Rayat Shikshan Sanstha's

Yashavantrao Chavan Institute of Science, Satara [Autonomous]

Accredited by NAAC "A+" Grade with CGPA 3.57

Choice Based Credit System

Syllabus For

B.Sc. Mathematics Part-III

Semester V and VI

(Revised Syllabus to be implemented from June, 2023 onwards)

STRUCTURE OF THE COURSE: B. SC. III MATHEMATICS

SEMESTER V [CREDIT -16]

Course Code	Title of the course	Instructions Lectures /Week	Duration of term end exam	Marks term end exam (Convert 50 marks to 30)	Marks ISE-I, MSE ISE-II	Credits
COMPULSORY COURSES						
BMT-501	Mathematical Analysis	3	2 hours	30	20	2
BMT-502	Abstract Algebra	3	2 hours	30	20	2
BMT-503	Optimization Techniques	3	2 hours	30	20	2
ELECTIVE COURSES [SELECT ONE COURSE]						
BMT 504(A)	Numerical Methods-I	3	2 hours	30	20	2
BMT-504(B)	Integral Transforms	3	2 hours	30	20	2
BMT-504(C)	Application of Mathematics in Finance	3	2 hours	30	20	2
PRACTICAL						
BMP-508	Operations Research Techniques	10	3 hours	50	----	4
BMP-509	Numerical Methods	10	3 hours	50	------	4

SEMESTER VI [CREDIT -16]

Course Code	Title of the course	Instructions Lectures /Week	Duration of term end exam	Marks term end exam	Marks ISE-I, MSE, ISE-II	Credit
COMPULSORY COURSES						
BMT-601	Metric Spaces	3	2 hours	30	20	2
BMT-602	Linear Algebra	3	2 hours	30	20	2
BMT-603	Complex Analysis	3	2 hours	30	20	2
ELECTIVE COURSES [SELECT ONE COURSE]						
BMT 604(A)	Numerical Methods-II	3	2 hours	30	20	2
BMT 604(B)	Discrete Mathematics	3	2 hours	30	20	2
BMT-604(C)	Application of Mathematics in Insurance	3	2 hours	30	20	2
PRACTICAL						
BMP-608	Mathematical Computation Using Python	10	3 hours	50	----	4
BMP-609	Project, Study-Tour, Viva – Voce	10	3 hours	50	----	4

SYLLABUS EQIVALENCE IN ACCORDANCE WITH TITLES OF THE COURSES WITH SHIVAJIUNIVERSITY, KOLHAPUR.

SHIVAJI UNIVERSITY, KOLHAPUR		YCIS, SATARA	
SEMESTER V			
All courses are compulsory		**Compulsory Courses**	
COURSE CODE	**TITLE OF THE COURSE**	**COURSE CODE**	**TITLE OF THE COURSE**
DSE-E9	Mathematical analysis	BMT-501	Mathematical analysis
DSE-E10	Abstract algebra	BMT-502	Abstract algebra
DSE-E11	Optimization technique	BMT-503	Optimization technique
DSE-E12	Integral transform	**Elective courses [choose one]**	
-		BMT-504(A)	Numerical Methods-I
		BMT-504(B)	Integral Transforms
		BMT-504(C)	Application of Mathematics in Finance
SEMESTER VI			
All courses are compulsory		**Compulsory courses**	
COURSE CODE	**TITLE OF THE COURSE**	**COURSE CODE**	**TITLE OF THE COURSE**
DSE F9	Metric Spaces	BMT-601	Metric Spaces
DSE F10	Linear Algebra	BMT-602	Linear Algebra
DSE F11	Complex Analysis	BMT-603	Complex Analysis
DSE F12	Discrete Mathematics	**Elective courses [choose one]**	
		BMT-604(A)	Numerical Methods-II
		BMT-604(B)	Discrete Mathematics
		BMT-604(C)	Application of Mathematics in Insurance
PRACTICAL			
COURSE CODE	**TITLE OF THE COURSE**	**COURSE CODE**	**TITLE OF THE COURSE**
CCPM IV	Operations Research	BMP-508	Operations Research Techniques
CCPM V	Laplace and Fourier Transforms	BMP-509	Numerical methods
CCPM VI	Python Programming	BMP-608	Mathematical Computation Using Python
CCPM VII	Project, study tour, Seminar, viva.	BMP-609	Project, Study- Tour, Viva – Voce

B.Sc. (Mathematics) (Part-III) (Semester–V)
(Choice Based Credit System)
(Revised from June 2023)

Course Code: BMT-501 **Title of Course: Mathematical Analysis**

Theory: 36 Hrs. (45 Lectures of 48 minutes) Marks – 50 (Credits: 02)

Course Objectives: Student will able to

1) study integration of bounded function on a closed and bounded interval.
2) learn some properties of Riemann integrable functions.
3) extend the Riemann integral to the improper integrals when either the interval of integration is infinite or the integrand has infinite limits at a finite number of points on the interval of integration.
4) expand functions in Fourier series and half range Fourier series.

Credits=2	**SEMESTER-V** **BMT 501: Mathematical Analysis**	**No. of hours per unit**
UNIT I	**Riemann Integration**	**(09)**
	Definition of Riemann integration and simple examples, norm of subdivision, lower and upper sum,lower and upper integrals, oscillatory sums, Riemann Integral, Inequalities for lower and upper Darboux's sums, Necessary and sufficient conditions for Riemann integrability, Set of Measure zero, almost everywhere property, Existence of Riemann integral.	
UNIT II	**Properties of Riemann Integral**	**(09)**
	Riemann integrability of monotonic functions and continuous functions, Algebra and properties of Riemann integrable functions, Piecewise monotonic and Piecewise continuous functions, Intermediate value theorem for integrals, Primitive of a function, First and second fundamental theorems of integral calculus, Integration by parts, Change of variable.	
UNIT III	**Improper Integrals**	**(09)**
	Definition of improper integral of first kind, second kind, third kind and its examples, Comparison test, μ – test for Convergence, Absolute and conditional convergence, Integral test for convergence of series, Definition of improper integral of second kind and some tests for their convergence, Cauchy Principle Value.	
UNIT IV	**Fourier series**	**(09)**
	Definition of Fourier series and examples on the expansion of functions in Fourier series, Fourierseries corresponding to even and odd functions, half range Fourier series, half range sine and cosine Series.	

Course Outcomes: Student should be able to

1) describe fundamental properties of the Riemann integration and existence theorems.
2) use properties of Reimann integral to simplify proper integrals.
3) examine the convergence of Improper integrals.
4) develop functions as a Fourier series.

Reference Books:

1) Kenneth. A. Ross, Elementary Analysis: The Theory of Calculus, Second Edition, Undergraduate Texts in Mathematics, Springer, 2013. (Chapter 6, Art. 32.1 to 32.11, 33.1 to 33.6 and 34.1 to 34.4).
2) D Somasundaram and B Choudhary, First Course in Mathematical Analysis, Narosa Publishing House New Delhi, Eighth Reprint 2013 (Chapter 8, Chapter 10, Art 10.1)
3) R.R. Goldberg, Methods of Real Analysis, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
4) R.G. Bartle and D.R. Sherbert, Introduction to Real Analysis, Wiley India Pvt. Ltd., Fourth Edition 2016.
5) Shanti Narayan and Dr. M.D. Raisinghania, Elements of Real Analysis, S. Chand& Company Ltd. New Delhi, Fifteenth Revised Edition 2014
6) Shanti Narayan and P.K. Mittal, A Course of Mathematical Analysis, S. Chand& Company Ltd. New Delhi, Reprint 2016.
7) HariKishan, Real Analysis, Pragati Prakashan, Meerut, Fourth Edition 2012.

B.Sc. (Mathematics) (Part-III) (Semester–V)
(Choice Based Credit System)
(Revised from June 2023)

Course Code: BMT-502 **Title of Course: Abstract Algebra**

Theory: 36 Hrs. (45 Lectures of 48 minutes) Marks – 50 (Credits: 02)

Course Objectives: Student will able to

1) study basic concepts of groups with examples.
2) identify whether the given set with the compositions form Ring, Integral domain, or field.
3) learn homomorphism and imbedding of rings.
4) understand polynomial rings, its properties and unique factorization domain.

Credits=2	**SEMESTER-V** **BMT 502: Abstract Algebra**	**No. of hours per unit**
UNIT I	**Groups**	**(09)**
	Definition and examples of groups, group S3 and Dihedral group D4, Commutator subgroups and its properties, Conjugacy in group and class equation.	
UNIT II	**Rings**	**(09)**
	Definition and examples of Rings, commutative ring, Non-commutative ring, Ring with unity, Ring with Zero divisor, Ring without zero divisor, Integral Domain, Division Ring, Field, Boolean ring, Subring, Characteristic of a ring: Nilpotent and Idempotent elements. Ideals, Sum of two ideals, Examples, Simple Ring.	
UNIT III	**Homomorphism and Imbedding of Ring**	**(09)**
	Quotient Rings, Homomorphism, Kernel of Homomorphism, Isomorphism theorems, imbedding of Ring, Maximal Ideals, Prime ideal, Semi-Prime Ideal.	
UNIT IV	**Polynomial Ring and Unique Factorization Domain**	**(09)**
	Polynomial Rings, degree of Polynomial, addition and multiplication of Polynomials and their properties, UFD, Gauss Lemma.	

Course Outcomes: Student should be able to

1) state fundamental theorem, Isomorphism theorems of groups.
2) classify ring, integral domain and field.
3) differentiate between maximal ideal and prime ideal.
4) solve problems on polynomial rings and UFD.

Reference Books:

1. Vijay K. Khanna, S.K. Bhambri, A Course In Abstract Algebra, Vikas publishing House Pvt.Ltd., New –Delhi-110014, Fifth Edition 2016. (Chap. 3 Art. The Dihedral Group, commutator, Chap. 4 Art. Conjugate elements, Chap.7 Art. Subrings, characteristic of a ring, Ideals, Sum of Ideals, Chap. 8 Art. Quotient rings, Homomorphism, Embedding of Rings, More on Ideal, Maximal Ideal, Chap 9 Polynomial Rings, Unique Factorization Domain.)
2. Jonh B. Fraleigh, A First Course in Abstract Algebra Pearson Education, Seventh Edition (2014).
3. Herstein I. N, Topics in Algebra, Vikas publishing House,1979.
4. Malik D. S. Moderson J. N. and Sen M. K., Fundamentals of Abstract Algebra,McGrew Hill,1997.
5. Surjeet Sing and QuaziZameeruddin, Modern Algebra, Vikas Publishing House,1991.
6. N.Jacobson, Basic Algebra Vol. I&II, Freeman and Company, New York 1980.

B.Sc. (Mathematics) (Part-III) (Semester–V)
(Choice Based Credit System)
(Revised from June 2023)

Course Code: BMT-503 **Title of Course: Optimization Techniques**

Theory: 36 Hrs. (45 Lectures of 48 minutes) Marks – 50 (Credits: 02)

Course Objectives: Student will able to

1) basic knowledge of Operations Research models and techniques, which can be applied to a variety of industrial and real life applications.
2) learn to formulate and apply suitable methods to solve problems.
3) identify and select procedures for various sequencing, assignment, transportation problems.
4) study linear programming and find algebraic solution to games.

Credits=2	**SEMESTER-V** **BMT 503: Optimization Techniques**	**No. of hours per unit**
UNIT I	**Linear Programming Problems**	**(09)**
	Introduction, Formulation of Linear Programming Problems, Graphical methods for Linear Programming Problems, General formulation of Linear Programming problems, Slack and surplus variables, Canonical form, Standard form of Linear Programming problems.	
UNIT II	**Transportation Problems**	**(09)**
	Transportation problem: Introduction, Mathematical formulation, Matrix form of Transportation Problem. Feasible solution, Basic feasible solution and optimal solution, Balanced and unbalanced Transportation problems. Methods of Initial basic feasible solutions: North west corner rule[Steppingstone method], Lowest cost entry method [Matrix minima method], Vogel's Approximation method [Unit Cost Penalty method], The optimality test [MODI method].	
UNIT III	**Assignment Problems**	**(09)**
	Assignment Models: Introduction, Mathematical formulation of assignment problem, Hungarian method for assignment problem. Unbalanced assignment problem. Travelling salesman problem.	
UNIT IV	**Game Theory**	**(09)**
	Game theory: Basic definitions, Minimax [Maximin] Criterion and optimal strategy, Saddle point, optimal strategy and value of game, Solution of games with saddle point, Fundamental theorem of game theory [Minimax theorem], Two by two (2×2) games without saddle point. Algebraic method of Two by two (2×2) games, Arithmetic method of Two by two (2×2) games, Graphical method for 2 x n games and $m \times 2$ games, Principle of dominance.	

Course Outcomes: Student should be able to

1) understand importance of optimization of industrial process management.
2) apply basic concepts of mathematics to formulate transportation problems.
3) examine for various assignment problems and their solution.
4) create a strategy to solve different types of games.

Reference Books:

1. Sharma S.D., Operations Research - Theory Methods and Applications, Kedarnath, Ramnath
2. Mohan, C. and Deep, Kusum, Optimization Techniques, New Age,2009.
3. Mittal, K. V. and Mohan, C., Optimization Methods in Operations, Research and Systems Analysis, New Age, 2003.
4. Taha, H.A. : Operations Research – An Introduction, Prentice Hall, (7th Edition), 2002.
5. Ravindran, A. , Phillips, D. T and Solberg, J. J., Operations Research: Principles and Practice,John Willey and Sons, 2nd Edition, 2009.
6. J.K.Sharma : Operation Research: Theory and Applications, Laxmi Publications, 2017.
7. KantiSwarup,P.K.Gupta and Manmohan, Operation Research, S.Chand& Co.
8. G.Hadley: Linear programming , Oxford and IBH Publishing Co.

B.Sc. (Mathematics) (Part-III) (Semester–V)
(Choice Based Credit System)
(Revised from June 2023)

Course Code: BMT-504 (A) **Title of Course: Numerical Methods - I**

Theory: 36 Hrs. (45 Lectures of 48 minutes) Marks – 50 (Credits: 02)

Course Objectives: Student will able to

1) learn appropriate numerical methods and determine the solutions to given non-linear equations.
2) study appropriate numerical methods and determine approximate solutions to systems of linear equations.
3) understand appropriate numerical methods and determine approximate solutions to ordinary differentialequations.
4) learn the use of interpolation methods to find intermediate values in given graphical and/or tabulated data.

Credits=2	**SEMESTER-V** **BMT 504 (A) : Numerical Methods - I**	**No. of hours per unit**
UNIT I	**Nonlinear Equations**	**(09)**
	Introduction: Polynomial equations, algebraic equations and their roots, iterative methods, Bisection method, algorithm, examples, Secant method: iterative sequence ofsecant method, examples, Regula-Falsi method: algorithm, graphical representation, examples. Newton's method: algorithm, examples.	
UNIT II	**System of Linear Equations: Exact Methods**	**(09)**
	Introduction: System of linear equations as a vector equation $Ax = b$, Augmented matrix, Direct methods: Gauss elimination method: Procedure, examples, Gauss-Jordan method: Procedure,examples. Iterative methods: General iterative rule.	
UNIT III	**System of Linear Equations: Iterative Methods**	**(09)**
	Jacobi iteration scheme, examples on Jacobi iteration scheme, Gauss-Seidel method: Formula, examples on Gauss-Seidel method.	
UNIT IV	**Eigen Values and Eigen Vectors**	**(09)**
	Eigen values and eigenvectors of a real matrix, Power method for finding an eigenvalue of greatest modulus, the case of matrix whose "dominant eigenvalue is not repeated", examples, Method of exhaustion, examples, Method of reduction, examples. Shifting of the eigen value, examples.	

Course Outcomes: Student should be able to

1) describe various methods to solve nonlinear equations.
2) illustrate direct methods to solve system of linear equations.
3) evaluate system of linear equations with iterative methods.
4) formulate power method for finding eigen value of greatest modulus.

Reference Books:

1. Devi Prasad, An Introduction to Numerical Analysis (Third Edition), Narosa Publishing House. Mohan, C. and Deep, Kusum, Optimization Techniques, New Age,2009.
2. S. S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall of India.
3. J.H. Mathews, Numerical Methods for Mathematics, Science and Engineering, Prentice Hall of India.
4. K. SankaraRao, Numerical Methods for Scientists and Engineers, Prentice Hall of India.
5. Bhupendra Singh, Numerical Analysis, Pragati Prakashan, KantiSwarup, P.K. Gupta and Manmohan, Operation Research, S. Chand & Co.

B.Sc. (Mathematics) (Part-III) (Semester–V)
(Choice Based Credit System)
(Revised from June 2023)

Course Code: BMT-504 (B) **Title of Course: Integral Transforms**

Theory: 36 Hrs. (45 Lectures of 48 minutes) Marks – 50 (Credits: 02)

Course Objectives: Student will able to

1) understand the concept of Laplace Transform.
2) learn properties of Laplace Transform to solve differential equations.
3) study relation between Laplace and Fourier Transform.
4) learn infinite and finite Fourier Transform.

Credits=2	**SEMESTER-V** **BMT 504 (B) : Integral Transforms**	**No. of hours per unit**
UNIT I	**Laplace Transform**	**(09)**
	Laplace Transform: Definitions; Piecewise continuity, Function of exponential order, Function ofclass A, Existence theorem of Laplace transform. Laplace transform of standard functions, First shifting theorem and Second shifting theorem and examples, change of scale property and examples, Laplace transform of derivatives and examples, Laplace transform of integrals and examples, Multiplication by power of t and examples. Division by t and examples, Laplace transform of periodic functions and examples. Laplace transform of Heaviside's unit step function.	
UNIT II	**Inverse Laplace Transform**	**(09)**
	Inverse Laplace Transform: Definition, Standard results of inverse Laplace transform, Examples, First shifting theorem and Second shifting theorem and examples. Change of scale property and Inverse Laplace of derivatives, examples. The Convolution theorem and Multiplication by S, examples, Division by S, inverse Laplace by partial fractions, examples, solving linear differential equations with constant coefficients by Laplace transform.	
UNIT III	**Infinite Fourier Transform**	**(09)**
	The infinite Fourier transform and inverse: Definition, examples, Infinite Fourier sine and cosine transform and examples, Definition: Infinite inverse Fourier sine and cosine transform and examples, Relationship between Fourier transform and Laplace transform, Change of Scale Property and examples, Modulation theorem, The Derivative theorem. Extension theorem, Convolution theorem and examples.	
UNIT IV	**Finite Fourier Transform**	**(09)**
	Finite Fourier Transform and Inverse, Fourier Integrals, Finite Fourier sine and cosine transform with examples, Finite inverse Fourier sine and cosine transform with examples, Fourier integral theorem, Fourier sine and cosine integral (without proof) and examples.	

Course Outcomes: Student should be able to

1) define Laplace transform and describe it's various properties.
2) use inverse Laplace transform to solve linear differential equations.
3) examine relationship between Fourier transform and Laplace transform.
4) evaluate Fourier sine and cosine integral.

Reference Books:

1. J. K. Goyal, K. P. Gupta, Laplace and Fourier Transform, A Pragati Edition (2016).
2. Dr. S. Shrenadh, Integral Transform, S. Chand Prakashan.
3. B. Davies, Integral Transforms and Their Applications, Springer Science Business Media LLC(2002)
4. Murray R. Spiegel, Laplace Transforms, Schaum's outlines.

B.Sc. (Mathematics) (Part-III) (Semester–V)
(Choice Based Credit System)
(Revised from June 2023)

Course Code: BMT-504 (C) **Title of Course: Applications of Mathematics in Finance**

Theory: 36 Hrs. (45 Lectures of 48 minutes) Marks – 50 (Credits: 02)

Course Objectives: Student will able to

1) understand the basic concepts in linear algebra, relating to linear equations, matrices, andoptimization.
2) learn the concepts relating to functions and annuities.
3) employ methods related to these concepts in a variety of financial applications.
4) study logical thinking to problem solving in context.

Credits=2	**SEMESTER-V** **BMT 504 (C) : Applications of Mathematics in Finance**	**No. of hours per unit**
UNIT I	**Financial Management**	**(09)**
	An overview, Nature and Scope of Financial Management, Goals of Financial Management and main decisions of financial management. Difference between risk, speculation and gambling.	
UNIT II	**Time Value of Money**	**(09)**
	Interest rate and discount rate, Present value and future value, discrete case as well as continuous compounding case, Annuities and its kinds, meaning of return, Return as Internal rate of Return (IRR), Numerical Methods like Newton Raphson Method to calculate IRR, Measurement of returns under uncertainty situations, Meaning of risk, difference between risk and uncertainty, Types of risks. Measurements of risk, Calculation of security and Portfolio Risk and Return- Markowitz Model, Sharpe's Single Index Model, Systematic Risk and Unsystematic Risk.	
UNIT III	**Taylor Series and Bond Valuation**	**(09)**
	Calculation of Duration and Convexity of bonds.	
UNIT IV	**Financial Derivatives**	**(09)**
	Futures, Forward, Swaps and Options, Call and Put Option, Call and Put Parity Theorem, Pricing of contingent claims through Arbitrage.	

Course Outcomes: Student should be able to

1) describe nature, scope and goals of financial management.
2) use numerical methods to calculate internal rate of return.
3) evaluation of duration of bonds and convexity of bounds.
4) assemble swaps, call and put options.

Reference Books:

1. Aswath Damodaran, Corporate Finance -Theory and Practice, John Wiley & Sons. Inc.
2. John C. Hull, Options, Futures, and Other Derivatives, Prentice-Hall of India Private Limited.
3. Sheldon M. Ross, An Introduction to Mathematical Finance, Cambridge University Press.
4. Mark S. Dorfman, Introduction to Risk Management and Insurance, Prentice Hall, Englwood Cliffs, New Jersey.

B.Sc. (Mathematics) (Part-III) (Semester–VI)
(Choice Based Credit System)
(Revised from June 2023)

Course Code: BMT-601 **Title of Course: Metric Spaces**

Theory: 36 Hrs. (45 Lectures of 48 minutes) Marks – 50 (Credits: 02)

Course Objectives: Student will able to

1) acquire the knowledge of notion of metric space, open sets and closed sets.
2) study the properties of continuous functions on metric spaces.
3) understand the basic concepts of connectedness, completeness andcompactness of metric spaces.
4) appreciate a process of abstraction of limits and continuity in metric spaces.

Credits=2	**SEMESTER-VI** **BMT 601: Metric Spaces**	**No. of hours per unit**
UNIT I	**Limits and Metric Spaces**	**(09)**
	Revision: Limits of a function on the real line, Metric space, Limits in Metric space, convergent sequence, Cauchy sequence.	
UNIT II	**Continuous Functions on Metric Spaces**	**(09)**
	Continuity at a point on the real line, Reformulation, Functions continuous on a metric space, Open Ball, Open Sets, Limit point, Closure of a set, Closed Sets, Homeomorphism, dense subset of a metric space.	
UNIT III	**Connectedness, Completeness and Compactness**	**(09)**
	More about open sets, Connected metric space, connected sets, Bounded and totally bounded sets, dense set, Complete metric space, contraction operator, Compact metric spaces, Covering and open covering, Heine Borel property, Finite intersection property.	
UNIT IV	**Some Properties of Continuous Functions on Metric Spaces**	**(09)**
	Continuous functions on compact metric spaces, Bounded function, Uniform continuity.	

Course Outcomes: Student should be able to

1) describe the Euclidean distance function on R^n and derivation of its properties.
2) demonstrate properties of homeomorphism associated to open and closed sets.
3) examine connectedness, completeness and compactness using examples.
4) derive properties of bounded function and uniform continuity.

Reference Books:

1. R. R. Goldberg, Methods of Real Analysis, Oxford and IBH Publishing House. (2017).
2. T. M. Apostol, Mathematical Analysis, Narosa Publishing House. (2002).
3. Satish Shirali, H. L. Vasudeva, Mathematical Analysis, Narosa Publishing House. (2013).
4. D. Somasundaram, B. Choudhary, First Course in Mathematical Analysis,Narosa Publishing House, (2018).
5. W. Rudin, Principles of Mathematical Analysis, McGraw Hill Book Company (1976).
6. Shantinarayan, Mittal, A Course of Mathematical Analysis, S. Chand and Company (2013).
7. J.N. Sharma, Mathematical Analysis-I, Krishna Prakashan Mandir, Meerut. (2014).
8. S.C. Malik, Savita Arora, Mathematical Analysis, New age international ltd(2005).

B.Sc. (Mathematics) (Part-III) (Semester–VI)
(Choice Based Credit System)
(Revised from June 2023)

Course Code: BMT-602 **Title of Course: Linear Algebra**

Theory: 36 Hrs. (45 Lectures of 48 minutes) Marks – 50 (Credits: 02)

Course Objectives: Student will able to

1) understand the notion of vector space.
2) study algebra of linear transformations.
3) learn connection between linear transformation and matrices.
4) understand Eigen values, Eigen vectors and its connection with real life situation.

Credits=2	**SEMESTER-VI** **BMT 602: Linear Algebra**	**No. of hours per unit**
UNIT I	**Vector Spaces**	**(09)**
	Vector space, Subspace, Sum of subspaces, direct sum, Quotient space, Homomorphism or Linear transformation, Kernel and Range of homomorphism, Fundamental Theorem of homomorphism, Isomorphism theorems, Linear Span, Finite dimensional vector space, Linear dependence and independence, basis, dimension of vector space and subspaces.	
UNIT II	**Linear Transformations**	**(09)**
	Linear Transformation, Rank and nullity of a linear transformation, Sylvester's Law, Algebra of Linear Transformations, Sum and scalar multiple of Linear Transformations. The vector space of homomorphism, Product (composition) of Linear Transformations, Linear operator, Linear functional, Invertible and non-singular Linear Transformation, Definition of Dual Space.	
UNIT III	**Inner Product Spaces**	**(09)**
	Inner product spaces: Norm of a vector, Cauchy- Schwarz inequality, Orthogonality, Pythagoras Theorem, orthonormal set, Gram-Schmidt orthogonalization process, Bessel's inequality.	
UNIT IV	**Eigen values and Eigen vectors**	**(09)**
	Eigen values and Eigen vectors: Eigen space, Characteristic Polynomial of a matrix and remarks onit, similar matrices, Characteristic Polynomial of a Linear operator, Examples on eigen values and eigen vectors.	

Course Outcomes: Student should be able to

1) explain the concepts of basis and dimension of a vector space.
2) apply Sylvester's law to find rank and nullity of linear transformation.
3) examine the relationship inner product spaces and vector spaces.
4) evaluate eigen values and eigen vectors for matrix associated with linear operator.

Reference Books:

1. Khanna V. K. and Bhambri S. K., A Course in Abstract Algebra, Vikas Publishing House PVT Ltd., New Delhi, 2016, 5th edition.
2. H. Anton & C. Rorres, Elementary Linear Algebra (with Supplemental Applications), WileyIndia Pvt. Ltd (Wiley Student Edition), New Delhi, 2016, 11th Edition.
3. S. Friedberg, A. Insel, L. Spence, Linear Algebra, Prentice Hall of India, 2014, 4th Edition.
4. Hoffman K. and Kunze R, Linear Algebra, Prentice Hall of India, 1978.W. Rudin, Principles of Mathematical Analysis, McGraw Hill Book Company (1976).
5. Lipschutz S, Linear Algebra, Schaum's Outline Series, McGraw Hill, Singapore, 1981.
6. David Lay, Steven Lay, Judi McDonald, Linear Algebra and its Applications, Pearson EducationAsia, Indian Reprint, 2016, 5th Edition.

B.Sc. (Mathematics) (Part-III) (Semester–VI)
(Choice Based Credit System)
(Revised from June 2023)

Course Code: BMT-603 **Title of Course: Complex Analysis**

Theory: 36 Hrs. (45 Lectures of 48 minutes) Marks – 50 (Credits: 02)

Course Objectives: Student will able to

1) learn basic concepts of functions of complex variable.
2) study concepts of analytic functions and complex integration.
3) understand the concepts of sequence and series of complex variable.
4) learn and apply concept of residues to evaluate certain real integrals.

Credits=2	**SEMESTER-VI** **BMT 603: Complex Analysis**	**No. of hours per unit**
UNIT I	**Analytic functions**	**(09)**
	Limit and continuity of a function of a complex variable, complex valued function. Differentiability and continuity and elementary rules of Differentiation. Analytic function and Analytic function in domain. Necessary and sufficient condition for f(z) = u+iv to be Analytic and examples, Limit of a sequence of complex numbers, Polar form of Cauchy- Riemann Equation, harmonic function, conjugate harmonic function, construction of Analytic function, problems related to the test of analyticity of functions and construction of analytic function.	
UNIT II	**Complex Integration**	**(09)**
	Elementary Definitions, complex line integral, Integral along oriented curve and examples, Cauchy's integral theorem and its consequences, Cauchy's integral formula for multiply connected domain and its examples, Jordan curve, orientation of Jordan curve, simple connected and multiply connected domain, rectifiable curve and their properties. Higher order derivative of an analytic function,	
UNIT III	**Singularities and Residues**	**(09)**
	Development of an analytic function as a power series, Taylor's theorem for complex function, Examples on Taylor's and Laurent series, Zeros of an analytic function, singular point, different types of singularity, poles and zeros, limiting point of zeros and poles. Residue theorem, residue at a pole and residue at infinity. Cauchy's residue theorem, computation of residue at a finite pole. Integration round unit circle, Jordan's lemma, Evaluation of Integrals $\int_{-\infty}^{\infty} f(z)$ when $f(z)$has no poles on the real line and when poles on the real line.	
UNIT IV	**Entire Meromorphic Functions**	**(09)**
	Definition of entire and meromorphic functions, Evaluate Characterization of polynomials as entire functions, Characterization of rational functions asmeromorphic functions, Mittag Leffler's expansion, Rouche's theorem and solved problems, Some theorems on poles and singularities.	

Course Outcomes: Student should be able to

1) describe analytic function and its properties.
2) use Cauchy's integral formula and Cauchy's Residue theorem to solve complex integration.
3) examine singularities and distinguish between them.
4) evaluate problems using Mittag Leffler's expansion and Rouche's theorem.

Reference Books:

1. James Ward Brown and Ruel V. Churchill, Complex Variables and Applications, 8th Ed., McGraw – Hill Education (India) Edition, 2014. Eleventh reprint 2018.
2. S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, Second Edition,2005, Ninth reprint 2013.
3. Lars V Ahlfors, Complex Analysis, McGraw-Hill Education; 3 edition (January 1, 1979).

B.Sc. (Mathematics) (Part-III) (Semester–VI)
(Choice Based Credit System)
(Revised from June 2023)

Course Code: BMT-604 (A) **Title of Course: Numerical Methods-II**

Theory: 36 Hrs. (45 Lectures of 48 minutes) Marks – 50 (Credits: 02)

Course Objectives: Student will able to

1) analyze the errors obtained in the numerical solution of problems.
2) understand the common numerical methods and how they are used to obtain approximate solutions.
3) learn numerical methods for various mathematical operations and tasks, such as interpolation,differentiation and integration.
4) Study various methods to find solution of linear and nonlinear equations, and the solution of differential equations.

Credits=2	**SEMESTER-VI** **BMT 604 (A): Numerical Methods-II**	**No. of hours per unit**
UNIT I	**Interpolation: Equal Intervals**	**(09)**
	Forward interpolation: Newton's forward differences, forward difference tableNewton's forward form of interpolating polynomial (formula only), examples Backward interpolation: Newton's backward differences, backward difference table, Newton's backward form of interpolating polynomial (formula only), examples.	
UNIT II	**Interpolation: Unequal Intervals**	**(09)**
	Introduction, Lagrangian interpolating polynomial (formula only), examples, Divided difference interpolation: Newton's divided differences, divided difference table, examples finding divided (differences of given data), Newton's divided difference form of interpolating polynomial, examples.	
UNIT III	**Numerical Differentiation and Integration**	**(09)**
	Numerical differentiation based on interpolation polynomial, Numerical integration: Newton-Cotes formula (statement only), Basic Trapezoidal rule (excluding the computation of error term), composite Trapezoidal rule, examples, Basic Simpson's 1/3rd rule (excluding the computation of error term), composite Simpson's 1/3rd rule, examples. Basic Simpson's 3/8th rule (excluding the computation of error term), composite Simpson's 3/8th rule, examples.	
UNIT IV	**Ordinary Differential Equations**	**(09)**
	Euler's Method, Examples, Second order Runge-Kutta method (formula only), examples Fourth order Runge-Kutta method (formula only), examples	

Course Outcomes: Student should be able to

1) explain forward and backward interpolation in equal intervals use Cauchy's integral formula and Cauchy's Residue theorem to solve complex integration.
2) solve examples to find divided difference of interpolating polynomials.
3) evaluate numerical differentiation and integration using various methods.

Reference Books:

1. Devi Prasad, An Introduction to Numerical Analysis (Third Edition), Narosa Publishing House.
2. S. S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall of India.
3. J.H. Mathews, Numerical Methods for Mathematics, Science and Engineering, Prentice Hallof India.
4. K. Sankara Rao, Numerical Methods for Scientists and Engineers, Prentice Hall of India.
5. Bhupendra-Singh, Numerical Analysis, Pragati Prakashan.

B.Sc. (Mathematics) (Part-III) (Semester–VI)
(Choice Based Credit System)
(Revised from June 2023)

Course Code: BMT-604 (B) **Title of Course: Discrete Mathematics**

Theory: 36 Hrs. (45 Lectures of 48 minutes) Marks – 50 (Credits: 02)

Course Objectives: Student will able to

1) learn classical notions of logic: implications, equivalence, negation, proof by contradiction, proof byinduction, and quantifiers.
2) study notions in logic in other branches of Mathematics.
3) know elementary algorithms: searching algorithms, sorting, greedy algorithms, and theircomplexity.
4) understand concepts of graph and trees to tackle real situations.

Credits=2	**SEMESTER-VI** **BMT 604 (B): Discrete Mathematics**	**No. of hours per unit**
UNIT I	**Mathematical Logic**	**(09)**
	The logic of compound statements: Statements, compound statements, truth values, logicalequivalence, tautologies and contradictions. Conditional statements: Logical equivalences involving implication, negation. The contra positive of a conditional statement, converse, inverse of conditionalstatements, biconditional statements.	
UNIT II	**Valid and Invalid Arguments**	**(09)**
	Modus Ponens and modus Tollens, Additional valid argument forms, rules of inferences,contradictions and valid arguments, Number system: Addition and subtraction of Binary, decimal, quintal, octal, hexadecimal number systems and their conversions.	
UNIT III	**Graphs**	**(09)**
	Graphs: Definitions, basic properties, examples, special graphs, directed and undirected graphs, concept of degree, Trails, Paths and Circuits: connectedness, Euler circuits, Hamiltonian circuits, Matrix representation of graphs, Isomorphism of graphs, isomorphic invariants, graph isomorphism for simple graphs.	
UNIT IV	**Trees**	**(09)**
	Definitions and examples of trees, rooted trees, binary trees and their properties. spanning trees, Minimal spanning trees, Kruskal's algorithm, Prim's algorithm, Dijkstra's shortest path algorithm.	

Course Outcomes: Student should be able to

1) explain the notion of mathematical thinking, mathematical proof's and algorithmic thinking.
2) use rules of inference to test valid and invalid arguments.
3) examine graphs and circuits under isomorphism.
4) evaluate shortest path using Dijkstra's algorithm.

Reference Books:

1. Susanna S. Epp, Discrete Mathematics with Applications, PWS Publishing Company, 1995.(Brooks/Cole, Cengage learning, 2011).
2. Kenneth H. Rosen, Discrete Mathematics and its Applications, McGraw Hill, 2002.
3. J. P. Tremblay and R. Manohar, Discrete Mathematical Structure with Applications, McGraw–Hill.
4. V. Krishnamurthy, Combinatories: Theory and Applications, East-West Press.
5. Kolman, Busby Ross, Discrete Mathematical Structures, Prentice Hall International.
6. R M Somasundaram, Discrete Mathematical Structures, (PHI) EEE, Edition 7.
7. A.B.P.Rao and R.V.Inamdar, A Graduate Text in Computer Mathematics, SUMS [1991]
8. Seymour Lipschutz and Marc Lipson, Discrete Mathematics, Schaum's Outlines Series, TataMcGraw - Hill.

B.Sc. (Mathematics) (Part-III) (Semester–VI)
(Choice Based Credit System)
(Revised from June 2023)

Course Code: BMT-604 (C) Title of Course: Applications of Mathematics in Insurance

Theory: 36 Hrs. (45 Lectures of 48 minutes) Marks – 50 (Credits: 02)

Course Objectives: Student will able to

1) learn statistics and probability theory together with mathematical analysis.
2) study modeling in the various applications.
3) know the different risks that challenge our everyday lives.
4) understand determination of the amount of claims in general insurance.

Credits=2	**SEMESTER-VI** **BMT 604 (C): Applications of Mathematics in Insurance**	**No. of hours per unit**
UNIT I	**Insurance Fundamentals**	**(09)**
	Insurance, Meaning of loss, Chances of loss, peril, hazard and proximate cause in insurance. Costs and benefits of insurance to the society and branches of insurance. Life insurance and various types of general insurance.	
UNIT II	**Life Insurance and Mathematics**	**(09)**
	Insurable loss, exposures features of a loss that is ideal for insurance, Construction of Mortality Tables, Computation of Premium of Life Insurance for a fixed duration and for the whole life.	
UNIT III	**Determination of Claims for General Insurance**	**(09)**
	Determination of claims for general insurance using Poisson distribution, Determination of claims for general insurance using Negative Binomial Distribution, The Polya Case.	
UNIT IV	**Determination of the Amount of Claims in General Insurance**	**(09)**
	Compound Aggregate claim model and its properties, claims of reinsurance, Calculation of a compound claim density function, F-recursive and approximate formulae.	

Course Outcomes: Student should be able to

1) explain life insurance and its various types.
2) use mathematics in computation of premium.
3) determine claims for general insurance.
4) evaluate compound claim density function.

Reference Books:

1. Aswath Damodaran, Corporate Finance -Theory and Practice, John Wiley &Sons. Inc.
2. John C. Hull, Options, Futures, and Other Derivatives, Prentice - Hall of India Private Limited.
3. Sheldon M. Ross, An Introduction to Mathematical Finance, Cambridge University Press.
4. Mark S. Dorfman, Introduction to Risk Management and Insurance, Prentice Hall, EnglwoodCliffs, New Jersey.

B.Sc. (Mathematics) (Part-III) (Semester–V)
(Choice Based Credit System)
(Revised from June 2023)

Course Code: BMP-508 Title of Course: Operations Research Techniques

Sr.No.	Title of the Experiment	Sessions
	Linear Programming	
1	Simplex Method : Maximization Case	1
2	Simplex Method : Minimization Case	1
3	Two-Phase Method	1
4	Big-M-Method	1
	Transportation Problems	
5	North- West Corner Method	1
6	Least Cost Method	1
7	Vogel's Approximation Method	1
8	Optimization of T.P. by Modi Method	1
	Assignment Problems	
9	Hungarian Method	1
10	Maximization Case in Assignment Problem	1
11	Unbalanced Assignment Problems	1
12	Travelling Salesman Problem	1
	Game Theory	
13	Games with saddle point	1
14	Games without saddle point: (Algebraic method)	1
15	Games without saddle point: a) Arithmetic Method b) Matrix Method	1
16.	Games without saddle point: Graphical method	1
	Total	**16**

Reference Books:

1. Sharma S.D., Operations Research - Theory Methods and Applications, Kedarnath, Ramnath Meerut, Delhi Reprint 2015.
2. Mohan, C. and Deep, Kusum, Optimization Techniques, New Age,2009.
3. Mittal, K. V. and Mohan, C., Optimization Methods in Operations, Research and Systems Analysis, New Age, 2003.
4. Taha, H.A.: Operations Research – An Introduction, Prentice Hall, (7th Edition), 2002.
5. Ravindran, A., Phillips, D. T and Solberg, J. J., Operations Research: Principles and Practice,John Willey and Sons, 2nd Edition, 2009.
6. J. K. Sharma: Operation Research: Theory and Applications, Laxmi Publications, 2017.
7. KantiSwarup, P.K. Gupta and Manmohan, Operation Research, S. Chand & Co.
8. G. Hadley: Linear programming, Oxford and IBH Publishing Co.

B.Sc. (Mathematics) (Part-III) (Semester–V)
(Choice Based Credit System)
(Revised from June 2023)
Course Code: BMP-509 Title of Course: Numerical Methods

Sr.No.	Title of the experiment	Sessions
1	Bisection method	1
2	Secant method	1
3	Newton's method	1
4	Gauss elimination method	1
5	Gauss-Jordan method	1
6	Jacobi iteration scheme	1
7	Gauss-Seidel method	1
8	Power method	1
9	Newton's forward interpolation	2
10	Newton's backward interpolation	1
11	Lagrangian interpolation	1
12	Divided difference interpolation	1
13	Trapezoidal rule	1
14	Simpson's 1/3rd rule	1
15	Second order Runge-Kutta method	1
16	Fourth order Runge-Kutta method	1
	Total	16

Reference Books:

1. Devi Prasad, An Introduction to Numerical Analysis (Third Edition), Narosa Publishing House. Mohan, C. and Deep, Kusum, Optimization Techniques, New Age,2009.
2. S. S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall of India.
3. J.H. Mathews, Numerical Methods for Mathematics, Science and Engineering, Prentice Hall of India.
4. K. SankaraRao, Numerical Methods for Scientists and Engineers, Prentice Hall of India.
5. Bhupendra Singh, Numerical Analysis, Pragati Prakashan, KantiSwarup, P.K. Gupta and Manmohan, Operation Research, S. Chand & Co.

B.Sc. (Mathematics) (Part-III) (Semester–VI)
(Choice Based Credit System)
(Revised from June 2023)

Course Code: BMP-605 Title of Course: Mathematical Computation Using Python

Sr.No.	Title of the experiment	Sessions
1	**Introduction to Python:** Python, Anaconda, Spyder IDE, Python Identifiers and Keywords, data types, simple mathematical operation, Indentation and Comments., Input and Output, First Python program.	**1**
2	**Expression and operators:** Expression, Boolean expression, logical operations: comparison operator, membership operator, identity operator, bitwise operator. Order of evaluation. File Handling: open, read, write, append modes of file.	**1**
3	**Conditional Statements:** if-else, nested if-else, if-elif-else, try-except block.	**1**
4	**Looping Statements, Control statements:** Looping Statements: for loop, while loop , Nested loops Control Statements: break, continue and pass.	**1**
5	**Functions:** Built-in functions, User-defined functions, Arguments, recursive function, Python Anonymous/Lambda Function, Global, Local and Nonlocal variables and return statement.	**1**
6	**Modules and packages in Python :** Modules, import, import with renaming, from-import statement, math module ,cmath module , random module, packages.	**1**
7	**Python Data structure:** Strings, list, tulpes, dictionary, set and array.	**1**
8	**Operations on set and array:** Set operations, Intersection, union, difference, symmetric difference, searching and sorting.	**1**
9	**Systems of linear algebraic equations:** Gauss Elimination Method, LU Decomposition Methods	**1**
10	**Roots of Equations:** Bisection, Newton-Raphson Method	**1**
11	**Initial Value Problems:** Euler‟s Method, Runge-Kutta Methods.	**1**
12	Magic square and Area calculation without measurement.	**1**
13	**Graph Theory : Networkx** Grpah, nodes, edges, directed graph, multigraph, drawing graph, Google page rank by random walk method	**1**
14	**Collatz conjecture and Monte Hall problem**	**1**
15	**Data compression using Numpy**	**1**
16	**Data visualization in Python:** 2D and 3D plot in python : line plot, bar plot, histogram plot, scatter plot, pie plot, area plot, Mandelbrot fractal set visualization.	**1**
	Total	**16**

Reference Books:

1. Jaan Kiusalaas, *Numerical Methods in Engineering with Python3,* Cambridge University Press.
2. Amit Saha, Doing Math with Python, No Starch Press, 2015.
3. Yashwant Kanetkar and Aditya Kanetkar, Let Us Python, BPB Publication, 2019.

B.Sc. (Mathematics) (Part-III) (Semester–VI)
(Choice Based Credit System)
(Revised from June 2023)

Course Code: BMP-609 Title of Course: Project, Study- Tour, Viva – Voce

Section	Activity	Marks
A	**Project**	**(30 Marks)**
	Each student of B.Sc. III is expected to read, collect, understand the culture of Mathematics, its historic development. He is expected to get adequate Mathematical concepts, innovations and relevance of Mathematics. Report of the project work should be submitted to the Department of Mathematics. Evaluation of the project report will be done by the external examiners at the time of annual examination.	
B	**Study Tour/ Seminar**	**(10 Marks)**
C	**Viva-Voce (on the project report)**	**(10 Marks)**

B.Sc. (Mathematics) (Part-III) (Semester–V)
(Choice Based Credit System)
(Revised from June 2023)

Course Code: SECCMT-507 Title of Course: Basic Numerical Skills in Mathematics

Theory: 25 lectures. Marks – 20 (Credits: 01)

Course Objectives: Student will able to

1) learn the geometry of lines and conics in the Euclidean plane.
2) study geometry with a degree of confidence and will gain fluency in the basics of Euclidean geometry.
3) understand three dimensional structures and their properties.

Credits=1	**SEMESTER-V** **SECCMT-507: Basic Numerical Skills in Mathematics**	**No. of lectures per unit**
UNIT I	**Sketching Techniques**	**(08)**
	Techniques for sketching parabola, ellipse and hyperbola. Reflection properties of parabola, ellipse and hyperbola.	
UNIT II	**Classification of Quadratic Equations**	**(08)**
	Classification of quadratic equations representing lines, parabola, ellipse and hyperbola.	
UNIT III	**Surfaces**	**(09)**
	Spheres, Cylindrical surfaces. Illustrations of graphing standard quadric surfaces like cone, ellipsoid.	

Course Outcomes: Student should be able to

1) evaluate the distance and angle also identify conics.
2) sketch conic sections and classification using quadratic equations.
3) construct standard quadratic surfaces.

Reference Books:

1. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi,2005.
2. H. Anton, I. Bivens and S. Davis, *Calculus*, John Wiley and Sons (Asia) Pvt. Ltd.,2002.
3. S.L. Loney, *The Elements of Coordinate Geometry*, McMillan and Company, London.
4. R.J.T. Bill, *Elementary Treatise on Coordinate Geometry of Three Dimensions*, McMillan India Ltd., 1994.

B.Sc. (Mathematics) (Part-III) (Semester–VI)
(Choice Based Credit System)
(Revised from June 2023)

Course Code: SECCMT-607

Title of Course: Entrepreneurship Development in Mathematics

Theory: 25 lectures. Marks – 20 (Credits: 01)

Course Objectives: Student will able to

1) acquire necessary knowledge and skills required for organizingand carrying out entrepreneurial activities
2) develop the ability of analyzing and understanding business situations in which entrepreneurs act and tomaster the knowledge necessary to plan entrepreneurial activities.
3) study various aspects of entrepreneurship – especially of taking over the risk.

Credits=1	**SEMESTER-VI** **SECCMT-607: Entrepreneurship Development in Mathematics**	**No. of lectures per unit**
UNIT I	**Entrepreneurship, Creativity & Opportunities**	**(10)**
	Concept, Classification &Characteristics of Entrepreneur, Creativity and Risk taking, Risk Situation, Types of risk& risk takers, Business Reforms,Process of Liberalization, Reform Policies,Impact of Liberalization, Emerging high growth areas, Business Idea Methods and techniques to generate business idea, Transforming Ideas in to opportunities transformation involves, Assessment of idea&Feasibility of opportunity SWOT Analysis **Information and Support Systems** Information needed and Their Sources: Information related to project, Information related to support system, Information related to procedures and formalities, Support Systems Small Scale Business Planning, Requirements, Govt. & Institutional Agencies, Formalities Statutory Requirements and Agencies. **Market Assessment** Marketing - Concept and Importance Market Identification, Survey Key components Market Assessment	
UNIT II	**Business Finance & Accounts**	**(10)**
	Business Finance Cost of Project Sources of Finance Assessment of working capital Product costing Profitability Break Even Analysis Financial Ratios and Significance **Business Account** Accounting Principles, Methodology Book Keeping Financial Statements Concept of Audit **Business Plan** Business plan steps involved from concept to commissioning, Activity Recourses, Time, Cost	

	Project Report Meaning and Importance, Components of project report/profile (Give list), Project Appraisal: 1) Meaning and definition 2) Technical, Economic feasibility 3) Cost benefit Analysis	
UNIT III	**Enterprise Management and Modern Trends**	**(05)**
	Enterprise Management: Essential roles of Entrepreneur in managing enterpriseProduct Cycle: Concept and importance Probable Causes of Sickness Quality Assurance: Importance of Quality, Importance of testing E-Commerce: Concept and Process **Mathematics Entrepreneur** Assess yourself-are you an entrepreneur? Prepare project report for mathematics and study its feasibility.	

Reference Books:

1. Alpana Trehan, Entrepreneurship. Wiley India.
2. G. N. Pandey, A complete guide to successful Entrepreneurship, Vikas Publications.