rings - A Particular Euclidean Ring - Polynomial Rings.
Unit IV **[18 Hours]**
Polynomial over the Rational Field - Polynomial Rings over commutative Rings - Modules.
Unit V **[18 Hours]**
Rings with chain conditions: Noetherian rings – Artinian rings – Examples and counter examples.

Text Books :

1. I. N. Herstein, Topics in Algebra, Second Edition, John Wiley & Sons Inc. (Reprint 2006).
2. Surjeet Singh, Qazi Zameeruddin, Modern Algebra, Eighth Edition, Vikas Publishing House Pvt Ltd, 2005.

Course Contents :

Unit I : Text Book 1: Chapter : 2 - Sections 2.9, 2.10, 2.11.
Unit II : Text Book 1: Chapter : 2 - Sections 2.12, 2.13, 2.14. [Supplementary Problems Excluded]
Unit III : Text Book 1: Chapter : 3 - Sections 3.7, 3.8, 3.9.
Unit IV : Text Book 1: Chapter : 3 - Sections 3.10, 3.11; Chapter : 4 - Section 4.5.
Unit V: Text Book 2: Chapter: 15 – Section 15.1, 15.2, 15.3.

Reference Books :

1. N. S. Gopala Krishnan, University Algebra, New age International Publishers, 2008.
2. Joseph A. Gallian,Contemporary Abstract Algebra, Eighth Edition, Brooks/Cole Cengage Learning, 2013.
3. Joseph J. Rotman, Advanced Modern Algebra, First Edition, Prentice Hall, 2002.

Core 2

Course Title: Real Analysis – I	**Total Hours: 90** **Contact Hours per Week: 6**
Course Code: P24MAC12	**Total Credits: 4**

Objectives:

- To train the students to move from the concrete structure of Real and Complex number systems to a Topological structure of sets.
- To study in detail about the continuity and differentiability of Real and Complex valued functions.

Course Outcomes:
On completing this course, students can/are

Cos	CO Statements
CO1:	Know how to connect abstract statement with concrete examples.
CO2:	Get experience in reading and writing proofs.
CO3:	Acquire more ideas about Calculus and Linear Algebra.
CO4:	Analyse the technical proofs and intuitive ideas.
CO5:	Learn how the principles and theory of Real Analysis can be applied in a variety of settings in subjects.

Unit I The Real and Complex Numbers system and Basic Topology [18 Hours]

Orderd sets – The Real field – Finite, countable and uncountable sets – Metric spaces.

Unit II Basic Topology and Numerical sequences [18 Hours]

Compact sets – Perfect sets – Connected sets – Convergent sequences – Subsequences – Cauchy sequences – Upper and lower limits – Some special sequences.

Unit III Series [18 Hours]

Series of Non-negative Terms – The number e – The Root and Ratio tests – Power series – Summation by parts – Absolute convergence.

Unit IV Continuity [18 Hours]

Limits of Functions – Continuous Functions – Continuity and Compactness – Continuity and connectedness – Discontinuities – Monotonic Functions.

Unit V Differentiation [18 Hours]

The derivative of a Real Function – Mean value Theorems – The continuity of Derivatives –L' Hospital's Rule - Derivatives of Higher order – Taylor's theorem.

Text Book(s):

1. Walter Rudin, Principles of Mathematical Analysis, Third Edition, Mc-Graw Hill Inc, 1976.

Course Contents :

Unit I : Chapter : 1 – Sections 1.5 -1.11 & 1.19 – 1.22.
Chapter : 2 – Sections 2.1 – 2.30.
Unit II : Chapter : 2 – Sections 2.31 – 2.47.
Chapter : 3 – Sections 3.1 – 3.20.
Unit III : Chapter : 3 – Sections 3.21 – 3.46.
Unit IV : Chapter : 4 – Sections 4.1 – 4.31.
Unit V : Chapter : 5 – Sections 5.1 – 5.15.

Reference Books :

1. V.Karunakaran, Real Analysis, Pearson 2012.
2. Richard R. Goldberg, Methods of Real Analysis, Oxford & IBH publications, New Delhi, 1964.
3. Tom M. Apostol, Mathematical Analysis, Second Edition (Indian Student Edition), Narosa Publishing House, 1985.

Core 3

Course Title: Ordinary Differential Equations	**Total Hours: 90** **Contact Hours per Week: 6**
Course Code: P23MAC13	**Total Credits: 4**

Objectives:

To enable the students to

- know the method of solving the ordinary differential equations particularly homogeneous, non homogeneous and homogeneous equations with analytic coefficients.
- be familiar with Legendre, Euler and Bessel equations.
- develop skills to solve partial differential equations using Cauchy, Charpit & Jacobi methods.
- acquire the knowledge of solving second order partial differential equations and understand Laplace equations and boundary value problems

Course Outcomes

On completing this course, students can/are

Cos	CO Statements
CO1:	Understand the method of solving initial value problems.
CO2:	Acquire the knowledge of relationship between Wronstian and independent of solutions.
CO3:	Become familiar with Legendre, Euler and Bessel equations.
CO4:	Analyze solutions using appropriate methods and give examples.
CO5:	Understand and use various theoretical ideas and results that underlie the mathematics in this course

Unit I **[18 Hours]**

Linear equations with constant coefficients

Second order homogeneous equations-Initial value problems-Linear dependence and independence-Wronskian and a formula for Wronskian-Non-homogeneous equation of order two.

Chapter 2: Sections 1 to 6

Unit II **[18 Hours]**

Linear equations with constant coefficients

Homogeneous and non-homogeneous equation of order n –Initial value problems- Annihilator method to solve non-homogeneous equation- Algebra of constant coefficient operators.

Chapter 2 : Sections 7 to 12.

Unit III **[18 Hours]**

Linear equation with variable coefficients

Initial value problems -Existence and uniqueness theorems – Solutions to solve a non-homogeneous equation – Wronskian and linear dependence – reduction of the order of a homogeneous equation – homogeneous equation with analytic coefficients-The Legendre equation.

Chapter : 3 Sections 1 to 8 (Omit section 9)

Unit IV **[18 Hours]**

Linear equation with regular singular points

Euler equation – Second order equations with regular singular points –Exceptional cases – Bessel Function.

Unit V **[18 Hours]**

Existence and uniqueness of solutions to first order equations: Equation with variable separated – Exact equation – method of successive approximations – the Lipschitz condition – convergence of the successive approximations and the existence theorem.

Text Book(s):

1. E.A.Coddington, *A introduction to ordinary differential equations* (3rd Printing) Prentice-Hall of India Ltd.,New Delhi, 1987.

Course Contents:

Unit I: Chapter 2: Sections 1 to 6
Unit II: Chapter 2 : Sections 7 to 12.
Unit III: Chapter 2: Sections 1 to 6
Unit IV: Chapter 4 : Sections 1 to 4 and 6 to 8 (Omit sections 5 and 9)
Unit V: Chapter 5 : Sections 1 to 6 (Omit Sections 7 to 9)

Reference Book(s):

1. Williams E. Boyce and Richard C. DI Prima, *Elementary differential equations and boundary value problems*,John Wiley and sons, New York, 1967.
2. George F Simmons, *Differential equations with applications and historical notes,* Tata McGraw Hill, New Delhi, 1974.
3. N.N. Lebedev, *Special functions and their applications*, Prentice Hall of India, New Delhi, 1965.

4. W.T. Reid. *Ordinary Differential Equations*, John Wiley and Sons, New York, 1971
5. M.D.Raisinghania, *Advanced Differential Equations*, S.Chand& Company Ltd. New Delhi 2001
6. B.Rai, D.P.Choudary and H.I. Freedman, *A Course in Ordinary Differential Equations*, Narosa Publishing House, New Delhi, 2002.

Core 4

Course Title: Probability and Statistics	**Total Hours: 90** **Contact Hours per Week : 6**
Course Code: P24MAC14	**Total Credits: 4**

Objectives:

- To study in detail about various probability distributions
- To acquire knowledge about sampling techniques.

Course Outcomes

On completing this course, students can/are

Cos	CO Statements
CO1:	Apply the different statistical measures for any data.
CO2:	Understand Statistics facilitates comparison.
CO3:	Formulate and test hypothesis.
CO4:	Attain several skill to solve various problems in all statistical concepts.
CO5:	Be able to deal with all sciences such as Biology, Zoology, Education, Economics, Planning, industry, Medical sciences.

Unit I Probability and Distributions [18 Hours]

Introduction - Set theory - The Probability set function - Conditional Probability and Independence – Random variables – Discrete Random variables – Continuous Random variables.

Unit II* Probability and Distributions [18 Hours]

Expectation of a random variable - Some special expectation – Important inequalities - **Multivariate Distributions:** Distribution of two random variables - Conditional distributions and expectations - The Correlation Coefficient.

Unit III* Multivariate Distributions [18 Hours]

Independent Random Variables - Extension to several random variables - **Some special distributions:** The Binomial and related distributions -The Poisson distribution - The Gamma and Chi-square and beta distributions.

Unit IV* Some Special Distributions [18 Hours]

The Normal distribution - t and F distributions – Expectations of functions.

Unit V Unbiasedness, Consistency and limiting distributions [18 Hours]

Convergence in probability – Convergence in distribution – Central limit theorem.

***- Students are recommended to have an industrial visit for better understanding of the course.**

Text Book :

1. R.V.Hogg, Joseph W.McKean and A.T.Craig, Introduction to Mathematical Statistics, Sixth Edition, Pearson's Education Asia, 2006.

Course Contents :

Unit I: Chapter : 1 - Sections 1.1 to 1.7.
Unit II: Chapter : 1 - Sections1.8 to 1.10.
Chapter : 2 - Sections 2.1, 2.3, 2.4.
Unit III: Chapter : 2 - Sections 2., 2.6
Chapter : 3 - Sections 3.1 to 3.3.
Unit IV: Chapter : 3 - Sections 3.4 and 3.6.
Chapter : 4 - Section 4.1.
Unit V: Chapter : 4 - Sections 4.2, 4.3 and 4.4

Reference Book :

1. Fundamentals of Mathematical Statistics, Eleventh Thoroughly Revised Edition, Sultan Chand & Sons.

Elective 1(a)

Course Title: Differential Geometry	**Total Hours: 90** **Contact Hours per Week :6**
Course Code: ~~P24MAE11~~	**Total Credits: 5**

Objective(s):

To acquire basic knowledge in differential geometry

Course Outcomes:

On completing this course, students can/are

Cos	CO Statements
CO1:	Determine the Arc length, Curvature, Torsion and Osculating Plane for any curve in the Euclidean space.
CO2:	Analyze the behavior of a space curve and its contact with the surfaces.
CO3:	Find the moving triad of a point in the space curve to identify the Evolutes and Involutes of the curve.
CO4:	Parametrize a surface using the local intrinsic properties of a surface.
CO5:	Construct the first and second fundamental forms for any given surface.

Unit I Theory of space curves (18 hours)

Introduction – Representation of space curves - Unique parametric representation of a space curve-Arclength- Tangent and Osculating plane- Principal normal and Bi-normal- Curvature and Torsion

Unit II Osculating Circle and Osculating sphere (18 hours)

Behavior of a curve in the neighbourhood of its points- Curvature and torsion of a curve as the intersection of the two surfaces - Contact between curves and surfaces - Osculating circle and Osculating sphere- Locus of centers of spherical curvature

Unit III Involutes and Evolutes (18 hours)

Tangent surfaces, Involutes and evolutes – Betrand curves – Spherical indicatrix – Intrinsic

equations of space curves – Fundamental existence theorem for space curves – Helices.

Unit IV Local intrinsic properties of a surface (18 hours)

Introduction - Definition of a surface – Nature of points on a surface – Representation of a surface - Curves in surface – Tangent plane and surface normal - General surface of revolution – Helicoids.

Unit V Metric on a surface (18 hours)

The first fundamental form – Direction coefficients on a surface–Families of curves – Orthogonal trajectories – Double family of curves - Isometric correspondence - Intrinsic properties.

TEXT BOOK:

1. D. Somasundaram, Differential geometry, Narosa publication, 2005.

Course Contents :

Unit I : Chapter 1 Section 1.1 to 1.7

Unit II : Chapter 1 Section 1.8 to 1.12

Unit III: Chapter 1 Section 1.13 to 1.18

Unit IV : Chapter 2 Section 2.1 to 2.8.

Unit V: Chapter 2 Section 2.9 to 2.15.

REFERENCE BOOKS:

1. T.G.Wilimore, An introduction to Differential Geometry, Oxford university press (1983).
2. D.T Struik, Lectures on Classical Differential Geometry, Addison-Wesely, Mass.1950
3. J.A. Thorpe, Elementary Topics in Differential Geometry, Springer-Verlag, NewYork,1979

Elective 1(b)

Course Title: Mathematical Python	**Total Hours: 90** **Contact Hours per Week : 6**
Course Code: P24MAE12	**Total Credits: 5**

Objectives:

To develop basic knowledge about Python programming.
To develop skills in using Python programming for solving mathematical problems.

Course Outcomes:
On completing this course, Students will be able to

COs	CO Statements
CO1:	Appreciate the importance and features of Python
CO2:	Define and classify functions

CO3:	Understand the use and application of iterators
CO4:	Understand how to create a class in Python
CO5:	Differentiate between inheritance and composition

Unit I **[18 Hours]**

Features of Python - Chronology and Uses - Installation of Anaconda - Basic Data Types Revisited – Strings - Lists and Tuples - Conditional Statements: if, if…else, and if…elif…else constructs – if…elif…else Ladder - Logical Operators - The Ternary Operator - get Construct – Examples.

Unit II **[18 Hours]**

Looping: While - Patterns -Nesting and Applications of Loops in Lists – Functions: Features of a Function - Basic Terminology - Definition and Invocation - Types of Function - Implementing Search – Scope – Recursion.

Unit III **[18 Hours]**

Iterations, Generators, and Comprehensions: Power of "For" - Iterators - Defining an Iterable Object - Generators – Comprehensions - File Handling: Introduction - File Handling Mechanism - Open Function and File Access Modes - Python Functions for File Handling - Command Line Arguments - Implementation and Illustrations.

Unit IV **[18 Hours]**

Strings: Introduction - Use of "For" and "While" - String Operators - Functions for String Handling - Introduction to Object Oriented Paradigm: Introduction - Creating New Types - Attributes and Functions - Elements of Object-Oriented Programming.

Unit V **[18 Hours]**

Classes and Objects: Introduction to Classes - Defining a Class -Creating an Object - Scope of Data Members - Nesting - Constructor - Constructor Overloading – Destructors – Inheritance: Introduction to Inheritance and Composition - Importance and Types – Methods - Search in Inheritance Tree - Class Interface and Abstract Classes.

Text Book:

- H.Bhasin: Python Basics, Mercury Learning and Information Dulles, Virginia Boston, Massachusetts New Delhi.

Course Contents:

Unit I: Chapter 1: 1.2, 1.4, 1.5; Chapter 2: 2.2 to 2.4; Chapter 3: 3.2 to 3.7
Unit II: Chapter 4: 4.2 to 4.4; Chapter 5: 5.2 to 5.8
Unit III: Chapter 6: 6.2 to 6.6; Chapter 7: 7.1 to 7.6
Unit IV: Chapter 8: 8.1 to 8.4; Chapter 9: 9.1 to 9.4
Unit V: Chapter 10: 10.1 to 10.8; Chapter 11: 11.1 to 11.5

Reference Books:

1. Beginning-Python, Second Edition by Magnus Lie Hetland
2. The Complete Reference Python by Martin C. Brown
3. Head First Python by Patrick Barry
4. Learning Python, O'Reilly by Mark Lutz
5. Python in a Nutshell, O'Reilly by Alex Martelli

SEMESTER - II

Core 5

Course Title: Abstract Algebra – II	**Total Hours: 90** **Contact Hours per Week : 6**
Course Code: P24MAC21	**Total Credits: 5**

Objectives:

- To study about geometrical structures in Vector spaces.
- To transform the properties of Linear Transformation into the corresponding properties of Matrices and Determinants.

Course Outcomes:
On completing this course, students can/are

Cos	CO Statements
CO1:	Understand the concept of dual spaces, inner product space.
CO2:	Understand the concept of the types of linear transformation and algebra of transformation
CO3:	Know about main application of the algebra in cryptography area.
CO4:	Learn about the determinants and its properties

Unit I **[18 Hours]**

Dual spaces – Inner product spaces.

Unit II **[18 Hours]**

Linear transformations - The algebra of linear transformations – characteristic roots – Matrices.

Unit III **[18 Hours]**

Linear transformations – canonical forms : Triangular form – Nilpotent transformations – Jordan form.

Unit IV **[18 Hours]**

Linear transformations – canonical forms : Rational canonical form – Trace and transpose.

Unit V **[18 Hours]**

Determinants – Hermitian, Unitary and Normal transformations.

Text Book:

1. I. N. Herstein, Topics in Algebra, Second Edition, John Wiley & Sons Inc. (Reprint 2006).

Course Contents :

Unit I : Chapter : 4 - Sections 4.3, 4.4.
Unit II : Chapter : 6 - Sections 6.1, 6.2, 6.3.
Unit III : Chapter : 6 - Section 6.4, 6.5, 6.6.
Unit IV : Chapter : 6 - Sections 6.7, 6.8.
Unit V : Chapter : 6 - Sections 6.9, 6.10.

Reference Book :

1. N. S. Gopala Krishnan, University Algebra, New age International Publishers, 2008.

Core 6

Course Title: Real Analysis – II	**Total Hours: 75** **Contact Hours per Week :5**
Course Code: P24MAC22	**Total Credits: 4**

Objectives :

- To study the integration of real valued functions and vector valued functions on interval and then on arbitrary sets.
- To study in detail about the convergence and continuity of sequence of functions and to relate convergence with differentiation and integration of functions**.**
- To study some special functions represented by Power series.

Course Outcomes:
On completing this course, students can/are

Cos	CO Statements
CO1:	Understand the analytic properties of functions, sequences, convergence, limit of sequences, continuity, linear transformation, differentiation, etc.,
CO2:	Become familiar with the concept of Riemann integrals.
CO3:	Analyse inverse operations such as integration and differentiation.
CO4:	Try to analyse the problems that arise when limit processes are interchanged.

Unit I **[15 Hours]**

The Riemann – Stieltjes Integral - Definition and Existence of the Integral - Properties of the Integral- Integration and Differentiation.

Unit II **[15 Hours]**

Integration of vector-valued Functions – Rectifiable Curves - Sequences and series of Functions – Discussion on main problem- Uniform convergence – Uniform convergence and continuity.

Unit III **[15 Hours]**

Uniform convergence and Integration - Uniform convergence and Differentiation – Equicontinuous Families of Functions.

Unit IV **[15 Hours]**

Some special Functions : Power series – The Exponential and Logarithmic Functions – Trigonometric Functions – The algebraic completeness of the complex field.

Unit V **[15 Hours]**

Fourier series - The Gamma Function - Functions of several variables : Differentiation – The contraction principle – The inverse Function theorem.

Text Book :

1. Principles of Mathematical Analysis, Third Edition by Walter Rudin, Mc-Graw Hill Inc, 1976.

Course Contents :

Unit I : Chapter : 6 – Sections 6.1 - 6.22
Unit II : Chapter : 6 – Sections 6.23 – 6.27.
Chapter : 7 – Sections 7.1 – 7.15.

Unit III : Chapter : 7 – Sections 7.16 – 7.32.
Unit IV : Chapter : 8 – Sections 8.1 – 8.8.
Unit V : Chapter : 8 – Sections 8.9 – 8.22.
Chapter : 9 – Sections 9.10 – 9.25.

Reference Books :

1. V. Karunakaran, Real Analysis, Pearson Education India, 2012.
2. Tom M. Apostol, Mathematical Analysis, Second Edition, Narosa Publications House,1985.

Core 7

Course Title: TOPOLOGY	**Total Hours: 75** **Contact Hours per Week : 5**
Course Code: P24MAC23	**Total Credits: 4**

Objectives :

- To enable the students to understand topological spaces.
- To enable the students to understand the concept of continuous functions .
- To enable the students to know about connected spaces.
- To enable the students to know about compact spaces .
- To study countability and separations axioms.

Course Outcomes:
On completing this course, students can/are

Cos	CO Statements
CO1:	Understand the terms and definitions of Topological Spaces, Accumulation Points, Interior, Closure, Boundary and exterior of sets, Coarser and Finer Topologies – Subspace and theorems related to topology.
CO2:	Be motivated to unify the basics like open set, closed sets, components, continuity, completeness and so on, that are learned through one semester course on Real and complex analysis.
CO3:	Elaborate the knowledge of concepts such as connectedness and compactness.
CO4:	Recognize Bases and Subbases for topologies and write Topologies generated by classes of sets.
CO5:	Understand the importance of Metrizable topological spaces and know sufficient conditions for metrizability of a topological space.
CO6:	Use the concept of homeomorphism to identify the spaces that are having similar geometrical structures.

Unit I Topological spaces [15 Hours]

Topological spaces - Basis for a topology - The order topology - The product topology on $X \times Y$ – The sub space topology - Closed sets and limit points.

Unit II Continuous Functions [15 Hours]

Continuous functions -The product topology - The metric topology- The metric topology (continued)

Unit III Connectedness [15 Hours]

Connected spaces - Connected Subspaces of the Real line – Components – Local connectedness.

Unit IV Compactness [15 Hours]

Compact spaces - Compact subspaces of the Real line - Limit point compactness.

Unit V Separation Axioms [15 Hours]

The separation axioms – Normal spaces - The Urysohn lemma - The Urysohn metrization theorem.

Text Book :

1. James R. Munkres, Topology, Second Edition, PHI Edition Private Ltd, New Delhi (2012).

Course Contents :

Unit I : Chapter : 2 – § 12, 13, 14, 15, 16, 17.
Unit II : Chapter : 2 – § 18, 19, 20, 21.
Unit III : Chapter : 3 – § 23, 24, 25.
Unit IV : Chapter : 3 – § 26, 27, 28.
Unit V : Chapter : 4 – § 31, 32, 33, 34.

Reference Books :

1. Dugundji, J., Topology, PHI Edition Private Ltd., New Delhi,1975.
2. J. L. Kelly, General Topology, Dover Publications Inc, New York, 2017.
3. G. F. Simmons, Introduction to Topology and Modern Analysis, Tata McGraw-Hill Edition, India, 2004.

Core 8

Course Title: Advanced Graph Theory	**Total Hours: 75** **Contact Hours per Week : 5**
Course Code: P24MAC24	**Total Credits: 4**

Objectives :

- To learn advanced topics in Graph Theory.
- To acquire more knowledge in Factorization and decomposition.
- To understand the concept of Ramsey Numbers.

Course Outcomes:
On completing this course, students can/are

Cos	CO Statements
CO1:	Know basic definitions & Graph theory.
CO2:	Use mathematical definitions to identify and construct examples and to distinguish the existence and non-existence of certain properties.
CO3:	Gather the graph theoretical knowledge and its application through algorithm.
CO4:	Identify special graphs and know related theorems.
CO5:	Solve some real time problems using the concepts of Graph theory.
CO6:	Apply graph as models for many standard problems.

Unit I **Connectivity** **[15 Hours]**

Cut Vertices - Blocks - Connectivity -Menger's theorem.

Unit II **Factorization and Decomposition** **[15 Hours]**

Factorization - Decomposition and graceful labelings- Instant insanity - The Petersen graph.

Unit III **Ramsey Numbers** **[15 Hours]**

The Ramsey number of graphs -Turan's theorem - Rainbow Ramsey numbers.

Unit IV **Distance** **[15 Hours]**

The centre of a graph - Distant vertices - Locating numbers.

Unit V **Domination number and Digraphs** **[15 Hours]**

The Domination number of a graph - Strong digraphs - Tournaments.

Text Book :

1. Gary Chartrand and Ping Zhang, A First course in Graph Theory, Dover Publications, Inc, New York, 2012.

Course Contents :

Chapter : 5 - Sections 5.1 to 5.4.
Chapter : 7 - Sections 7.1 to 7.2.
Chapter : 8 - Sections 8.2 to 8.5.
Chapter : 11 - Sections 11.1 to 11.3
Chapter : 12 - Sections12.1 – 12.3.
Chapter : 13 - Section 13.1.

Reference Books :

1. J. A.Bondy and U.S.R. Murty, Graph Thoery with Applications, North –Holland, New York, 1976.
2. Gary Chartrand, Linda Lesniak, Ping Zhang, Graphs and Digraphs, Chapman and Hall (CRC), 2015.

Core -9

Course Title: Partial Differential Equations	**Total Hours: 75** **Contact Hours per Week : 5**
Course Code: P23MAC25	**Total Credits: 4**

Course Objectives:

To classify the second order partial differential equations and to study Cauchy problem, method of separation of variables, boundary value problems.

Course Outcomes:

On completing this course, students can/are/able

Cos	CO Statements
CO1:	To understand and classify second order equations and find general solutions
CO2:	To analyse and solve wave equations in different polar coordinates
CO3:	To solve Vibrating string problem, Heat conduction problem, to identify and solve

	Laplace and beam equations
CO4:	To apply maximum and minimum principle's and solve Dirichlet, Neumann problems for various boundary conditions
CO5:	To apply Green's function and solve Dirichlet, Laplace problems, to apply Helmholtz operation and to solve Higher dimensional problem

Unit I: Mathematical Models and Classification of second order equation: [15 Hours]
Classical equations- The Vibrating string – The Vibrating membrane – Second order equations in two independent variables – canonical forms – equations with constant coefficients – general solution

Unit II: Cauchy Problem [15 Hours]
The Cauchy problem – The Cauchy-Kowalewskaya theorem – Homogeneous wave equation – Initial Boundary value problem- Equations with Non-homogeneous boundary conditions – Vibration of Finite string with fixed ends.

Unit III: Method of separation of variables: [15 Hours]
Separation of variable- The Vibrating string problem – Existence and uniqueness of solution of vibrating string problem- The Heat conduction problem – Existence and uniqueness of solution of heat conduction problem

Unit IV*: Boundary Value Problems [15 Hours]
Boundary value problems – Maximum and minimum principles – Uniqueness and continuity theorem – Dirichlet Problem for a circle , Dirichlet Problem for a circular annulus.

Unit V*: Green's Function [15 Hours]
Introduction-The Dirac Delta function – Properties of Green's functions – Method of Green's function – Dirichlet Problem for the Laplace operator - Dirichlet Problem for the Helmholtz operators.

Text book:

- Tyn Myint-U and Lokenath Debnath, *Linear Partial Differential Equations for Scientists and Engineers* (Fourth Edition), Birkhauser, Boston, 2007.

Course Contents :

Unit-I **Chapter 3 : Sections 3.1 to 3.3 , Chapter 4 : Sections 4.1 to 4.4**

Unit-II **Chapter 5 : Sections 5.1 to 5.6**

Unit-III **Chapter 7 : Sections 7.1 to 7.6**

Unit-IV **Chapter 9 : Sections 9.1 to 9.5**

Unit-V **Chapter 11 : Section 11.1 to 11.6**

Reference books:

1. M.M.Smirnov, *Second Order partial Differential Equations*, Leningrad, 1964.
2. I.N.Sneddon, *Elements of Partial Differential Equations*, McGraw Hill, New Delhi, 1983.
3. R. Dennemeyer, *Introduction to Partial Differential Equations and Boundary Value Problems*, McGraw Hill, New York, 1968.
4. M.D.Raisinghania, *Advanced Differential Equations*,S.Chand& Company Ltd., New Delhi, 2001.
5. S. Sankar Rao, *Partial Differential Equations*, 2nd Edition, Prentice Hall of India, New Delhi. 2004

NME

Course Title: Industrial Statistics	**Total Hours: 60** **Contact Hours per Week : 4**
Course Code: P23MAN21	**Total Credits: 4**

Pre-Requeste: Under graduate level statistics.

Objectives:

- Statistics deals with all sciences such as Biology, Zoology, Education, Economics, Planning, Industry, Medical Sciences, an Index Number is widely used Statistical device for comparing the level of a certain phenomenon with the level of same phenomenon at some standard period.

Course Outcomes:
On completing this course, students can/are

COs	CO Statements
CO1:	Understand the concept of statistical inference by testing hypothesis.
CO2:	Apply t-test for small samples.
CO3:	Understand the concept of control chart, types of control chart.
CO4:	Learn the construction of index numbers and uses of index numbers.
CO5:	Utilize the concept of time series to fit a given straight line and parabola.

Unit I Statistical Inference [12 Hours]

Introduction-Procedure of testing hypothesis-standard error and sampling distribution-estimation (P.No : 881-894).

Unit II Test of significance for small samples [12 Hours]

Student's t-distribution-To test the significance of the mean of a random sample-Testing difference between means and two samples (independent)-Testing difference between means and two samples (dependent samples) - (P.No:910-923) (exercise problems not included)
Illustration-28,29,30,31,32,33,34,35,36,37.

Unit III Statistical Quality Control [12 Hours]

Introduction-Control charts-x charts-R charts-Control charts for c(no. of defects per unit)-control chart for *p*(Fraction Defective). (P.No:1051-1072)(exercise problems not included). Illustration-1,2,3,4,5,6,7,8,9,10,11,12.

Unit IV Index Numbers [12 Hours]

Introduction-Uses of index numbers-problems in the construction of index numbers-Weighted Aggregative Indices(P.No:515-522 & 529-534). Illustration-5,6,7(Exercise problems not included).

Unit V Analysis of Time Series [12 Hours]

Introduction-Time series defined-utility of time series-Components of time series-Preliminary adjustment before analyzing time series-Method of least squares-Fitting straight line trend-Second degree parabola.(P.No:589-600 & 613-622). Illustration-10,11,12,13,14(Exercise problems not included)

Text Book(s):

1. S.P.Gupta, Statistical Methods, Thirty-Seventh Revised Edition 2008, Sultan Chand & sons

Reference Book(s):

1. K.Alagar, Business Mathematics, Tata McGraw Hill company.
