

DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
(A Central University)
Department of Mathematics and Statistics
B.Sc./B.A.–III Semester

MTS SE 311	Logic and Sets	L	T	P	C
		2	0	0	2
		Max. Marks : 100			

Mid Sem-20

Internal assessment-20

End Sem-60

Course Learning Outcomes: This course will enable the students to:

- (i) Employ truth table in various logical situations.
- (ii) Learn about the fundamental concepts Propositional equivalence
- (iii) Understand counting principle

Unit – I:

Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators.

(6 hours)

Unit – II:

Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.

(6 hours)

Unit – III:

Sets, subsets, Set operations, the laws of set theory and Venn diagrams. Examples of finite and infinite sets. Finite sets and counting principle. Empty set, properties of empty set. Standard set operations.

(6 hours)

Unit – IV:

Classes of sets. Power set of a set. Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections.

(6 hours)

Unit – V:

Relation: Product set, Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation.

(6 hours)

Suggested Readings:

1. R.P. Grimaldi, *Discrete Mathematics and Combinatorial Mathematics*, Pearson Education, 1998.
2. P.R. Halmos, *Naive Set Theory*, Springer, 1974.

Essential Readings:

1. E. Kamke, *Theory of Sets*, Dover Publishers, 1950.

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
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Department of Mathematics and Statistics
B.Sc./B.A.-III Semester

MTS SE 312	Analytical Geometry	L	T	P	C
		2	0	0	2
		Max. Marks : 100			

Mid Sem-20

Internal assessment-20

End Sem-60

Course Learning Outcomes: After completion of this course the students will be able to:

- (i) Be able to basic properties of various conic sections.
- (ii) Learn about the fundamental concepts of quadratic equations
- (iii) Understand quadratic surfaces

Unit – I: Techniques for sketching parabola, ellipse and hyperbola.	(6 hours)
Unit – II: Reflection properties of parabola, ellipse and hyperbola.	(6 hours)
Unit – III: Classification of quadratic equations representing lines, parabola, ellipse and hyperbola.	(6 hours)
Unit – IV: Spheres, Cylindrical surfaces.	(6 hours)
Unit – V: Illustrations of graphing standard quadric surfaces like cone, ellipsoid	(6 hours)

Suggested Readings:

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.

Additional Readings:

1. S.L. Loney, *The Elements of Coordinate Geometry*, McMillan and Company, London.
2. R.J.T. Bill, *Elementary Treatise on Coordinate Geometry of Three Dimensions*, McMillan India Ltd., 1994.

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR

(Central University)

Department of Mathematics and Statistics

VDM OE 101	Vedic Arithmetic	L	T	P	C
		2	0	0	2
		Max. Marks : 100			

Mid Sem-20

Mid Sem-20

Internal Assessment-20

End Sem-60

Unit-I: Multiplication

1. Ekadhikenpurven method (multiplication of two numbers of two digits)
2. Eknunenpurven method (multiplication of two numbers of three digits)
3. Urdhvatiragbhyam method (multiplication of two numbers of three digits)
4. Nikhilam Navtashchramam Dashtaha (multiplication of two numbers of three digits)
5. Combined Operations

Unit-II: Division and Divisibility

Part A: Division

1. Nikhilam Navtashchramam Dashtaha (two digits divisor)
2. Paravartya Yojyet method (three digits divisor)

Part B: Divisibility

1. Ekadhikenpurven method (two digits divisor)
2. Eknunenpurven method (two digits divisor)

Unit-III: LCM and HCF

Unit-IV: Power and Root

Power: (i) Square (two digit numbers), (ii) Cube (two digit numbers).

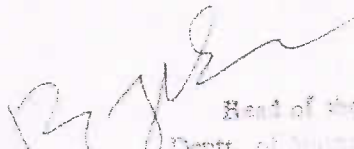
Root: (i) Square root (four digit number) (ii) Cube root (six digit numbers)

Unit-V: Contribution of Indian Mathematicians (In light of Arithmetic)

1. Aryabhatt
2. Brahmagupt
3. Mahaveeracharya
4. Bharti Krishna Tirtha

Recommended Books:

1. Vedic Mathematics, Motilal Banarsi Das, New Delhi.
2. Vedic Ganita: Vihangama Drishti-1, Siksha Sanskriti Uthana Nyasa, New Delhi.
3. Vedic Ganita Praneta, Siksha Sanskriti Uthana Nyasa, New Delhi.
4. Vedic Mathematics: Past, Present and Future, Siksha Sanskriti Uthana Nyasa, New Delhi.
5. Leelavati, Chokhambba Vidya Bhavan, Varanasi.
6. Bharatiya Mathematicians, Sharda Sanskrit Sansthan, Varanasi.


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Dr. H. S. Gaur, Vedic Mathematics



DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
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Department of Mathematics and Statistics
B.Sc.\ B.A.-III Semester

MTS SE 313	Integral Calculus	L	T	P	C
		2	0	0	2
		Max. Marks : 100			

Mid Sem-20

Internal assessment-20

End Sem-60

Course Learning Outcomes: After completion of this course the students will be able to:

- (i) Be able to basic properties of Integration by Partial fractions.
- (ii) Learn Properties of definite integrals
- (iii) Understand Double and Triple integrals and be able to apply them in various applications

Unit – I: Integration by Partial fractions, integration of rational and irrational functions. (6 hours)
Unit – II: Properties of definite integrals. Reduction formulae for integrals of rational, trigonometric, exponential functions. (6 hours)
Unit – III: Reduction formulae for logarithmic functions and others. (6 hours)
Unit – IV: Areas and lengths of curves in the plane, volumes and surfaces of solids of revolution. (6 hours)
Unit – V: Double and Triple integrals. (6 hours)

Suggested Readings:

1. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.

Essential Readings:

1. H. Anton, I. Bivens and S. Davis, *Calculus*, John Wiley and Sons (Asia) P. Ltd., 2002.

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR

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Department of Mathematics and Statistics

VDM OE 102	Vedic Algebra	L	T	P	C
		2	0	0	2
		Max. Marks : 100			

Mid Sem-20

Internal Assessment-20

End Sem-60

Unit-I: Multiplication (Quadratic expressions of single variable)

1. Urdhvatiragbhyam Method
2. Combined Operations

Unit-II: Division and Factorization

1. Division (Divisor: Linear expression of single variable)
2. Factorization (Quadratic expression of single variable)

Unit-III: LCM and HCF

Unit-IV: Solution of linear simultaneous equations

Unit-V: Contribution of Indian Mathematicians (In light of Algebra)

1. Varahmihir
2. Bhaskaracharya
3. Neelkanth Somayya
4. Bharti Krishna Tirtha

Recommended Books:

1. Vedic Mathematics, Motilal Banarsi Das, New Delhi.
2. Vedic Ganita: Vihangama Drishti-1, Siksha Sanskriti Uthana Nyasa, New Delhi.
3. Vedic Ganita Praneta, Siksha Sanskriti Uthana Nyasa, New Delhi.
4. Vedic Mathematics: Past, Present and Future, Siksha Sanskriti Uthana Nyasa, New Delhi.
5. Beejganitam, Chokhambba Vidya Bhavan, Varanasi.
6. Bharatiya Mathematicians, Sharda Sanskrit Sansthan, Varanasi.


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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
(A Central University)
Department of Mathematics and Statistics
B.Sc./ B.A.–IV Semester

B.Sc. (B.A.) - IV Semester					
MTS SE 411	Vector Calculus	L	T	P	C
		2	0	0	2
		Max. Marks : 100			

Mid Sem-20

Internal assessment-20

End Sem-60

Course Learning Outcomes: This course will enable the students to:

1. Learn the concept of vectors and their differentiation.
2. Understand the derivative of sum dot and cross product of vector functions.
3. Optimize the application of vector functions in form of Gradient, divergence and curl.

Unit – I: Differentiation of a vector function.	(6 hours)
Unit – II: Partial differentiation of a vector function	(6 hours)
Unit – III: Derivative of sum and dot product of two vectors and their properties.	(6 hours)
Unit – IV: Derivative of cross product of two vectors and their properties.	(6 hours)
Unit – V: Gradient, divergence and curl.	(6 hours)

Suggested Readings :

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) P. Ltd. 2002.

Essential Readings:

1. P.C. Matthew's, *Vector Calculus*, Springer Verlag London Limited, 1998.

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR

(Central University)

Department of Mathematics and Statistics

VDM OE 103	Vedic Geometry	L	T	P	C
		2	0	0	2
		Max. Marks : 100			

Mid Sem-20

Mid Sem-20
Internal Assessment-20
End Sem-60

Unit-I: Concept of Bhaudhayana Number (BN)

1. BN of an angle
2. Multiplication of a constant in a BN
3. BN of complementary angles
4. BN of sum and difference ($\alpha \pm \beta$) of an angle.
5. BN of half angle

Unit-II: Trigonometry

1. Definitions of trigonometric ratios
2. Trigonometric Identities

Unit-III: Co-ordinate Geometry

Different forms of straight lines.

Unit-IV: Complex Numbers

Multiplication, Division and Square root.

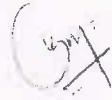
Unit-V: Contribution of Bharatiya Mathematicians (In the light of Geometry)

1. Bhaskaracharya
2. Madhavan
3. Parmeshvaran
4. Bharti Krishna Tirtha
5. Baudhayana

Recommended Books:

1. Vedic Mathematics, Motilal Banarsi Das, New Delhi.
2. Vedic Ganita: Vihangama Drishti-1, Siksha Sanskriti Uthana Nyasa, New Delhi.
3. Vedic Ganita Praneta, Siksha Sanskriti Uthana Nyasa, New Delhi.
4. Vedic Mathematics: Past, Present and Future, Siksha Sanskriti Uthana Nyasa, New Delhi.
5. Beejganitam, Chokhambba Vidya Bhavan, Varanasi.
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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR

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Department of Mathematics and Statistics

VDM OE 104	Assignment & Presentation Work	L	T	P	C
		0	0	2	2
		Max. Marks : 100			

Internal Assessment-(20+20)

End Sem-60

1. Original Manuscript on any one of the following subjects:

- Vedic Mathematics
- Contribution of Indian Mathematicians
- Ancient Bharatiya Mathematical Work (Leelavati, Sulba Sutra, Ganita Kaumudi etc. or any other Ancient Indian Text)

The manuscript may be a review article based upon personal observations or research article giving some new idea.

2. Candidates may deliver lecture in any educational institute (School or College) on Vedic Mathematics and feedback from head of the institute may be submitted to the University. Feedback must be on letter head of the institute duly signed and stamped.

Pr. J. S.

Head of the Department

Department of Mathematics and Statistics

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
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Department of Mathematics and Statistics
B.Sc.\ B.A.-IV Semester

MTS SE 412	Theory of Equations	L	T	P	C
		2	0	0	2
		Max. Marks : 100			

Mid Sem-20

Internal assessment-20

End Sem-60

Course Learning Outcomes: This course will enable the students to:

1. Learn the basic concept of polynomial.
2. Explore polynomial using graphical representation.
3. Find the maximum and minimum value of polynomials.
4. Understand the equations and their solutions.

Unit – I: General properties of polynomials, Graphical representation of a polynomials, maximum and minimum values of a polynomials.	(6 hours)
Unit – II: General properties of equations, Descarte's rule of signs positive and negative rule.	(6 hours)
Unit – III: Relation between the roots and the coefficients of equations. Symmetric functions, Applications of symmetric function of the roots.	(6 hours)
Unit – IV: Transformation of equations. Solutions of reciprocal and binomial equations.	(6 hours)
Unit – V: Algebraic solutions of the cubic and biquadratic. Properties of the derived functions.	(6 hours)

Suggested Readings :

1. W.S. Burnside and A.W. Panton, *The Theory of Equations*, Dublin University Press, 1954.

Essential Readings :

1. C. C. MacDuffee, *Theory of Equations*, John Wiley & Sons Inc., 1954.

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
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Department of Mathematics and Statistics
B.Sc./B.A.–IV Semester

MTS SE 413	Elementary Number Theory	L	T	P	C
		2	0	0	2
		Max. Marks : 100			

Mid Sem-20

Internal assessment-20

End Sem-60

Course Learning Outcomes: This course will enable the students to:

1. Understand the concept of numbers and impact of algorithm on it.
2. Familiar with several theorems used for numbers.
3. Explore the Möbius inversion formula, the greatest integer function, Euler's phi-function for numbers.

Unit – I: Division algorithm, Lame's theorem, linear Diophantine equation, fundamental theorem of arithmetic. (6 hours)
Unit – II: Prime counting function, statement of prime number theorem, Goldbach conjecture. Binary and decimal representation of integers, linear congruences. (6 hours)
Unit – III: Complete set of residues. Number theoretic functions, sum and number of divisors. (6 hours)
Unit – IV: Totally multiplicative functions. Definition and properties of the Dirichlet product. (6 hours)
Unit – V: The Möbius inversion formula, the greatest integer function, Euler's phi-function. (6 hours)

Suggested Readings :

1. David M. Burton, *Elementary Number Theory* 6th Ed., Tata McGraw-Hill Edition, Indian reprint, 2007.

Essential Readings:

1. Richard E. Klima, Neil Sigmon, Ernest Stitzinger, *Applications of Abstract Algebra with Maple*, CRC Press, Boca Raton, 2000.
2. Neville Robinns, *Beginning Number Theory*, 2nd Ed., Narosa Publishing House Pvt. Limited, Delhi, 2007.

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
(A Central University)
Department of Mathematics and Statistics
B.Sc.\ B.A.–V Semester

MTS SE 511	Portfolio Optimization	L	T	P	C
		2	0	0	2
		Max. Marks : 100			

Mid Sem-20

Internal assessment-20

End Sem-60

Course Learning Outcomes: This course will enable the students to:

- (i) Understand basic principles of arbitrage and time value of money.
- ii) Realize the importance of mean and variance in portfolio optimization.
- iii) Study Markowitz model and its applications.

Unit – I:

Basic principles: Comparison, arbitrage and risk aversion, Interest (simple and compound, discrete and continuous), time value of money.

(6 hours)

Unit – II:

Inflation, net present value, internal rate of return (calculation by bisection and Newton-Raphson methods), Comparison of NPV and IRR. Bonds, bond prices and yields.

(6 hours)

Unit – III:

Floating-rate bonds, immunization, Asset return, short selling, portfolio return.

(6 hours)

Unit – IV:

Brief introduction to expectation, variance, covariance and correlation, Random returns, portfolio mean return and variance.

(6 hours)

Unit – V:

Diversification, portfolio diagram, feasible set, Markowitz model (review of Lagrange multipliers for 1 and 2 constraints).

(6 hours)

Suggested Readings:

1. David G. Luenberger, *Investment Science*, Oxford University Press, Delhi, 1998.

Essential Readings:

1. John C. Hull, *Options, Futures and Other Derivatives*, 6th Ed., Prentice-Hall India, Indian reprint, 2006.
2. Sheldon Ross, *An Elementary Introduction to Mathematical Finance*, 2nd Ed., Cambridge University Press, USA, 2003.

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
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Department of Mathematics and Statistics
B.Sc.\ B.A.-V Semester

MTS SE 512	Mathematical Modeling	L	T	P	C
		2	0	0	2
		Max. Marks : 100			

Mid Sem-20

Internal assessment-20

End Sem-60

Course Learning Outcomes: This course will enable the students to:

- (i) Understand the basic principles and applications of differential equations.
- ii) Understand the use of simultaneous differential equations in Physical sciences.
- iii) Study gravitational potential.

Unit – I: Applications of differential equations: the vibrations of a mass on a spring, mixture problem.	(6 hours)
Unit – II: Free damped motion, forced motion, resonance phenomena.	(6 hours)
Unit – III: Electric circuit problem, mechanics of simultaneous differential equations.	(6 hours)
Unit – IV: Applications to Traffic Flow. Vibrating string, vibrating membrane.	(6 hours)
Unit – V: Conduction of heat in solids, gravitational potential, conservation laws.	(6 hours)

Suggested Readings:

1. Shepley L. Ross, *Differential Equations*, 3rd Ed., John Wiley and Sons, 1984.

Essential Readings:

1. I. Sneddon, *Elements of Partial Differential Equations*, McGraw-Hill, International Edition, 1967.

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
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Department of Mathematics and Statistics
B.Sc.\ B.A.–VI Semester

MTS SE 513	Boolean Algebra	L	T	P	C
		2	0	0	2
		Max. Marks : 100			

Mid Sem-20

Internal assessment-20

End Sem-60

Course Learning Outcomes: This course will enable the students to:

- i) Appreciate the basic principles and applications of Boolean Algebra.
- ii) Understand the use of lattices as algebraic structures.
- iii) Study applications of switching circuits.

Unit – I:

Definition, examples and basic properties of ordered sets, maps between ordered sets, duality principle, maximal and minimal elements.

(6 hours)

Unit – II:

Lattices as ordered sets, complete lattices, lattices as algebraic structures, sub lattices. Products and homomorphisms.

(6 hours)

Unit – III:

Definition, examples and properties of modular and distributive lattices, Boolean algebras.

(6 hours)

Unit – IV:

Boolean polynomials, minimal forms of Boolean polynomials, Quinn-McCluskey method.

(6 hours)

Unit – V:

Karnaugh diagrams, switching circuits and applications of switching circuits.

(6 hours)

Suggested Readings: 1. B A. Davey and H. A. Priestley, *Introduction to Lattices and Order*, Cambridge University Press, Cambridge, 1990.

Essential Readings:

1. Rudolf Lidl and Günter Pilz, *Applied Abstract Algebra*, 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
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Department of Mathematics and Statistics
B.Sc.\ B.A.–VI Semester

MTS SE 611	Mathematical Finance	L	T	P	C
		2	0	0	2
		Max. Marks : 100			

Mid Sem-20

Internal assessment-20

End Sem-60

Course Learning Outcomes: This course will enable the students to:

- Understand financial markets and derivatives including options and futures.
- Appreciate pricing and hedging of options, interest rate swaps and no-arbitrage pricing concepts.
- Learn stochastic analysis, Ito's formula, Ito integral and the Black-Scholes model.
- Study and use Hedging parameters, trading strategies and currency swaps.

Unit-I: Basic Theory of Interest

Principal and interest: simple, compound and continuous; Net present value, Internal rates of return and their comparison.

(6 hours)

Unit-II: Bonds and Derivatives

Spot rates, forward rates, Exchange-traded markets and over-the-counter markets; Derivatives: Forward contracts, Future contracts, Options, Types of traders.

(6 hours)

Unit-III: Mechanics of Options Markets

No-arbitrage principle, Short selling, Forward price for an investment asset; Types of options: Call and put options, Option positions, Underlying assets, Factors affecting option prices.

(6 hours)

Unit-IV: Stochastic Analysis of Stock Prices

Binomial option pricing model, Risk neutral valuation: European and American options on assets following binomial tree model.

(6 hours)

Unit-V: Black-Scholes Model and Hedging Parameters

Volatility, Extension of risk-neutral valuation to assets following geometric Brownian motion, Black-Scholes formula for European options. Hedging.

(6 hours)

Suggested Readings:

- John C. Hull & Sankarshan Basu (2018). *Options, Futures and Other Derivatives* (10th edition). Pearson Education.
- Sheldon M. Ross (2011). *An Elementary Introduction to Mathematical Finance*.

Essential Readings:

- David G. Luenberger (2013). *Investment Science* (2nd edition). Oxford University Press.

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
(A Central University)
Department of Mathematics and Statistics
B.Sc.\ B.A.–VI Semester

MTS SE 612	MATLAB	L	T	P	C
		2	0	0	2
		Max. Marks : 100			

Mid Sem-20

Internal assessment-20

End Sem-60

Course Learning Outcomes: This course will enable the students to:

- i) Analyse the data.
- ii) Plot 2D and 3D graphs.
- iii) Develop the MATLAB code for a particular problem.

Unit – I: Introduction to MATLAB, MATLAB environment, variables and arrays, scalar and array operations.	(6 hours)
Unit – II: Displaying output data, introduction to plotting, 2-3 dimensional plots.	(6 hours)
Unit – III: Arithmetic operators, relational operators, logical operators.	(6 hours)
Unit – IV: Branching statements, if construct, if else construct, switch construct	(6 hours)
Unit – V: While loop, for loop, nesting loops. Solution of Differential equations.	(6 hours)

Suggested Readings:

1. Stephen J. Chapman, Matlab Programming for Engineers, 4th edition, Thomson Learning, 2007.
2. Rudra Pratap, Getting started with Matlab 7, oxford university Press, 2009.

Essential Readings:

3. Hunt, Brian R., Ronald L. Lipsman, and Jonathan M. Rosenberg. A guide to MATLAB: for beginners and experienced users. Cambridge university press, 2014.
4. Register, Andy H. A guide to MATLAB object-oriented programming. Chapman and Hall/CRC, 2007.
5. Otto, Steve, and James P. Denier. An introduction to programming and numerical methods in MATLAB. Springer Science & Business Media, 2005.

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
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Department of Mathematics and Statistics
B.Sc.\B.A.–VI Semester

MTS SE 613	Graph Theory	L	T	P	C
		2	0	0	2
		Max. Marks : 100			

Mid Sem-20 **Internal assessment-20** **End Sem-60**
Course Learning Outcomes: This course will enable the students to:

- i) Learn the basic properties of graphs.
- ii) Understand the Travelling salesman's problem.
- iii) Form Floyd-Warshall algorithm and apply it in various situations.

Unit – I: Definition, examples and basic properties of graphs, pseudo graphs, complete graphs. (6 hours)
Unit – II: Bipartite graphs, Isomorphism of graphs, paths and circuits. (6 hours)
Unit – III: Eulerian circuits, Hamiltonian cycles, the adjacency matrix, weighted graph. (6 hours)
Unit – IV: Travelling salesman's problem, shortest path. (6 hours)
Unit – V: Dijkstra's algorithm, Floyd-Warshall algorithm. (6 hours)

Suggested Readings:

1. Edgar G. Goodaire and Michael M. Parmenter, *Discrete Mathematics with Graph Theory* 2nd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2003.

Essential Readings:

1. Rudolf Lidl and Günter Pilz, *Applied Abstract Algebra*, 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
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Department of Mathematics and Statistics
B.Sc.\ B.A.–III Semester

STAT- SE-311	Portfolio Optimization	L	T	P	C
		2	0	0	2
		Max. Marks : 100			

Mid Sem-20
Internal assessment-20
End Sem-60

- Objectives:** (1) To learn various financial markets world wise.
(2) To learn understanding designing portfolio.
(3) To study expected risk and return of portfolio.
(4) To study portfolio optimization by using mean variance method.
(5) To find various measures of portfolio.

UNIT I Financial markets. Investment objectives.	(06 hours)
UNIT II Measures of return and risk. Types of risks. Portfolio of assets.	(06 hours)
UNIT III Expected risk and return of portfolio. Diversification.	(06 hours)
UNIT IV Mean-variance portfolio optimization- the Markowitz model and the two-fund theorem, risk-free assets and one fund theorem, efficient frontier.	(06 hours)
UNIT V Portfolio performance evaluation measures.	(06 hours)

Learning Outcomes: After completion of this course the students will be able to perform mean variance portfolio optimization using Markowitz model.

Essential Readings:

1. H.M. Markowitz, Mean-Variance Analysis in Portfolio Choice and Capital Markets, Blackwell, New York, 1987.
2. D.G. Luenberger, Investment Science, 2nd Ed., Oxford University Press, 2013.

Suggested Reading :

- 1 F.K. Reilly, Keith C. Brown, *Investment Analysis and Portfolio Management*, 10th Ed., South-Western Publishers, 2011.

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
(A Central University)

Department of Mathematics and Statistics

B.Sc\ B.A.–III Semester

STAT-SE-312	Mathematical Analysis-I	L	T	P	C
		2	0	0	2
		Max. Marks : 100			

Mid Sem-20

Internal assessment-20

End Sem-60

- Objectives:** (1) To explain generation of real numbers & its properties.
(2) To learn sequences & their convergence.
(3) To understand general principle of convergence.
(4) To grasp the concept of $\limsup$ & $\liminf$ & series.
(5) To test the convergence of series.

UNIT-I	(06 hours)
Real Analysis: Representation of real numbers as points on the line and the set of real numbers as complete ordered field. Bounded and unbounded sets.	
UNIT-II	(06 hours)
Neighborhoods and limit points. Supremum and infimum, derived sets, open and closed sets, sequences and their convergence.	
UNIT-III	(06 hours)
limits of some special sequences such as r^n , $(1 + 1/n)^n$ and $n^{1/n}$ and Cauchy's general principle of convergence, Cauchy's first theorem on limits.	
UNIT-IV	(06 hours)
Monotonic sequences limit superior and limit inferior of a bounded sequence. Infinite series, positive term series and their convergence, Comparison test.	
UNIT-V	(06 hours)
D'Alembert's ratio test, Cauchy's nth root test, Raabe's test. Gauss test, Cauchy's condensation test and integral test (Statements and Examples only), absolute convergence of series, Leibnitz's test .	

Learning Outcomes: After completion of course the students will be able to understand the real number systems & they can explain the behavior of sequence & series of real numbers.

Essential Readings:

1. **Somasundram D. and Chaudhary B.:** A First Course in Mathematical Analysis, Narosa Publishing House, New Delhi, 1987.
2. **Gupta S.L. and Nisha Rani:** Principles of Real Analysis, Vikas Publ. House Pvt. Ltd., New Delhi, 1995.

Suggested Reading :

1. **Malik S.C. and Savita Arora:** Mathematical Analysis, Second Edition, Wiley Eastern Limited, New Age International Limited, New Delhi, 1994.

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
(A Central University)
Department of Mathematics and Statistics
B.Sc.\ B.A.–IV Semester

STAT-SE-411	Mathematical Finance	L	T	P	C
		2	0	0	2
		Max. Marks : 100			

Mid Sem-20
Internal assessment-20
End Sem-60

Objectives: (1) To study interest rate arbitrage and risk aversion.
(2) To explain the NPV and IRR in context of portfolio optimization.
(3) To understand portfolio returns with the concept of immunization.
(4) To study portfolio return.
(5) To explore Markowitz model.

Unit-I: Basic principles: Comparison, arbitrage and risk aversion, Interest (simple and compound, discrete and continuous).	(06 hours)
Unit-II: Time value of money, inflation, net present value, internal rate of return (calculation by bisection and Newton-Raphson methods).	(06 hours)
Unit-III: Comparison of NPV and IRR. Bonds, bond prices and yields. Floating-rate bonds, immunization.	(06 hours)
Unit-IV: Asset return, short selling, portfolio return, (brief introduction to expectation, variance, covariance and correlation).	(06 hours)
Unit-V: Random returns, portfolio mean return and variance, diversification, portfolio diagram, feasible set, Markowitz model (review of Lagrange multipliers for 1 and 2 constraints).	(06 hours)

Learning Outcomes: After studying the syllabus the student will be able to understand basics of Mathematical Finance as an investment science.

Essential Readings:

1. John C. Hull, *Options, Futures and Other Derivatives*, 6th Ed., Prentice-Hall India, Indian reprint, 2006.
2. Sheldon Ross, *An Elementary Introduction to Mathematical Finance*, 2nd Ed., Cambridge University Press, USA, 2003.

Suggested Readings:

1. David G. Luenberger, *Investment Science*, Oxford University Press, Delhi, 1998.

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
(A Central University)
Department of Mathematics and Statistics
B.Sc.\ B.A.-IV Semester

STAT-SE-412	Mathematical Analysis-II	L	T	P	C
		2	0	0	2
		Max. Marks : 100			

Mid Sem-20
Internal assessment-20
End Sem-60

- Objectives:** (1) To explain continuity and differentiability & its properties.
(2) To learn MVT.
(3) To understand series expansions of various functions.
(4) To learn Newton-Raphson method.
(5) To study interpolation.

UNIT-I Review of limit, continuity and differentiability, uniform Continuity and boundedness of a function. Rolle's Mean Value theorem.	(06 hours)
UNIT-II Lagrange's Mean Value theorem, Taylor's theorem with lagrange's and Cauchy's form of remainder (without proof).	(06 hours)
UNIT-III Taylor's and Maclaurin's series expansions of $\sin x$, $\cos x$, $\log(1+x)$, $\exp x$, $(1+x)^n$.	(06 hours)
UNIT-IV Numerical Analysis: Factorial, finite differences and interpolation. Operators, E and divided difference. Bisection method and Newton-Raphson method.	(06 hours)
UNIT-V Newton's forward, backward and divided differences interpolation formulae. Lagrange's interpolation formulae, central differences, Gauss and Stirling interpolation formulae.	(06 hours)

Learning Outcomes: After completion of course the students will be able to understand the functions of real number MVT, Taylor series and basics of Numerical methods.

Essential Readings:

- Somasundram D. and Chaudhary B.: A First Course in Mathematical Analysis, Narosa Publishing House, New Delhi, 1987.
- Gupta S.L. and Nisha Rani: Principles of Real Analysis, Vikas Publ. House Pvt. Ltd., New Delhi, 1995.

Suggested Readings:

- Malik S.C. and Savita Arora: Mathematical Analysis, Second Edition, Wiley Eastern Limited, New Age International Limited, New Delhi, 1994.

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
(A Central University)
Department of Mathematics and Statistics
B.Sc./B.A.–V Semester

STAT-SE-511	Introduction to Operations Research	L	T	P	C
		2	0	0	2
		Max. Marks : 100			

Mid Sem-20
Internal assessment-20
End Sem-60

- Objectives:** (1) To introduce the scope of operations research and.
(2) To formulation of LPP.
(3) To obtain the solution of LPP by Simplex method.
(4) To find the initial basic feasible solution of a transportation problem.
(5) To study Assignment problem.

UNIT I Introduction to Operations Research, phases of O.R., model building, various types of O.R. problems.	(06 hours)
UNIT II Linear Programming Problem, Mathematical formulation of the L.P.P, graphical solutions of a L.P.P.	(06 hours)
UNIT III Optimum solution to a L.P.P: Simplex method, concept of artificial variables and Charne's big M-technique. Graphically identifying special cases of L.P.P. Concept of duality in L.P.P.	(06 hours)
UNIT IV Transportation Problem: Initial solution by North West corner rule, Least cost method and Vogel's approximation method (VAM), MODI's method to find the optimal solution.	(06 hours)
UNIT V Assignment problem: Hungarian method to find optimal assignment.	(06 hours)

Learning Outcomes: After completion of this course/paper students will able to formulate and find solution of Linear Programming Problem, Transportation problem, and project evaluations.

Essential Readings:

1. Swarup Kanti, Gupta, P.K. and Manmohan (2007): Operations Research, 13th Edition, Sultan Chand and Sons.
2. Ravindran, A, Phillips, D.T., Solberg, J.J.(2005): Operations Research- Principles and Practice, John Wiley & Sons.

Suggested Readings:

1. Taha, H. A. (2007): Operations Research: An Introduction, 8th Edition, Prentice Hall of India.

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR

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Department of Mathematics and Statistics

B.Sc./ B.A.-V Semester

STAT-SE-512	CALCULUS -I	L	T	P	C
		2	0	0	2
		Max. Marks : 100			

Mid Sem-20

Internal assessment-20

End Sem-60

- Objectives:** (1) To study basic properties of real functions of one and two variables.
 (2) To evaluate indeterminate forms and study Euler's theorem
 (3) To learn Max./ min. techniques
 (4) To find singular points of a function.
 (5) To study linear partial differential equations.

Unit – I: Limits of function, continuous functions, properties of continuous functions, partial differentiation and total differentiation.	(06 hours)
Unit – II: Indeterminate forms: L-Hospital's rule, Leibnitz rule for successive differentiation. Euler's theorem on homogeneous functions.	(06 hours)
Unit – III: Maxima and minima of functions of one and two variables, constrained optimization techniques (with Lagrange multiplier) along with some problems.	(06 hours)
Unit – IV: Jacobian, concavity and convexity, points of inflexion of function, singular points.	(06 hours)
Unit – V: Formation and solution of a partial differential equations. Equations easily integrable. Linear partial differential equations of first order.	(06 hours)

Learning Outcomes: After completion of this course/paper students able to understand the basic of the calculus and differential equations.

Essential Readings:

1. Zafar Ahsan: Differential Equations and their Applications, Prentice-Hall of India Pvt. Ltd., New Delhi (2nd Edition -2004).
2. Piskunov, N: Differential and Integral Calculus, Peace Publishers, Moscow.

Suggested Reading:

1. Gorakh Prasad: Differential Calculus, Pothishala Pvt. Ltd., Allahabad (14TH Edition - 1997).

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
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Department of Mathematics and Statistics
B.Sc.\ B.A.-VI Semester

STAT-SE-611	Econometrics	L	T	P	C
		2	0	0	2
		Max. Marks : 100			

Mid Sem-20
Internal assessment-20
End Sem-60

- Objectives:** (1) To study model building.
(2) To learn basic concepts of Econometrics.
(3) To understand Autocorrelation.
(4) To learn Heteroscedastic disturbances.
(5) To study Lag models etc.

UNIT- I Introduction: Objective behind building econometric models, nature of econometrics, model building, role of econometrics, structural and reduced forms. General linear model(GLM). Estimation under linear restrictions.	(06 hours)
UNIT-II Multicollinearity: Introduction and concepts, detection of multicollinearity, consequences, tests and solutions of multicollinearity, specification error.	(06 hours)
UNIT- III Generalized least squares estimation, Aitken estimators. Autocorrelation: concept, consequences of auto correlated disturbances, detection and solution of autocorrelation.	(06 hours)
UNIT- IV Heteroscedastic disturbances: Concepts and efficiency of Aitken estimator with OLS estimator under heteroscedasticity. Consequences of heteroscedasticity.	(06 hours)
UNIT- V Tests and solutions of heteroscedasticity. Autoregressive and Lag models, Dummy variables, Qualitative data.	(06 hours)

Learning Outcomes: After completion of course the students will be able to understand the model building in Econometrics, which will be helpful in advanced analysis of probabilistic as well as deterministic models.

Essential Readings:

1. Koutsoyiannis, A. (2004): Theory of Econometrics, 2nd Edition, Palgrave Macmillan Limited,
2. Maddala, G.S. and Lahiri, K. (2009): Introduction to Econometrics, 4th Edition, John Wiley & Sons.

Suggested Readings:

1. Gujarati, D. and Sangeetha, S. (2007): Basic Econometrics, 4th Edition, McGraw Hill Companies.
2. Johnston, J. (1972): Econometric Methods, 2nd Edition, McGraw Hill International.

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DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR

(A Central University)

Department of Mathematics and Statistics

B.Sc\ B.A.–VI Semester

STAT-SE-612	CALCULUS-II	L	T	P	C
		2	0	0	2
		Max. Marks : 100			

Mid Sem-20

Internal assessment-20

End Sem-60

- Objectives:** (1) To study Exact differential and total differential equations.
(2) To discuss order and degree of Differential Equations.
(3) To study first order Differential Equations.
(4) To study Higher Order Differential Equations.
(5) To discuss linear differential equations with non-constant coefficients.

UNIT I Differential Equations: Exact differential equations, integrating factors, change of variables, Total differential equations.	(06 hours)
UNIT II Differential equations of first order and first degree, Differential equations of first order but not of first degree.	(06 hours)
UNIT III Equations solvable for x, y, q, Equations of the first degree in x and y, Clairaut's equations.	(06 hours)
UNIT IV Higher Order Differential Equations: Linear differential equations of order n, Homogeneous and non-homogeneous linear differential equations of order n with constant coefficients.	(06 hours)
UNIT V Different forms of particular integrals, Linear differential equations with non-constant coefficients, Reduction of order method.	(06 hours)

Learning Outcomes: After completion of this course, students will be able to find the solution of various types of first and higher order differential equations and they will also be able to use it in various sciences.

Essential Readings:

1. Zafar Ahsan: Differential Equations and their Applications, Prentice-Hall of India Pvt. Ltd., New Delhi (2nd Edition -2004).
2. Piskunov, N: Differential and Integral Calculus, Peace Publishers, Moscow.

Suggested Readings:

1. Gorakh Prasad: Differential Calculus, Pothishala Pvt. Ltd., Allahabad (14Th Edition - 1997).

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