Anekant Education Society's
TuljaramChaturchand College of Arts, Science and Commerce, Baramati
Autonomous
Course Structure for B.Sc. Mathematics
T.Y.B.Sc Mathematics

Semester	Paper Code	Title of Paper	No. of Credits
V	MAT3501	Metric Spaces	3
	MAT3502	Real Analysis I	3
	MAT3503	Problem Course based on MAT3501 &MAT3502	2
	MAT3504	Group Theory	3
	MAT3505	Ordinary Differential Equation	3
	MAT3506	Problem Course based on MAT3504 &MAT3505	2
	MAT3507	Operation Research	3
	MAT3508	Number Theory	3
	MAT3509	Practical based on MAT3507 &MAT3508	2
VI	MAT3601	Complex Analysis	3
	MAT3602	Real Analysis II	3
	MAT3603	Problem Course based on MAT3601 & MAT3602	2
	MAT3604	Ring Theory	3
	MAT3605	Partial Differential Equation	3
	MAT3606	Problem Course based on MAT3604 & MAT3605	2
	MAT3607	Optimization Techniques	3
	MAT3608	Lebesgue Integration	3
	MAT3609	Practical based on MAT3607 & MAT3608	2
	MAT3610	Project	2

SYLLABUS (CBCS) FOR T. Y. B. Sc. MATHEMATICS
(w.e.f. June, 2021)

Academic Year 2021-2022

Class : T.Y. B. Sc. (Semester- V)
Paper Code:MAT3501
Paper : I **Title of Paper :**Metric Spaces
Credit : 3 **No. of lectures:** 48

A) Learning Objectives:

- Understand basic definitions with various examples.
- Cauchy sequence and understand which metric spaces are complete.
- Understand metric properties such as connectedness and compactness
- To develop analytical thinking of students toward higher mathematics.

B) Learning Outcome: It will create a skill of understanding which spaces are homeomorphic. This subject will develop a platform for subjects like Topology and Manifolds in postgraduate mathematics.

TOPICS/CONTENTS:

Unit 01: Basic Concepts [*8 Lectures*]

- Inequalities
- Metric Spaces
- Sequences in Metric Spaces
- Cauchy Sequences
- Completion of a Metric Space

Unit 02: Topology of a Metric Space [*8Lectures*]

- Open and Closed Sets
- Relativisation and Subspaces
- Countability Axioms and Separability
- Baire's Category Theorem

Unit 03: Continuity [*10 Lectures*]

- Continuous Mappings
- Extension Theorems
- Real and Complex-valued Continuous Functions
- Uniform Continuity
- Homeomorphism, Equivalent Metrics and Isometry

Unit 04: Connected Spaces [*8 Lectures*]

- Connectedness
- Local Connectedness
- Arcwise Connectedness

Unit 05: Compact Spaces [*10 Lectures*]

- Bounded sets and Compactness
- Other Characterisations of Compactness
- Continuous Functions on Compact Spaces
- Locally Compact Spaces
- Compact Sets in Special Metric Spaces

Unit 05: Product Spaces [*4 Lectures*]

- Finite and Infinite Products of Sets
- Finite Metric Products
- Infinite Metric Products
- Cantor Set .

Textbook:
Satish Shirali and Harkrishan L. Vasudeva, Metric Spaces, Springer

Reference Books:

1) O'Searcoid, Metric Spaces, Springer
2) James R. Munkres, Topology, Pearson
3) Richard R. Goldberg, Methods of Real Analysis**,** Oxford & IBH Publishing Co Pvt.Ltd

Class : T.Y. B. Sc. (Semester- V)
Paper Code:MAT3502
Paper : II**Title of Paper:**Real Analysis – I
Credit : 3 **No. of lectures:** 48

A) Learning Objectives:

- Definition of sets; functions between sets; equivalent sets; finite, countable and uncountable sets, least upper bound.
- Definition of sequence, and recognize convergent, divergent, bounded, Cauchy and monotone sequences.
- Calculate the limit superior, limit inferior, and the limit of a sequence.
- Definition of series, and recognize alternating, convergent, conditionally and absolutely convergent series.

B) Learning Outcome:

- Describe fundamental properties of the real numbers that lead to the formal development of real analysis.
- Determine the nature of an infinite sequence.

TOPICS/CONTENTS:

Unit 01: Sets and functions [*12 Lectures*]

- Sets and elements
- Operations on sets
- Functions
- Real-valued functions
- Equivalence. Countability
- Real numbers
- Least upper bounds

Unit 02: Sequences of Real Numbers [*18 Lectures*]

- Definition of sequence and subsequence
- Limit of a sequence
- Convergent sequences
- Divergent sequences
- Bounded sequences
- Monotone sequences
- Operations on convergent sequences
- Operations on divergent sequences
- Limit superior and limit inferior
- Cauchy sequences

Unit 03: Series of Real Numbers [*18 Lectures*]

- Convergence and divergence
- Series with nonnegative terms
- Alternating series
- Conditional convergence and absolute convergence
- Tests for absolute convergence
- Series whose terms form a nonincreasing sequence
- The class l^2

Text book:

R. R. Goldberg, *Methods of Real Analysis*, Oxford & I. B. H. Publications, 1970.

Ch. 1, Art 1.1 to 1.7; Ch. 2, Art 2.1 to 2.10; Ch. 3, Art 3.1 to3.7 and 3.10.

Reference Books:

1. Ajit Kumar and S.Kumaresan, *A Basic Course in Real Analysis*, CRC Press, Second Indian Reprint 2015.
2. D. Somasundaram and B. Choudhary, *A first course in Mathematical Analysis*, Narosa Publishing House, 1997.
3. Robert, G. Bartle, Donald Sherbert, *Introduction to Real Analysis*, Third edition, John Wiley and Sons.
4. Shantinarayan and Mittal, *A course of Mathematical Analysis*, Revised edition, S. Chand and Co. (2002).
5. S.C. Malik and Savita Arora, *Mathematical Analysis*, New Age International Publications, third Edition,(2008).

Class : T.Y. B. Sc. (Semester- V)
Paper Code:MAT3504
Paper : IV **Title of Paper:**Group Theory
Credit : 3 **No. of lectures:** 48

A) Learning Objectives:

- Definition of a Group, Subgroup and standard examples.
- Study of symmetries of square, Dihedral groups, order of groups, cyclic group examples.
- Definition of normal subgroups and Homorphisms.

B) Learning Outcome:

Students determine possible subgroups of group. Be able to construct Caley table, identify normal subgroups and cyclic groups. Examine symmetry and permutation groups. Understand group concepts and solve problems individually.

TOPICS/CONTENTS:

Unit 01: Introduction to Groups [*8Lectures*]

- Symmetries of square
- The Dihedral groups
- Definition and examples of groups
- Elementary properties of groups

Unit 02:Finite Groups and Subgroups [*8Lectures*]

- Order of group, order of elements.
- Subgroup Tests and examples.
- Center of a group
- Centralizer of element.
- Cosets: definition and properties
- Lagrange's theorem and corollary

Unit 03: Cyclic Groups [*10Lectures*]

- Properties of cyclic groups and examples
- Order of finite cyclic groups
- Generators of finite cyclic groups
- Generators of Zn
- Fundamental theorem of Cyclic Groups

Unit 04: Permutation Groups [*8Lectures*]

- Definition and examples
- Permutation on S_n, detail discussion of S_3
- Cycle notation
- Properties and theorems on permutation.
- Even odd permutation

Unit 05:Normal Subgroup [*4Lectures*]

- Definition
- If G is abelian then every subgroup of G is normal subgroup
- Theorems on Normal subgroup.

Unit 06: Homomorphism and Isomorphism's [*10Lectures*]

- Homomorphism and fundamental theorem of homomorphism
- Group isomorphism's
- Cayley's Theorem
- Properties of isomorphism
- Automorphisms

Textbook:

1. Contemporary Abstract Algebra, Joseph Gallian. (Ch. 1 to 6 and ch .9)
2. I.N. Herstein, Topics in Algebra,Wiley.(Normal subgroup chapter).

Reference Books:

1. P. B. Bhattacharya, S. K. Jain and S. R. Nagpal, Basic abstract Algebra, Second Ed.

2. J. B. Fraleigh, A. First Course in Abstract Algebra, Third Edition, Narosa publication.

3. M. Artin, Algebra, Prentice Hall of India, New Delhi.

Class : T.Y. B. Sc. (Semester- V)
Paper Code: MAT3505
Paper : V **Title of Paper:** Ordinary Differential Equations
Credit : 3 **No. of lectures:** 48

A) Learning Objectives:

- State basic existence theorem of first order differential equation.
- Understand methods of solving non-homogenous differential equations.
- Definition of power series solution and study the convergence of solution.
- Introduce linear system with distinct types of roots.

B) Learning Outcome:

Distinguish linear, nonlinear, partial and ordinary differential equations. Identify the appropriate method to solving non-homogenous differential equation. Understand ordinary, regular singular point and respective power series solution.Be familiar with the various formulas of solving linear differential equations using differential operator.

TOPICS/CONTENTS:

Unit 01: Linear Differential Equations with constant coefficients[*12Lectures*]

- The auxiliary equations.
- Distinct roots, repeated roots, Complex roots.
- Particular solution.
- The operator $1/f\ (D)$ and its evaluation for the functions $x^m, e^{mx}, e^{axv}v$.
- The operator $1/(D^2 + a^2)$ acting on $sinax$ and $cosax$ with proofs.

Unit 02: Non-Homogeneous Differential Equations [*14Lectures*]

- Method of undetermined coefficients.
- Method of variation of parameters.
- Method of reduction of order.
- The use of a known solution to find another.

Unit 03: Power series solutions [*12Lectures*]

- Introduction and review of power series.
- Linear equations and power series.
- Convergence of power series.
- Ordinary points and regular singular points.

Unit 04: **System of First-Order Equations** [*10Lectures*]

- Introductory remarks
- Linear systems
- Homogeneous linear systems with constant Coefficients
- Distinct roots, repeated roots, Complex roots

Textbook:

Elementary Differential Equations, Rainville and Bedient, Macmillan Publication.

Reference Books:

- Differential Equations by George F. Simmons, Steven G. Krantz, Tata McGrawHill.
- Ordinary and Partial Differential Equation, by M.D.Raisinghania, S.Chand and Company LTD, 2009.
- Daniel Murray, Introductory Course in Differential Equations, Orient Longman.

Class : T.Y. B. Sc. (Semester- V)
Paper Code: MAT3507
Paper : VII **Title of Paper:** Operations Research
Credit : 3 **No. of lectures:** 48

A) Learning Objectives:

- Basic concepts of optimization, modeling and linear modeling (LP).
- Understand graphical sensitivity analysis.
- Set up transportation problem in the general LP format.
- Set up assignment problem in the general LP format.

B) Learning Outcome:

- Model the decision making problems by using LP techniques.

TOPICS/CONTENTS:

Unit 01: Modeling with Linear Programming [*08 Lectures*]

- Two variable LP Model
- Graphical LP solution
- Selected LP Applications
- Graphical Sensitivity analysis

Unit 02: The Simplex Method [*16 Lectures*]

- LP Model in equation form
- Transition from graphical to algebraic solutions
- The simplex method
- Artificial starting solutions.

Unit 03: Duality [*06 Lectures*]

- Definition of the dual problem
- Primal dual relationship

Unit 04: Transportation Model [*12 Lectures*]

- Definition of the Transportation model
- The Transportation algorithm

Unit 05: Assignment Model [*06 Lectures*]

- The Hungarian method
- Simplex explanation of the Hungarian method.

Text Book:

Hamdy A. Taha, *Operation Research* (8thEdition, 2009), Prentice Hall of India Pvt. Ltd, New Delhi.
Ch.2: 2.1,2.2,2.3(2.3.4, 2.3.5, 2.3.6). Ch.3: 3.1, 3.2, 3.3, 3.4, 3.5, 3.6 (3.6.1).
Ch.4: 4.1, 4.2. Ch.5: 5.1,5.3 (5.3.1, 5.3.2, 5.3.3), 5.4(5.4.1, 5.4.2).

Reference Books:

1. Frederick S. Hillier, Gerald J. Lieberman, *Introduction to Operation Research* (8th Edition) Tata McGraw Hill.
2. J. K. Sharma, *Operations Research: Theory and Applications*, (2nd Edition, 2006), Macmilan India Ltd.
3. Hira and Gupta, *Operation Research*.

Class : T.Y. B. Sc. (Semester- V)
Paper Code: MAT3508
Paper : VIII **Title of Paper :** Number Theory
Credit : 3 **No. of lectures:** 48

A) Learning Objectives:

- Definition of divisibility in integers and understand their properties
- Definition of congruences and use their properties to solve problems on divisibility
- Definition of Legendre and Jacobi symbol and use them to solve quadratic equations

B) Learning Outcome:

Demonstrate knowledge and understanding of topics including, but not limited to divisibility, prime numbers, congruence, quadratic reciprocity, Diophantine equations. Learn methods and techniques used in number theory.

TOPICS/CONTENTS:

Unit 01: Divisibility [*8 Lectures*]

- Divisibility in integers, Division Algorithm
- GCD, LCM,
- Fundamental theorem of Arithmetic
- Infinitude of primes

Unit 02: Congruences [*12 Lectures*]

- Properties of Congruences
- Residue classes, complete and reduced residue system, their properties
- Fermat's theorem. Euler's theorem, Wilson's theorem
- Linear Congruences of degree 1
- Chinese remainder theorem

Unit 03: Greatest integer function [*10 Lectures*]

- Arithmetic functions Euler's function
- the number of divisors d(n)
- $\sigma(n)$, $\omega(n)$ and $\Omega(n)$
- Multiplicative functions, Mobius function, Mobius inversion formula.

Unit 04: Quadratic Reciprocity [*10 Lectures*]

- Quadratic residues
- Legendre's symbol and its properties
- Law of quadratic reciprocity
- Jacobi symbol

Unit 05: Diophantine Equations [*8 Lectures*]

- Diophantine Equations ax + by = c
- Pythagorean triplets

Text Book:

I. Niven, H. Zuckerman and H.L. Montgomery, An Introduction to Theory of Numbers, 5th Edition, John Wiley and Sons.
(§1.1- §1.3, §2.1- §2.3, §3.1- §3.3, §4.1 -§4.3, §5.1 and §5.3.)

Reference Book:

David M. Burton, Elementary Number Theory (Second Ed.), Universal Book Stall, New Delhi, 1991.

Class : T.Y. B. Sc. (Semester- VI)
Paper Code: MAT3601
Paper : I **Title of Paper :** Complex Analysis
Credit : 3 **No. of lectures:** 48

A) Learning Objectives:

- Determine continuity/differentiability/analyticity of a function and find the derivative of a function;
- Evaluate a contour integral using parametrization, fundamental theorem of calculus and Cauchy's integral formula;
- Find the Taylor series of a function and determine its circle or annulus of convergence;
- Compute the residue of a function and use the residue theory to evaluate a contour integral or an integral over the real line;

B) Learning Outcome:

Student will be able to find analyticity of functions, find integration of complex valued functions, use residue theorem to find real integrals

TOPICS/CONTENTS:

Unit 01: Complex Numbers [*6 Lectures*]

- Sums and products, Basic algebraic properties GCD, LCM,
- Vectors and Moduli, Complex Conjugates
- Exponential Form, Products and powers in exponential form
- Arguments of products and quotients, Roots of complex numbers
- Regions in the complex plane

Unit 02: Analytic functions [*12 Lectures*]

- Functions of Complex Variables, Limits, Theorems on limits
- Limits involving the point at infinity
- Continuity, Derivatives, Differentiation formulas, Cauchy- Riemann Equations
- Sufficient Conditions for differentiability
- Polar coordinates, Analytic functions, Harmonic functions.

Unit 03: Elementary Functions [*7 Lectures*]

- The Exponential functions, The Logarithmic function
- Branches and derivatives of logarithms
- Complex exponents
- Trigonometric functions, Hyperbolic functions.

Unit 04: Integrals [*12 Lectures*]

- Derivatives of functions, Definite integrals of functions
- Contours, Contour integral, Examples, Upper bounds for Moduli of contour integrals,
- Anti-derivatives, Examples, Cauchy-Groursat's Theorem (without proof)
- Simply and multiply connected domains. Cauchy integral formula
- Derivatives of analytic functions
- Liouville's Theorem and Fundamental Theorem of Algebra.

Unit 05: Series [*5 Lectures*]

- Convergence of sequences and series
- Taylor's series, Laurent series (without proof), examples

Unit 06: Residues and Poles [*6 Lectures*]

- Isolated singular points, Residues, Cauchy residue theorem
- residue at infinity, types of isolated singular points, residues at poles
- zeros of analytic functions, zeros and poles.

Text Book:
J.W. Brown and R.V. Churchill, Complex Variables and Applications, International Student Edition, 2009. (Eighth Edition).
Chapter1 : §1 to §11. Chapter 2: §12,§15 to §26. Chapter 3 : §29 to §35. Chapter4 : §37 to §46 and §48 to §53. Chapter:5 §55 to §60 and §62.Chapter 6: §68 to §76.

Reference Books:
1. S. Ponnusamy, Complex Analysis, Second Edition (Narosa).
2. S. Lang, Complex Analysis, (Springer Verlag).
3. A.R. Shastri, An Introduction to Complex Analysis, (MacMillan)

Class : T.Y. B. Sc. (Semester- VI)
Paper Code:MAT3602
Paper : II **Title of Paper:**Real Analysis – II
Credit : 3 **No. of lectures:** 48

A) Learning Objectives:

- Understand the meaning of the definite integral, particularly as limits of Riemann upper sum and lower sums.
- Understand the relationship between the derivative and the definite integral as expressed in both parts of the Fundamental Theorem of Calculus.
- Given an improper integral, determine whether it converges or diverges by evaluation, the comparison test, or the mu test.
- Recognize the difference between pointwise and uniform convergence of a sequence of functions.

B) Learning Outcome:

- Solve problems in a range of mathematical applications using the integral.
- Examine various techniques of integration and apply them to definite and improper integrals.
- Illustrate the effect of uniform convergence on the limit function with respect to continuity, differentiability and integrability.

TOPICS/CONTENTS:

Unit 01: Riemann Integral [*16 Lectures*]

- Sets of measure zero
- Definitionof the Riemann integral
- Existence of the Riemann integral
- Properties of the Riemann integral
- Fundamental theorem of integral calculus
- Mean value theorems of integral calculus

Unit 02: Improper Integrals [*16 Lectures*]

- Definition of improper integral of first kind
- Comparison test
- Absolute and conditional convergence
- Integral test for convergence of series
- Definition of improper integral of second kind
- Cauchy principal value

Unit 03: Sequences and series of functions [*16 Lectures*]

- Point wise convergence of sequences of functions
- Uniform convergence of sequences of functions
- Consequences of uniform convergence

- Convergence and uniform convergence of series of functions
- Integration and differentiation of series of functions

Text Books:

1. R. R. Goldberg, *Methods of Real Analysis*, Oxford & I. B. H. Publications, 1970.
   Ch. 7, Art. 7.1 to 7.4 and 7.8 Ch. 9, Art 9.1 to 9.5
2. D. Somasundaram andB. Choudhary, *A first course in Mathematical Analysis*, Narosa Publishing House, 1997.
   Ch. 8, Art 8.5

Reference Books:

1. Ajit Kumar and S.Kumaresan, *A Basic Course in Real Analysis*, CRC Press, Second Indian Reprint 2015.
2. Robert, G. Bartle, Donald Sherbert,*Introduction to Real Analysis*, Third edition, John Wiley and Sons.
3. Shantinarayan and Mittal,*A course of Mathematical Analysis*, Revised edition, S. Chand and Co.(2002).
4. S.C. Malik and Savita Arora, *Mathematical Analysis*, New Age International Publications, third Edition,(2008).

Class : T.Y. B. Sc. (Semester- VI)
Paper Code: MAT3604
Paper : IV **Title of Paper :** Ring Theory
Credit : 3 **No. of lectures:** 48

A) Learning Objectives:

- Definition of rings, Prime, maximal ideals and examples.
- DetermineEisenstein's criterion for irreducibility
- Definition of Integral domain, Homomorphism ring.
- Definition of PID,UFD.

B) Learning Outcome:

Student will be able to check the irreducibility of higher degree polynomials over rings. Understand the concepts like ideals and quotient rings. Understand the concept of ring homomorphism. Apply Eisenstein's criterion for irreducibility of a polynomial

TOPICS/CONTENTS:

Unit 01: Ring [5 Lectures]

- Definition and properties of Ring,
- Subring.

Unit 02:Integral Domains [*5 Lectures*]

- Zero divisors,
- Cancellation Law,
- Field,
- Characteristics of Ring.

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Unit 03:Ideals and Factor Rings [*6 Lectures*]

- Existence of Factor Ring,
- Prime Ideals,
- Maximal Ideals.

Unit 04:Homomorphism of Rings [*8Lectures*]

- Properties of Ring Homomorphism,
- Kernel, First isomorphism Theorem for Ring,
- Prime Fields,
- The field of Quotients..

Unit 05:Polynomial Ring[*6 Lectures*]

- Definition,
- The division Algorithm,
- Principle Ideal Domain.

Unit 06: Factorization of Polynomial[*8Lectures*]

- Reducibility and Irreducibility Tests,
- Eisenstein criterion. Ideals in F[x],
- Unique Factorization in Z[x]

Unit 07: Divisibility in Integral Domain[*10Lectures*]

- Associates, IrreducibleandPrimes,
- Unique Factorization Domains,
- Ascending chain Condition for PID,
- PID implies UFD, Euclidean Domains.
- ED Implies PID, D is UFD implies D[x] is UFD.

Text Book:
Joseph, A. Gallian, Contemporary Abstract Algebra,(4th Edition), Narosa Publishing House. Chapter Numbers : 12,13,14,15,16,17 and 18.

Reference Books:
1.J.B. Fraleigh, First course in Abstract Algebra (4rd Edition). Narosa Publishing House.

2. I.N. Herstein, Abstract Algebra, (3rd Edition), Prentitice Hall of India, 1996.

3. N.S. Gopalkrishnan, University of Algebra, Wiley Eastern 1986. 4. C. Musili, Rings and Modules, NarosaPublishing House, 1992.

Class : T.Y. B. Sc. (Semester- VI)
Paper Code:MAT3605
Paper : V**Title of Paper :**Partial Differential Equations
Credit : 3 **No. of lectures:** 48

A) Learning Objectives:

- Definition of the concept of partial differential equations.
- Study Charpits method and Jacobi's method.
- Finding integral curves using various methods.
- Determine the Solution of Pfaffian Differential Equations.

B) Learning Outcome:
Student will be able to classify the partial differential equations.Identify methods and implement on solving Pfaffian differential equations.

TOPICS/CONTENTS:
Unit 01: Ordinary Differential Equations in More Than Two Variables[*22 Lectures*]

- Surface and Curves in Three Dimensions
- Simultaneous Differential Equations of the First Order and First Degree in 3 Variables.
- Methods of solution of $dx/P = dy/Q = dz/R$
- Orthogonal Trajectories of a System of curves on a Surface.
- Pfaffian Differential Forms and Equations.
- Solution of Pfaffian Differential Equations in Three Variables.

Unit 02:First Order Partial Differential Equations [*26 Lectures*]

- Genesis of First Order Partial Differential Equations
- Classification of Integrals
- Linear Equations of the First Order
- Pfaffian Differential Equations
- Compatible Systems
- Charpit's Method
- Jacobi's Method
- Integral Surfaces through a given curve
- Quasi-Linear Equation.

Text Book:
1. Ian Sneddon, Element of Partial Differential Equations, McGraw-Hill Book Company, McGraw-Hill Book Company. Chapter 1: §1 to §6.
2. T. Amaranath, An Elementary Course in Partial Differential Equations, Narosa Publishing, House 2nd Edition, 2003 (Reprint, 2006). Chapter 1: §1 to §10.

Reference Books:
1. W.E. Williams, Partial Differential Equations, Clarendon Press, Oxford.
2. Frank Ayres Jr., Differential Equations, McGraw-Hill Book Company, SI Edition (International Edition, 1972).
3. K. SankaraRao, Introduction to Partial Differential Equations, Third Edition,PHI.

Class : T.Y. B. Sc. (Semester- VI)
Paper Code: MAT3607
Paper :VII **Title of Paper:** Optimizations Techniques
Credit : 3 **No. of lectures:** 48

A) Learning Objectives:

- Formulate and solve problems as networks and graphs.
- Familiarize students with the basic concepts, models and statements of the game theory.
- Study the performance of item for its replacement and/or maintenance.
- Formulate job sequence to minimize the processing time.
- Familiarize students with nonlinear programming.

B) Learning Outcome:

- Develop mathematical models associated with network flows and related real life applications.
- Should find Nash equilibrium in mixed strategies in games 2x2 and 2xN.
- Knows Lagrange multipliers methods for solving problems on finding extremum.

TOPICS/CONTENTS:

Unit 01: Network Models [*12 Lectures*]

- CPM and PERT
- Network representation
- Critical Path Computations
- Construction of the time schedule
- Linear programming formulation of CPM, PERT calculations.

Unit 02: Decision Analysis and Games [*12 Lectures*]

- Decision under uncertainty
- Game theory: Some basic terminologies
- Optimal solution of two person zero sum game
- Solution of mixed strategy games
- Graphical solution of games
- Linear programming solution of games.

Unit 03: Replacement and Maintenance Models [*08 Lectures*]

- Introduction
- Types of failure
- Replacement of items whose efficiency deteriorates with time

Unit 04: Sequencing Problems [*06 Lectures*]

- Introduction
- Notation, terminology and assumptions
- Processing n jobs through two machines
- Processing n jobs through three machines

Unit 05: Classical Optimization Theory [*10 Lectures*]

- Unconstrained problems
- Necessary and sufficient conditions
- Newton Raphson method
- Constrained problems
- Equality constraints (Lagrangian Method Only)

Text Book:

1. Hamdy A. Taha, *Operation Research* (8^{th}Edition, 2009), Prentice Hall of India Pvt. Ltd, New Delhi.
   Ch.6: 6.5 (6.5.1 to 6.5.5), Ch.13: 13.3, 13.4(13.4.1,13.4.2,13.4.3). Ch.18: 18.1(18.1.1, 18.1.2),18.2 (18.2.1).
2. J. K. Sharma, *Operations Research: Theory and Applications*, (2^{nd} Edition, 2006), Macmilan India Ltd.
   Ch.17: 17.1, 17.2, 17.3, Ch.20: 20.1, 20.2, 20.3, 20.4.

Reference Books:

1. Frederick S. Hillier, Gerald J. Lieberman, *Introduction to Operation Research* (8^{th} Edition) Tata McGraw Hill.
2. Hira and Gupta, *Operation Research*.

Class : T.Y. B. Sc. (Semester- VI)
Paper Code: MAT3608
Paper : VIII **Title of Paper :** Lebesgue Integration
Credit : 3 **No. of lectures:** 48

A) Learning Objectives:

- Definitionof measurable sets, functions and study their properties.
- Calculate Lebesgue integration of bounded and unbounded functions.

B) Learning Outcome:

Students will be able to calculate Lebesgue integration and understand their properties and relation with Reimann integration. This course will be useful for probability theory.

TOPICS/CONTENTS:

Unit 01: Measurable Sets [*12 Lectures*]

- Length of open sets and closed sets
- Inner and outer measure
- Measurable sets
- Properties of measurable sets

Unit 02: Measurable Functions [*12 Lectures*]

- Measurable functions
- Nonmeasurable fuctions
- Properties of measurable functions

Unit 03: The Lebesgue integrals [*24 Lectures*]

- Definition and example of the Lebesgue integrals for bounded functions
- Properties of Lebesgue integrals for bounded measurable functions
- The Lebesgue integral for unbounded functions
- Some fundamental theorems

Text-Book:

Richard R. Goldberg, Methods of Real Analysis, Oxford and IBH Publishing Co. Pvt. Ltd. (1970).
(Chapter No. 11, 11.1 to 11.8).

Reference Books:

1. Tom Apostol, Advanced Calculus, 2nd Edition, Prentice Hall of India, (1994).
2. D. Somasundaram and B. Choudhari, A first course in Mathematical Analysis, Narosa Publishing House, (1997).
3. R.G. Bartle and D.R. Scherbert, Introduction to real analysis 2nd Edition, John Wiley, (1992).
4. Inder K. Rana, Measure and Integration