Course Name: Bachelor of Science
Discipline : Mathematics
(Those who join in 2022 and after)

III year B.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
V	Core 7	**Theory of Numbers**	6	4	25+75=100	✔	✔	✔	✔					✔	✔	✔	**U24MAC51**	**New**
	Core 8	Linear Algebra and Matrices	5	4	25+75=100	✔	✔	✔	✔					✔	✔	✔	U2MAC52/ **U24MAC52**	No Change
	Core 9	**Real Analysis**	5	4	25+75=100	✔	✔	✔	✔					✔	✔	✔	**U24MAC53**	**New**
	Allied 7	**Graph Theory**	5	5	25+75=100	✔	✔	✔	✔					✔	✔	✔	**U24MAA51**	**New**
	Elective 1	Linear Programming	5	5	25+75=100	✔	✔	✔	✔					✔	✔	✔	U3MAE51/ **U24MAE51**	No Change
	SBE - 4	**Employability Skills**	2	1	25+75=100	✔	✔	✔	✔					✔	✔	✔	**U24PS51**	**New**
	NME - 1	Fundamentals of Mathematics	2	2	25+75=100	✔	✔	✔	✔					✔	✔	✔	U3MAN51/ **U24MAN51**	No Change
	Total		**30**	**25**														
VI	Core 10	**Complex analysis**	6	5	25+75=100	✔	✔	✔	✔					✔	✔	✔	**U24MAC61**	**Revised 10%**
	Core 11	**Probability and Statistics**	6	5	25+75=100	✔	✔	✔	✔					✔	✔	✔	**U24MAC62**	**New**
	Core 12	**Operations Research**	6	5	25+75=100	✔	✔	✔	✔					✔	✔	✔	**U24MAC63**	**Revised 20%**
	Allied 8	Project work	6	5	100+0=100	✔	✔	✔	✔					✔	✔	✔	U1MA6PR/ **U24MA6PR**	No Change
	SBE - 5	Transformation Techniques	2	2	25+75=100	✔	✔	✔	✔					✔	✔	✔	U3MAS61/ **U24MAS61**	No Change
	SBE - 6	**Basics of Statistics**	2	2	25+75=100	✔	✔	✔	✔					✔	✔	✔	**U24MAS62**	**New**
	NME - 2	Statistics and Operations Research	2	2	25+75=100	✔	✔	✔	✔					✔	✔	✔	U2MAN61/ **U24MAN61**	No Change
	Total		**30**	**26**														

Self-Learning Course:

Subject	Credit	Ext =Tot	Subject Code
Advanced Programming Techniques	5	100 = 100	U1MASL51

SEMESTER V
Core 7: Theory of Numbers

Credit: 4 **Subject Code: U24MAC51**
Contact Hours per week: 6 **Contact Hours per semester : 90**

Course Objectives:

1. To acquire knowledge of the theory of divisibility and primes.
2. To understand the concept of theory of congruence.
3. To analyze some familiar number theoretic functions.
4. To become familiar with some interesting special numbers.
5. To be able to solve non linear Diophantine equations.

Course Outcomes:
Upon completion of the course, the students will be able to

CO1: Explain the importance of prime numbers and their properties.
CO2: Analyze the divisibility algorithm and the Euclidean algorithm.
CO3: Determine solutions of linear congruence using Chinese remainder theorem.
CO4: Construct Fibonacci sequence and many identities involving Fibonacci numbers.
CO5: Examine and develop many relationships among the number theoretic functions.
CO6: Solve non-linear Diaphantine equations.

Unit I – Divisibility theory and Primes (18 hours)

The division algorithm – the greatest common divisor – the Euclidean algorithm – the Diophantine equation $ax + by = c$ – the fundamental theorem of arithmetic – the sieve of Eratosthenes – the Goldbach conjecture.

Unit II – The theory of congruences and Fermat's theorem (18 hours)
Basic properties of congruence – Binary and decimal representation of integers – Linear congruence and the Chinese remainder theorem – Fermat's little theorem and the pseudo primes – Wilson's theorem.

Unit III – Number – theoretic functions and special numbers (18 hours)

The sum and the number of divisors – the Mobius inversion formula – the great integer function – an application to the calendar –perfect numbers – Mersenne primes and amicable numbers – Fermat numbers.

Unit IV – Fibonacci numbers and continued fractions (18 hours)

The Fibonacci sequence – certain identities involving Fibonacci numbers – Finite continued fractions

Unit V – Sum of squares and non linear Diophantine equations (18 hours)

Sum of two squares – sum of more than two squares – the equation $x^2 + y^2 = z^2$ – Fermat's last theorem.

Text Book :

- David M. Burton, Elementary number theory (Sixth Edition), McGraw Hill – Boston – 2007.

  Unit – I: Sections 2.2 – 2.5, 3.1 – 3.3
  Unit – II: Sections 4.2 – 4.4, 5.2 – 5.3
  Unit – III: Sections 6.1 – 6.4, 11.2 – 11.4
  Unit – IV: Sections 14.2 – 14.3, 15.2
  Unit – V: Sections 12.1 – 12.2, 13.2 – 13.3

References:

1. Tom. Apostol, Introduction to Analytic number theory, Springer International Student Edition,1998
2. Ivan Niven, H.S. Zuckerman and H.L.Montgomery, An Introduction to the theory of numbers (Fifth Edition), John Wiley & sons, Inc., New York, 2006.
3. G.H.Hardy and E.M.Wright, An introduction to the theory of numbers (Sixth Edition), Oxford University Press, 2009.
4. G.A.Jones and J.M.Jones, Elementary number theory, Springer – Verlag, 2005.

William A. Stein, Elementary number theory, Springer, 2009.

Core 8: Linear Algebra and Matrices

Credits: 4 **Subject Code:** U2MAC52/ **U24MAC52**
Contact Hours: 5/week **Contact Hours: 75 / Semester**

Objectives:

- To introduce the basic concepts of Vector spaces and linear transformations.
- To introduce the concept of Matrices and its eigen values; eigen vectors and its basic properties

COURSE OUTCOMES:

In this course the students will

CO1: Gain knowledge about the basic concepts of vector spaces and linear transformations.

CO2: Know the relationship between matrices and linear transformations.
CO3: Become familiar with the rank of the matrices.
CO4: Have thorough acquaintance with eigen values and eigen vectors.

UNIT-I :- **(15 hours)**
Introduction on vector spaces - Definitions – Subspaces - Linear Transformations – Kernel– Span of a set – linear span.

UNIT- II: - **(15 hours)**
Basic concepts of linear independence - Theorems – Basis & Dimension – Maximal linear independent set - rank and nullity – singular linear transformations.

UNIT – III: - **(15 hours)**
Inner Product Space – norm – orthogonality – orthogonal complements.

UNIT – IV: - **(15 hours)**
Theory of matrices – Algebra of matrices - Elementary transformations - rank – simultaneous linear equations – Cayley Hamilton theorem.

UNIT – V: **(15 hours)**
Eigen values and eigen vectors.

TEXT BOOKS:

- **Aumugarm. S and Issac A. T.,** Modern Algebra, SciTech publications (2006).
  UNIT – I: Chapter 5: 5.1 – 5.4
  UNIT – II: Chapter 5: 5.5 – 5.7
  UNIT – III: Chapter 6: 6.1 – 6.3
  UNIT – IV: Chapter 7: 7.1 – 7.6
  UNIT – V: Chapter 7: 7.7 – 7.8

REFERENCE BOOKS:

1. Grossman, Introduction to Linear Algebra, Saunders College Pub. – 1994.
2. David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007

Core 9: Real Analysis

Credits: 4 **Subject Code: U24MAC53**
Contact Hours: 5/week **Contact Hours: 75 / Semester**
Objectives:

- To introduce the concept of countable sets, metric spaces and its importance.
- To learn the concept of open sets, closed sets, compact sets and connected sets in metric spaces.
- To learn the essence of completeness of a metric space and to introduce the concept of continuity between metric spaces.
- To introduce the notion of homeomorphism between metric spaces and uniform continuity.

Course Outcomes:

On successful completion of this course, a student will be

CO1:	Able to identify the important properties of a non-empty subset of a metric space.
CO2:	Able to apply the concept of continuity in real life problems.
CO3:	Able to figure out similarities (in the sense of homeomorphism) among the metric spaces
CO4:	Able to apply the theory to identify the complete metric spaces and make use of these spaces directly or indirectly to the real life problems.
CO5	Able to demonstrate the class of compact subsets of R and its applications and the concept of uniform continuity

Unit I: **(15 hours)**

Equivalence, countability – Real numbers – Least upper bounds - Limit of a function on the real line – Metric spaces.

Unit II: **(15 hours)**

Limits in metric spaces – Functions continuous at a point on the real line – Reformulation – Functions continuous on a metric space – Open sets.

Unit III: **(15 hours)**

Closed sets – Discontinuous functions on R – More about open sets.

Unit IV: **(15 hours)**

Connected sets – Bounded sets and totally bounded sets – Complete metric spaces.

Unit V: **(15 hours)**

Compact metric spaces – Continuous functions on compact metric spaces – Continuity of inverse function – Uniform continuity.

Text Book:

- Richard R. Gold berg, Methods of Real Analysis, Oxford & IBH Publishing Company, New Delhi.
  Unit I: Chapter1: Sections 1.5, 1.6, 1.7; Chapter4: Sections: 4.1, 4.2
  Unit II: Chapter4: Section 4.3; Chapter5: Sections 5.1, 5.2, 5.3, 5.4
  Unit III: Chapter5: Sections 5.5, 5.6; Chapter6: Section 6.1
  Unit IV: Chapter6: Sections 6.2, 6.3, 6.4
  Unit V: Chapter6: Sections 6.5, 6.6, 6.7, 6.8

Reference Books:

1. D.Soma Sundram & B.Choudhary, A First course in Mathematical Analysis, Narosa Publishing House, Chennai
2. Modern Analysis, S. Arumugam and A. Thanga Pandi Isaac. New Gamma Publishing House, Palayamkottai, 2017
3. Mathematical Analysis, 5th Edition, S.C. Malik, Savita Arora, New Age International Publishers, India, 2017.

Allied 7: Graph Theory

Credits: 5 **Subject Code: U24MAA51**
Contact Hours: 5/week **Contact Hours: 75 / Semester**

OBJECTIVES:

i) To understand the concepts of graph theory.

COURSE OUTCOMES :

In this course the students will

CO1: Gain the knowledge & the basic concepts of graph theory.

CO2: Master the ways & solving real life problems using graph models.

CO3: Develop the ability to apply various graph concepts in solving the challenging problems in real life.

CO4: Possess the Knowledge & various important conjectures and established theorems in graph theory.

UNIT –I : Graphs (15hrs)

Definition and examples – Degrees- Subgraphs- Isomorphism-Independent sets and Coverings-Matrices- Operations on graphs.

UNIT – II: Connectedness, Eulerian and Hamiltonian graphs (15hrs)

Walks-Trails and Paths-Connectedness and Components-Connectivity-Eulerian graphs-Hamiltonian graphs.

UNIT –III : Tree (15hrs)

Characterisation of trees-Centre of a tree.

UNIT –IV :Planarity and Matching (15hrs)

Matchings - Matchings in bipartite graphs- Definition and properties-Euler's formula.

UNIT – V: Colorability (15hrs)

Chromatic number and chromatic index-The five colour theorem -Chromatic polynomials-Definition and basic properties.

TEXT BOOKS:

- **S.Arumugam and S.Ramachandran,** Invitation to graph theory, Scitech publications, Chennai(2001)
  UNIT I:Sections 2.1-2.4, 2.6-2.9
  UNIT II: Sections 4.1,4.2, 4.4, 5.1, 5.2
  UNIT III: Sections6.1, 6.2,
  UNIT IV: Sections 7.1,7.2, 8.1
  UNIT V: Sections 9.1,9.2, 9.4

REFERENCE BOOKS:

1) **S.A.Choudum,** A first course in graph theory, Macmillan India Ltd, New Delhi(1987).
2) **K.R.Parthasarathy,** Basic graph theory, Tata McGraw.Hill Publishing Co.Ltd NewDelhi (1994).

Elective 1-Linear Programming

Credits: 5 **Subject Code:** U3MAE51/ **U24MAE51**
Contact Hours: 5/week **Contact Hours: 75 / Semester**

Course Outcomes:
For a student who learned this course will be

CO1: Getting the ability of converting the real life problems in to a LPP and apply the techniques of LPP to solve the problems.
CO2: Able to apply the methods of optimization, viz., simplex method, Big-m method to solve the real life problems.
CO3: Getting the idea of transporting the goods from source to destination at minimum cost.
CO4: Able to assign the jobs optimally to more suitable persons/machines so as to reduce the total working hours which in turn yields a maximum profit.
CO5: Realize the mathematical background of each and every industry as a part of the industrial visit.

Objectives:

- To enable the students to formulate real world problems in to suitable LPP
- To understand the types of solution of LPP and techniques of solving an LPP
- To get clear understanding of transportation problem and its optimal solution
- To use assignment problem to the real life problems for finding optimal assignments.

Unit-I: (15 hours)

Linear Programming Problem-Mathematical Formulation: Introduction-Linear programming problem-Mathematical formulation of the problem-Illustrations on mathematical formulation on LPPs.

Unit-II: (15 hours)

Linear Programming Problem-Graphical Solution and Extension: Introduction-Graphical solution method-Some Exceptional cases-General linear programming problem-Canonical and standard forms of L.P.P. **Linear Programming Problem-Simplex Method:** Introduction - The computational procedure (The simplex algorithm and problems)

Unit-III: (15 hours)

Linear Programming Problem-Simplex Method (contd..): - Use of artificial variables: Big-M method only-Solution of simultaneous linear equations – Inverting a matrix using simplex method.

Unit-IV: (15 hours)

Transportation Problem: Introduction-LP formulation of the transportation problem-Existence of solution in T.P-The transportation table-Loops in transportation tables-Finding an IBFS-Test for optimality-Degeneracy in transportation problem-Transportation algorithm (MODI method) – Stepping stone solution method.

Unit-V: (15 hours)

Assignment Problem: Introduction-Mathematical Formulation of the assignment problem-Solution methods of assignment problem-Special cases in assignment problem-A typical assignment problem.

NOTE: For all the units marked with *, one or more industrial visits may be organized by the Faculty member(s). This will enable the students to understand more about the course contents in relation to real life.

Text Book :

- **Kanti swarup, P.K. Gupta, Man Mohan,** Operations Research, 19th Edition (Reprint 2018), Sultan Chand and Sons Educational Publishers, New Delhi.

Unit –I: Chapter 2 - Sections 2.1 to 2.4.
Unit-II: Chapter 3 - Sections 3.1 to 3.5 and Chapter 4: Section 4.1 and 4.3.
Unit-III: Chapter 4 - Sections 4.4 (Big-M method only), 4.6, 4.7.
Unit-IV: Chapter 10 – Sections 10.1, 10.2, 10.3, 10.5, 10.6, 10.9, 10.10, 10.12, 10.13, 10.14.
Unit-V: Chapter 11 – Sections 11.1, 11.2, 11.3, 11.4, 11.5.

Reference Books :

1. **V.Sundaresan, K.S.Ganapathy,** Resource Management Techniques
2. **Subramanian, K.Ganesan**, Operations Research, A.R.Publications
3. **S.Arumugam,** Operations Research**,** New Gamma Publications

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EMPLOYABILITY SKILLS

Course Title : Employability Skills	**Total Hours : 30 Hours**
Course Code : U24PS51	**Total Credits : 1**

COURSE OUTCOMES:

On completing this course, students can/are able to

Cos	CO STATEMENT
CO1:	enhance their skills in solving quantitative aptitude problems
CO2:	expertise themselves in solving verbal and non-verbal reasoning problems.
CO3:	prepare for various public and private sector exams and placement drives.
CO4:	interpret the concepts of LOGICAL REASONING Skills.
CO5:	analyze the problems logically and approach the problems in a different manner

Unit I: Quantitative Aptitude – I **6 Hours**

H.C.F. and L.C.M. of Numbers - Average - Percentage - Profit and Loss - Ratio and Proportion - Time and Work - Time and Distance - Train Speed.

Unit II: Quantitative Aptitude – II **6 Hours**

Area related problems - Problems on Ages - Boat and Stream - Simple Interest - Compound Interest – True discount – Calendar – Clocks - Data Interpretation - Bar Graphs - Pie Chart.

Unit III: Verbal Reasoning – I **6 Hours**

Analogy - Classification – Series - Coding & Decoding - Coded inequality - Blood relations - Direction sense test.

Unit IV: Verbal Reasoning – II **6 Hours**

Number Test - Ranking and Time Sequence Test - Seating arrangements - Alphabet Test - Logical Venn Diagram.

Unit V: General Knowledge **6 Hours**

Abbreviations & Acronyms - Famous Personalities - Important Days (National & International) - Capital Cities and Currencies – Current affairs - Sports – RBI & Banking Terms – Basics of Computers and Internet.

Reference Books:

1. R.S.Agarwal, Quantitative Aptitude for Competitive Examinations, S Chand Publishing company; Revised edition (21 February 2017).
2. R.S.Agarwal, A modern approach to logical reasoning, S Chand Publishing company; August 2022.
3. R.S.Agarwal, A Modern Approach To Verbal Reasoning (Old Edition), S Chand Publishing company.
4. R.S.Agarwal, Advanced objective general knowledge revised edition, S Chand Publishing company, 2017.

e-Resources:

1. https://www.cuemath.com/numbers/hcf-and-lcm/
2. https://www.geeksforgeeks.org/speed-time-distance-formula-and-aptitude-questions/
3. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://cdn1.byjus.com/wp-content/uploads/2020/06/Boat-Stream-Sample-Questions.pdf
4. https://www.hitbullseye.com/Simple-Interest-and-Compound-Interest.php
5. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://examsdaily.in/wp-content/uploads/2018/09/br.pdf
6. https://testbook.com/objective-questions/mcq-on-direction-and-distance--5eea6a0e39140f30f369e42a
7. https://unacademy.com/content/cat/study-material/data-interpretation-and-logical-reasoning/ranking-and-time-sequence/
8. https://www.toppr.com/guides/computer-aptitude-and-knowledge/basics-of-computers/basic-computer-terminology/

NME-1: Fundamentals of Mathematics

Credits: 2 **Subject code:** U3MAN51/ **U24MAN51**
Contact Hours: 2/week **Contact Hours: 30 / Semester**

Objectives:

- ♦ To lay the foundation in the basic principles of Mathematics

COURSE OUTCOMES:

In this course the students will
CO1: Classify different types of equations and solve them.
CO2: Be able to define sequence of numbers and understand progression as sequence.
CO3: Study different types of progressions and thereby study Arithmetic and Geometric means.
CO4: Understand the notion of set and describe different types of sets.
CO5: Possess the knowledge of Matrix and write down different types of matrices.
CO6: Perform algebra of Matrices.

Unit I: Equation (6 hours)

Equations- Linear equations- Simultaneous Equations- Quadratic Equations- Simultaneous Equations-Linear and Quadratic equations (Examples only).

Unit II: Progression (6 hours)

Sequence of Numbers- Arithmetic Progression- Geometric Progression- Arithmetic mean and Geometric Mean. (Examples only)

Unit III: Theory of Sets (6 hours)

Sets-Representation of Sets- Finite and Infinite Sets-Sub-sets- Properties of subsets-Universal Sets-Venn Diagrams- Set Operation- Properties of set Union and Intersection. (Examples only).

Unit IV: Matrix (6 hours)

Introduction-Matrices-Types of Matrices- Algebra of Matrices. (Examples only).

Unit V: Differential Calculus (6 hours)

Derivatives-Differential Coefficients-$u \pm v$ form, uv form, u/v form (Examples only).

Text Book:

- **G.K Ranganth, C.S. Sampangiram, Y. Rajaram**, Business Mathematics, Himalaya Publishing House-2006.

  Unit: I chapter 4 section 4.1 to 4.5
  Unit: II chapter 6 section 6.1to 6.4
  Unit: III chapter 7 section 7.1 to 7.10
  Unit: IV chapter 8 section 8.1 to 8.4
  Unit: V chapter 11 section 11.9 and 11.10

Reference Book:

- **Dr. M. Manoharan, Dr. C. Elango, Prof. K. L. Eswaran**, Business Mathematics, Palani Paramount Publications-2007.

SEMESTER VI
Core 10: Complex Analysis

Credits: 5 **Subject code : U24MAC61**
Contact Hours: 6/week **Contact Hours: 90 / Semester**

Objectives:

To enable the students to understand that the study of complex Analysis is an essential background for Mathematicians, Physicists and other Scientists and to acquire a good knowledge of Analytic Functions in terms of Power series approach, differentiability approach and the Geometric approach and Perceive them all as unified.

COURSE OUTCOMES :

In this course the students will

CO1: Demonstrate the idea of the Complex number system and work with arithmetic of complex numbers.

CO2: Acquire a good knowledge of analytic functions in terms of power series approach, differentiability approach and the geometrical approach.

CO3: Identify many important applications of line integrals and curve integrals by recalling Green's theorem, Stoke's theorem and Gauss Divergence theorem from vector calculus.

CO4: Know the importance of improper integrals and the application of "Contour integration".

CO5: Understand main ideas behind the elementary transformations like translation, rotation, homothetic transformation and inversion in transforming regions in the complex plane.

Unit I: **(18 hours)**

The Extended Complex plane – Limits – Continuous Function – Differentiability – The Cauchy – Riemann equations – Analytic function – Harmonic functions.

Unit II: **(18 hours)**

Bilinear Transformations – Cross ratio – Fixed points of Bilinear transformations – Some Special Bilinear Transformations: The real axis onto itself- The unit circle onto itself-The real axis onto the unit circle.

Unit III: **(18 hours)**

Definite Integral – Cauchy's Theorem – Cauchy's Integral Formula – Higher Derivatives.

Unit IV: **(18 hours)**

Taylor's Series – Laurent's Series – Zeros of an Analytic function – Singularities.

Unit V: **(18 hours)**

Residues – Cauchy's Residue theorem – Argument theorem, Rouche's Theorem, Fundamental Theorem of Algebra – Evaluation of Definite Integrals.

Text Book:

- **S.Arumugam, T.ThangaPandi Isaac and A.SomaSundram,** Complex Analysis, Scitech Publications (India) Pvt. Ltd., Chennai – (June 2004)

Unit I-Chapter 1 (Section 1.9) Chapter 2 (Sections 2.2, 2.4, 2.5, 2.6, 2.7, 2.8)
Unit II-Chapter 3 (Sections 3.2, 3.3, 3.4, 3.5)
Unit III-Chapter 6 (Full)
Unit IV-Chapter 7 (Full)
Unit V-Chapter 8 (Full)

Reference Books:

1. **T.K.Manicavachagam Pillai & Others,**Complex Analysis, S.Viswanathan (Printers and Publishers) Pvt. Ltd., Chennai.
2. **P.DuraiPandian and Others,** Complex Analysis, Emerald Publishers, Chennai.
3. **James Ward Brown, Ruel V. Churchill,** Complex Variables and Applications, 8th Edition, McGraw-Hill Company, New Delhi, 2009.

Core 11 -Probability and Statistics

Credits: 5 **Subject Code : U24MAC62**
Contact Hours: 6/week **Contact Hours: 90 /Semester**

Objectives:

- To introduce the theoretical background for the theory of probability.
- To Introduce various special types of probability distributions and sampling techniques
- To impart the knowledge of test of hypothesis, Goodness of fit and Analysis of variance.

Course Outcome:

A successful completion of this course the student

CO1	Can understand the basics of probability, theorems on probability and expected value.
CO2	Is able to calculate probabilities, and derive the marginal and conditional distributions of various theoretical distributions.
CO3	Can understand and discuss the issues/significance in the framed hypothesis based on the Samples
CO4	Can understand the Chi-Square Test and fit its goodness.
CO5	Is able to translate real-world problems into probabilistic models and critically evaluate the underlying assumptions of analysis tools.

Unit I: Introduction-Importance of the Concept of Probability-Calculation of Probability-Theorems of Probability- Conditional Probability- Bayes' Theorem- Mathematical Expectation.

Unit II: Introduction- Binomial Distribution-Multinomial Distribution-Negative Binomial Distribution - Poisson Distribution -Hypergeometric Distribution -Normal Distribution.

Unit III: Introduction - Procedure of Testing Hypothesis -Standard Error and Sampling Distribution -Estimation - Test of Significance for Attributes - Test of Significance for Large Samples -Test of Significance for Small Samples.

Unit IV: Introduction - χ^2Defined - Conditions for Applying χ^2 Test - Yates' Corrections - Uses of χ^2 Test - Additive Property of χ^2 - Chi-Square Test for Specified Value of Population Variance.

Unit V: The F-Test or the Variance Ratio Test – Assumptions in F-Test- Applications of F-Test - Analysis of Variance - Assumptions in Analysis of Variance - Technique of Analysis of Variance - Analysis of Variance in Two-Way Classification Model.

Text Book :

1.S.P Gupta, Statistical Methods, Sultan Chand & Sons(37th Revised Edition, 2008)

Unit I: Volume II- Chapter 1
Unit II : Volume II- Chapter 2
Unit III : Volume II- Chapter 3
Unit IV: Volume II- Chapter 4
Unit V : Volume II- Chapter 5

Reference Book(s):

1. Statistics by S.Arumugam and Isaac., New Gamma Publishing house.
2. S.C.Gupta, V.K.Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons

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Core 12- Operations Research

Credits: 5 **Subject Code : U24MAC63**
Contact Hours: 6/week **Contact Hours: 90 / Semester**

Objectives

- To impart the knowledge of formulation of practical problems using the linear programming method
- Impart comprehensive knowledge and understanding of sequencing, replacement, game theory and network problems
- This course aims in providing the students with a rigorous framework with which to model and analyze queuing systems.
- The course is aims to provide deep understanding of the theory and concepts of various scheduling problems in the area of operations research

Course Outcome:

Students completing this course will be able to:

CO1:	Identify and develop operations research models from the verbal description of the real
CO2:	Understand the mathematical tools that are needed to solve optimization problems
CO3:	Apply the knowledge of game theory concepts to articulate real-world decision situations for identifying, analyzing, and practicing strategic decisions to counter the
CO4:	Demonstrate solution methods including graphs and linear programming to analyze and solve the Two-person, zero-sum games
CO5:	Know the fundamental concepts of Operations Research.
CO6:	Develop mathematical models associated with network problems and find critical path analysis for an optimum solution

Unit -I: **(18 hours)**

Sequencing: Problem of sequencing-basic terms used in sequencing-processing n jobs through 2 machines- processing n jobs through k machines- processing 2 jobs through k machines.

Unit-II: **(18 hours)**

Games and strategies: Introduction-Two person zero-sum games-some basic terms-the maximin-minimax principle - games without saddle points-mixed strategies-graphic solutions of $2 \times n$ & $m \times 2$ games dominance property-arithmetic method for $n \times n$ games-general solution of $m \times n$ rectangular games.

Unit-III: **(18 hours)**

Replacement problem: Replacement of equipment/asset that deteriorates gradually-replacement of equipment that fails suddenly.

Unit IV: **(18 hours)**

Inventory Control-I: Introduction – Types of inventories – Reasons for carrying inventories – The inventory decisions – Objectives of scientific inventory control – Costs associated with inventories – Factors affecting inventory control – An inventory control problem – The concept of EOQ – Deterministic inventory problems with no shortages.

Unit-V: **(18 hours)**

Network scheduling by PERT/CPM: Introduction-Network and basic components-logical sequencing- rules for network constructions-concurrent activities-critical path analysis.

Text Book :

- **Kanti swarup, P.K. Gupta , Man Mohan,** Operations Research, 19th Edition (Reprint 2018), Sultan Chand and Sons Educational Publishers, New Delhi.

  Unit –I: Chapter 12 - Sections 12.1 to 12.6 .

  Unit-II: Chapter 17 - Sections 17.1 to 17.9.

  Unit-III: Chapter 18 - Sections 18.1 to 18.3.

  Unit-IV: Chapter 19 – Sections 19.1 to 19.10.

  Unit-V: Chapter 25 – Sections 25.1 to 25.6.

Reference Books :

1. **V.Sundaresan, K.S.Ganapathy,** Resource Management Techniques
2. **Subramanian, K.Ganesan**, Operations Research, A.R.Publications
3. **S.Arumugam,** Operations Research**,** New Gamma Publications

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Project work

Credits: 5 **Subject Code :** U1MA6PR/ **U24MA6PR**
Contact Hours: 6/week **Contact Hours: 90 / Semester**

Course Outcomes:

Upon successful completion of this project work the student:

- Will get a little exposure to the field of research in mathematics.
- Able to convert a real life problem into a mathematical model and solve it by mathematical skills.
- Able to frame the hypothesis, derivations and conclusions of their mathematical model.
- Will familiarize about various applications of mathematics.

Guidelines:

- The maximum marks for the project work shall be 100.
- There shall be single internal valuation only.
- Students are encouraged to work on the topic of their own interest or shall do a project in the field of Differential equations, Statistics, Numerical methods, graph theory, fuzzy mathematics, image processing, mathematical analysis, etc., under the supervision of a faculty member.
  The report of the project shall be in about 35-40 pages with works cited properly.

SBE – 5: Transformation Techniques

Credits: 2 **Subject Code :** U3MAS61/ **U24MAS61**
Contact Hours: 2/week **Contact Hours:30 / Semester**

Objectives

- This course aims to introduce the concept of transforms and transform techniques to solve the difference as well as differential equations.
- Introduce the concept of Fourier series to represent and hence to handle complicated functions which arouse naturally in terms of known sine and cosine functions
- Enable the students to know more on applications of integral transform and Fourier series.

Course Outcome:

CO1:	Understand and apply Z Transforms techniques.
CO2:	Solve the finite difference problems using Z transforms.

CO3:	Write the Fourier series of functions which arouse naturally in real world problems.
CO4:	Apply the techniques of Fourier transform to solve the differential equations.

Unit – I

Z Transforms – Definition – Proprieties – Z Transforms of some basic functions – Problems.

Unit – II

Inverse Z Transforms – Methods to find the inverse Z Transform – Use of Z – Transforms to solve finite Difference Equations – problems.

Unit – III

Fourier Series – Definition – even and odd functions.

Unit – IV

Half range Fourier Series – problems – Change of interval- (Harmonic analysis not included)

Unit – V

Fourier Transforms – Properties of Fourier Transform — Fourier sine and cosine Transforms – properties – Parsevals Identity - Problems – Convolution theorem (Worked out examples only)

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Text Books:

1. Engineering Mathematics 3rd Edition by T.Veerarajan, Tata McGraw Hill Publishing Company Limited, New Delhi.
2. Calculus Volume III by S.Narayanan and T.K.ManicavachagomPillay, S.Viswanathan (Printers & Publishers) Pvt. Ltd., 2014.

Unit I	Text Book 1: Chapter 7 sections 7.1 to 7.23
Unit II	Text Book 1: Chapter 7 sections 7.26 to 7.40
Unit III	Text Book 2: Chapter 6 sections 1 to 3
Unit IV	Text Book 2: Chapter 6 sections 4 to 7
Unit V	Text Book 2: Chapter 6 sections 9 to 12

Book for Reference:

1. Transforms and Partial Differential Equations by Dr.A.Singaravelu, Meenakshi Agency, Chennai

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SBE-6: Basics of Statistics

Credits: 2 **Subject Code: U24MAS62**

Contact Hours: 2/week **Contact Hours: 30/ Semester**

Objectives:

- To introduce the fundamental concepts of measures of dispersion.

- Introduce the concept of correlation and regression.
- Learn about the concept of Index numbers and to understand the analysis of time series

COURSE OUTCOMES:

Upon successful completion of this course, students are able to
CO1: Demonstrate about the measures of dispersion including mean deviation and standard deviation.
CO2: To analyze the correlation and regression between the set of data.
CO3: To compare the level of certain phenomenon with the level of the same phenomenon at some standard period.
CO4: Develop the attitude of analyzing the series of values of a variable over a period of time.

Unit-I : Measures of Dispersion: Measures of Dispersion-Moments-Skewness and kurtosis **(6 hours)**

Unit-II : Correlation: Correlation and Rank Correlation **(6 hours)**

Unit-III : Regression and Principle of Least Squares: Regression, Fitting a straight line(parabola omitted) **(6 hours)**

Unit-IV : **Index Numbers**: Index Numbers-Consumer Price Index numbers. (Cost of Living Index numbers) **(6 hours)**

Unit-V: Analysis of Time Series
Time Series-Components of Time series-Measurement of Trends **(6 hours)**

Text Book:

- Statistics by S.Arumugam and Isaac., New Gamma Publishing house.(July 2013)

  Unit I-Chapter 3(3.1) and Chapter 4(4.1,4.2)
  Unit II-Chapter 6 (6.1,6.2)
  Unit III-Chapter 6 (6.3) Chapter 5 (5.1)
  Unit IV-Chapter 9 (9.1,9.2)
  Unit V-Chapter 10(10.1,10.2,10.3)

Reference Book(s):

- S.P Gupta, Statistical Methods, Sultan Chand & Sons(37th Revised Edition, 2008)
  S.C.Gupta, V.K.Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons.

NME 2 - Statistics and Operations Research

Credits: 2 **Subject code :** U2MAN61/ **U24MAN61**
Contact Hours: 2/week **Contact Hours: 30 / Semester**

Course Outcomes:
Upon completion of this course, students are

CO1:	Able to apply mean, median and mode concepts in real life problems.
CO2:	Getting the ability of analyzing the economic problems using index numbers.
CO3:	Able to apply the optimization techniques in real life situations.
CO4:	Getting the ability of converting the real life problems in to a LPP and apply the techniques of LPP to solve the problems.
CO5:	Getting the idea of transporting the goods from source to destination at minimum cost.

Objectives:

- To develop the ability of understanding statistical concepts.
- To apply the Linear Programming techniques to solve practical problems

Unit I: Mean—Median—Mode **(6 hours)**

Unit II: Index numbers— simple aggregate method --Weighted index numbers—Laspeyre's ,Paasche's, Fisher's ideal Index numbers, Marshall-Edgeworth and Kelly's method. **(6 hours)**

Unit III: Operations Research : Introduction—definition—modeling in OR—General solution methods for OR models—scientific method in OR—Applications of OR. **(6 hours)**

Unit IV: Mathematical formulations of LPP –Graphical solutions of LPP—General LPP—Canonical and standard forms of LPP. **(6 hours)**

Unit V: LP formulations of Transportation Problem – Existence of solution in TP – Initial Basic Feasible Solution of Transportation problem using North West Corner Rule, Matrix minima method, Vogels Approximation methods **(6 hours)**

Text Books:

1. R.S.N.Pillai, Bagavathi, Statistics S.Chand & company Ltd., edition 2008 [For Units I, II]
2. Kanti Swarup, P.K.Gupta, Man Mohan, Operations Research, Sultan chand and sons, 12th revised edition. [For Units III, IV and V]

Reference Books:

1. S.P.Gupta, Statistical Methods,Sultan Chand & Sons (37^{th} Revised Edition , 2008)
2. V. K. Kapoor, Operations Research, Sultan Chand & Sons.
