E.M.G. YADAVA WOMEN'S COLLEGE, MADURAI – 625 014.

(*An Autonomous Institution – Affiliated to Madurai Kamaraj University*)

Re-accredited (3rd Cycle) with Grade A+ & CGPA 3.51 by NAAC

DEPARTMENT OF MATHEMATICS

CBCS CURRICULUM

MASTER OF SCIENCE

PROGRAMME CODE - PM

COURSE STRUCTURE

(w.e.f. 2017 – 2018 onwards)

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DEPARTMENT OF MATHEMATICS-PG
(w.e.f. 2017- 2018 onwards)

Sem	Sub. code	Title of the Paper	Lecture hrs per week	Duration of Exam hrs.	Marks Allotted			
					C.A	S.E	Total	Credits
I	17PM11	Algebra	6	3	25	75	100	5
	17PM12	Analysis	6	3	25	75	100	5
	17PM13	Differential Equations	6	3	25	75	100	5
	17PM14	Differential Geometry	6	3	25	75	100	4
		Elective –I	6	3	25	75	100	4
II	17PM21	Advanced Algebra	6	3	25	75	100	5
	17PM22	Measure and Integration	6	3	25	75	100	5
	17PM23	Graph Theory with Applications	6	3	25	75	100	4
	17PM24	Statistics	6	3	25	75	100	4
		Elective - II	6	3	25	75	100	4
III	17PM31	Advanced Statistics	6	3	25	75	100	5
	17PM32	Complex Analysis	6	3	25	75	100	5
	17PM33	Mechanics	6	3	25	75	100	4
	17PM34	Topology	6	3	25	75	100	4
		Elective -III	6	3	25	75	100	4
IV	17PM41	Advanced Topology	6	3	25	75	100	5
	17PM42	Combinatorial Mathematics	6	3	25	75	100	4
	17PM43	Functional Analysis	6	3	25	75	100	4
	17PM44	Operations Research	6	3	25	75	100	5
	17PMPR	Project	6	3	20	80	100	5

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ELECTIVE PAPERS

Elective – I has to be chosen in Semester I from the following:

1. Number Theory -17PME1A
2. Visual Basic - 17PME1B

Elective – II has to be chosen in semester II from the following:

1. Numerical Methods - 17PME2A
2. Automata Theory and Formal Languages - 17PME2B

Elective – III has to be chosen in semester III from the following:

1. Fuzzy sets and Logic - 17PME3A
2. Stochastic Process -17PME3B

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Title of the paper : **Algebra**
Semester : **I** **Contact Hours:6**
Sub Code : **17PM11** **Credits :5**

Objectives:

1. Enabling to learn more concepts in Algebra
2. To develop logical thinking
3. To develop mathematical thinking

Unit – I Another counting Principle - Sylow's theorems **.**

Unit – II Direct products -Finite abelian groups

Unit – III Solvable Groups - Jordan Holder theorem

Unit – IV Euclidean rings-A particular Euclidean ring-Polynomial Rings over commutative ring

Unit – V Dual Spaces - Modules

Text Books:-

1. I.N. Herstein, Topics in Algebra, 2nd Edition, John Wiley & Sons Pvt. ,Ltd., (2004).
2. A.R.Vasishtha and A.K. Vasishtha, Modern Algebra, 15th Edition Krishna Prakashan Media Pvt., Ltd(2006)

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Chapters:

Unit – I : Chapter 2: sections 2.11 and 2.12 from Text Book I

Unit – II : Chapter 2: sections 2.13 and 2.14 from Text Book I

Unit – III : Chapter 3: sections 3.12 and 3.13 from Text Book II

Unit – IV : Chapter 3: sections 3.7,3.8 and 3.11 from Text Book I

Unit – V : Chapter 4: sections 4.3 and 4.5 from Text Book I

Reference Books:-

1. John B.Fraleigh, A First Course In Abstract Algebra ,7th Edition, Published by Dorling Kindersley(India)Pvt.Ltd(2008)
2. Micheal Artin, Algebra,Original U.S Edition, Prentice Hall of India (1991).
3. Viay.K.Khanna & S.K.Bhambri. A Course in Abstract Algebra (Third Edition) Vikas Publishing House Pvt.Ltd (2011)

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Title of the paper	:	**Analysis**	
Semester	:	**I**	**Contact Hours:6**
Sub Code	:	**17PM12**	**Credits :5**

Objectives:

To give Comprehensive ideas about the underlying principles of Mathematical Analysis

Unit – I The derivative of a real function – Mean Value Theorem - The continuity of derivatives – L' Hospital's Rule - Taylor's Theorem.

Unit – II Differentiation of vector –valued functions: Definition and Existence of the Integral - Properties of the Integral. Integration and differentiation - integration of vector-valued functions - Rectifiable curves.

Unit-III Uniform convergence and Continuity- Uniform convergence and Integration- Uniform convergence and differentiation –Equicontinuous Families of functions- The Stone-Weierstrass Theorem.

Unit–IV Power Series –The Exponential and Logarithmic Functions –The Trigonometric Functions-The Algebraic Completeness of the complex Field- Fourier series- The Gamma functions.

Unit – V Integration-Primitive mappings-Partitions of unity change of variables – Differential forms –Simplexes and chains-Stokes theorem.

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Text Book:-

Walter Rudin, Principles of Mathematical Analysis, 3rd Edition, McGraw – Hill Book Company (1976).

Chapters:

Unit – I : Chapter 5 : sections 5.1 to 5.15

Unit – II : Chapter 5and 6: sections 5.16 to5.19 and 6.1 to 6.27

Unit – III : Chapter 7 : sections 7.1 to 7.26

Unit – IV : Chapter 8 : sections 8.1 to 8.22

Unit – V : Chapter 10 : sections 10.1 to 10.33

Reference Books:-

1. Dr.B.S.Vatsa. Introduction to Real Analysis. CBS Publishers & Distributions First Edition (2002)

2. Russell A.Gordon. Real Analysis. Second Edition (2002) , Pearson P.vt Ltd.

3) S.C.Malik. Principles of Real Analysis. New Age Rnter National (p) ltd Publishers Second Edition (2008)

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Title of the paper	:	**Differential Equations**		
Semester	:	**I**	**Contact Hours:**	**6**
Sub Code	:	**17PM13**	**Credits**	**:5**

Objectives:

1. To study the techniques of solving linear equation with variable coefficients.
2. To study the techniques of solving partial differential equations.

Unit - I Introduction - Initial value problems for the homogeneous equation - Solutions of the homogeneous equation - The Wronskian and Linear independence - Reduction of the order of homogeneous equation - The Non homogeneous equation - Homogeneous equation with analytic coefficients – The Legendre Equation.

Unit – II Introduction - The Euler equation - Second order equations with regular singular points - An example – Second order Equations with regular singular points - The general case - Bessel Equation.

Unit - III Introduction – Equations with variables separated - Exact equations -The method of successive approximations - The Lipschitz condition - Convergence of successive approximations – Non-local existence of solutions – Equations with complex valued functions.

Unit - IV Origins of first order partial differential Equations - Cauchy's problem for First order Equations - Linear equations of the first order - Integral surfaces passing through a given Curve - Surfaces orthogonal to given system of surfaces.

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Unit – V Cauchy's method of characteristics - Compatible systems of first order equations – Charpit's method - Special types of first order equations. The Jacobi's method- Applications of first order equations**.**

Text Books:-

1. Earl A. Coddington. *An Introduction to Ordinary Differential Equations*. Sixteenth Indian Reprint, Prentice - Hall of India Pvt., Ltd. (2010).
2. Ian. N. Sneddon . *Elements of Partial Differential Equations*.Mc Graw- Hill International Editions, (1957).

Chapters:-

Unit – I : Chapter III : 1 to 7 from Text Book I
Unit – II : Chapter IV : 1 to 4 and 7 from Text Book I
Unit – III : Chapter V : 1 to 7 and 9 from Text Book I
Unit – IV : Chapter II : 2 to 6 from Text Book II
Unit – V : Chapter II : 7 to 13 from Text Book II

Reference Books:-

1. D. Somasundaram. Ordinary Differential Equations. Narosa Publishing House (2002).
2) E. Rukmanga Dachari. Differential Equation.Published by Dorling Kindersley (India) Pvt. Ltd (2012)
3) N.P. Bali. Firewall Media. An Imprint of Laxmi Publications Pvt. Ltd (2011),New Delhi – 110002.

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Title of the paper : **Differential Geometry**
Semester : **I** **Contact Hours :6**
Sub Code : **17PM14** **Credits :4**

Objective :

To Study the properties of space curves, surfaces and point wise properties of space curves.

Unit – I Arc length - Tangent, normal and binomial – Curvature and torsion of a curve given as intersection of two surfaces- Contact between curves and surfaces – Tangent surface – Involutes and Evolutes – Intrinsic equations – Fundamentals existence theorem for space curves – Helices .

Unit – II Definition of a surface – Curves on a surface – Surface of revolution – Helicoids – Metric – Direction Coefficients – Families of Curves – Isometric correspondence - Intrinsic properties .

Unit – III Geodesics – Canonical Geodesic equations – Normal property of Geodesics – Existence theorems – Geodesic parallels – Geodesic curvature.

Unit – IV The Second fundamental form – Principal curvature – Lines of curvature

Unit – V Developables – Developables associated with space curve – Developables associated with curves on surfaces – Minimal surfaces – Ruled surfaces – The fundamental equations of surface theory.

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Text Book :

T.J.Willmore. An Introduction to Differential Geometry, Oxford University Press (2008).

Chapters:-

Unit- I : ChapterI: Sections : 2 to 9
Unit –II : Chapter-II : Sections :1 to 9
Unit –III : Chapter-II: Sections :10 to 15
Unit –IV : Chapter-III: Sections :1 to 3
Unit –V : Chapter-III : Sections :4 to 13

Reference Books:

1) D. Somasundaram, Differential Geometry, Narosa Publishing House (2008)
2) J.A.Thorpe, Elementary topics in Differential Geometry, Springs-verlag,(1997)
3) S.C.Mittal and D.C.Agarwall, Differential Geometry, Krishna Prakashan Media (P) Ltd (2001),

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Title of the paper	:	**Number Theory**		
Semester	:	**I**	**Contact Hours:6**	
Sub Code	:	**17PME1A**	**Credits**	**:4**

Objectives :

1. To understand the techniques of analytic number.
2. To study some special functions.

Unit – I Introduction – Divisibility – Greatest Common divisor – Prime numbers - The fundamental theorem of Arithmetic – The series of reciprocals of the Primes - The Euclidean algorithm - The greatest common divisor of more than two numbers.

Unit – II Introduction – The Mobius function $\mu(n)$ – The Euler totient function $\Phi(n)$ – A Relation connecting φ and μ – A product formula for $\Phi(n)$ – The Dirichlet product of arithmetical functions – Dirichlet inverses and the mobius inversion formula – The Mangoldt function $\Lambda(n)$ – Multiplicative functions - Multiplicative functions and Dirichlet Multiplication – The inverse of a completely multiplicative function- Liouville's function $\lambda(n)$ - The divisor functions $\sigma_\alpha(n)$ - Generalized convolutions – Formal power series – The Bell series of an arithmetical function – Bell series and Dirichlet multiplication – Derivatives of an arithmetical functions – The Selberg Identity.

Unit - III Introduction – The big Oh notation-Asymptotic equality of functions – Euler's summation formula – Some elementary asymptotic formulas – The average order of d(n) - The average order of the divisor functions $\sigma_\alpha(n)$ - The average order of $\Phi(n)$ - An application to the distribution of lattice points visible from the origin – The average

order of $\mu(n)$ and $\wedge(n)$ - The partial sums of a Dirichlet product - Applications to $\mu(n)$ and $\Lambda(n)$ - Another identity for the partial sums of a Dirichlet product .

Unit – IV Introduction – Chebyshev's functions $\chi(x)$ and $I(x)$ – Congruences - Definition and basic properties of congruences - Residue classes and complete residue systems – Linear congruences – Reduced residue systems and Euler Fermat theorem – Polynomial congruences modulo p - Lagrange's theorem – Applications of Lagrange's theorem – Simultaneous linear Congruences – The Chinese Remainder theorem – Applications of the Chinese Remainder theorem – Polynomial congruences with prime power moduli - The Principle of cross classification – A decomposition property of reduced residue systems.

Unit – V Quadratic residues – Legendre's symbol and its properties – Evaluation of (-1/p) and (2/p)- The Jacobi symbol - Applications of Diophantine equations- Gauss sums and the Quadratic reciprocity law.

Text Book:-

Tom.M. Apostol, Introduction to Analytic *Number theory*. Narosa Publishing House (1998).

Chapters :-

Unit I - Chapter 1 : Sections 1 to 8

Unit II – Chapter 2: Sections 1 to 19

Unit III – Chapter 3 : Sections 1 to 12

Unit IV - Chapter 4 : Sections 1 and 2 and Chapter5 : Sections 1 to 11

Unit V - Chapter 9 : Sections 1 to 9

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Reference Books:-

1) S.G. Telang, Number Theory, Tata McGraw-Hill (2001).

2) S.B.Malik.Basic number Theory, Vikas Publishing House Pvt .,Ltd(2000)

3) K.Ramachandra. Theory of Numbers, Narosa Publishing House(2007)

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(w.e.f. 2017- 2018 onwards)

Title of the paper	:	**Visual Basic with Practical**	
Semester	:	**I**	**Contact Hours:6**
Sub Code	:	**17PME1B**	**Credits : 4**

Objective:

To develop programming knowledge working with application environment

Unit – I Introduction – First application – Programming environment

Unit – II Intrinsic Controls – Projects in VB6 – Working with properties – Methods – Events

Unit –III Data types – Constants – Variables – Making statements in programs.

Unit – IV Conditional statements – Loops – Arrays – Strings – Type casting.

Unit – V Creating menus – Dialog boxes and enhancement of programs – Key board – Mouse input programs – Graphics.

Text Book:

Bop Roselmen and Richard Peasley, Practical Visual Basic 6,(QUE Publications) – Prentice Hall of India (2000).

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Chapters :-

Unit – I: Chapter 1: Sections 1,2,3

Unit – II: Chapter 1: Sections 4,5,6

Unit – III: Chapter 2: Sections 7, 8

Unit – IV: Chapter 2: Sections 9,10,11,12

Unit – V: Chapter 3: Sections 13,14,15,17

Reference Books:-

1. Evangelos Petroutsos, Visual Basic *6,* BPB Publications,New Delhi-2005

2. Gary cornell. Visual Basic *6.* Tata Mcgraw Hill Education Pvt.,Ltd-2010

3. Steven Holzner. Visual BasicNET Programmming. Dreamkech Press-2010.

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Title of the paper	:	**Advanced Algebra**		
Semester	:	**II**	**Contact Hours:6**	
Sub Code	:	**17PM21**	**Credits**	**:5**

Objectives:

To make students to understand the aspects of Field theory.

Unit – I Extension Fields – The Transcendence of e-Roots of Polynomials.

Unit – II More about Roots – The Elements of Galois theory – Solvability by Radicals

Unit – III The Algebra of Linear Transformations – Characteristic Roots – Matrices.

Unit – IV Canonical Forms: Triangular Form – Nilpotent Transformations – A Decomposition of V: Jordan Form.

Unit – V Trace and Transpose – Determinants – Hermitian – Unitary and Normal transformations.

Text Book:

I.N.Herstein, Topics in Algebra, 2nd Edition, John Wiley and sons (2004).

Chapters:

Unit I : Chapter 5: Sections 1,2 and 3

Unit II : Chapter 5: Sections 5,6 and 7

Unit III : Chapter 6: Sections 1,2 and 3

Unit IV : Chapter 6: Sections 4,5 and 6

Unit V : Chapter 6: Sections 8,9 and 10

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Reference Books:

1) I.S.Luthar, I.B.S. Pasi, Field Theory, Narosa Publishing House (2010).

2) N.S.Gopalakrishnan, University Algebra, 2nd Edition, WileyEastern Limited (1991).

3) Patrick Morandi. Graduate Texts in Mathematics (Field & Galois Theory)

University Press (India) Private Limited (2010).

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Title of the paper	:	**Measure and Integration**		
Semester	:	**II**	**Contact Hours:**	**6**
Sub Code	:	**17PM22**	**Credits**	**:5**

Objectives:

To learn Measure, Integration on Real line and Measurable Spaces.

Unit– I Lebesgue Outer Measure - Measurable Sets – Measurable Functions, - Integration of non - negative functions.

Unit – II The General Integral - Integration of Series – Riemann and Lebesgue Integral- Measure spaces.

Unit – III Integration with respect to a Measure- The L^p spaces -Convex functions – Jensen's Inquality.

Unit – IV The Inqualities of Holder and Minkowski - Signed measures and the Hahn Decomposition – The Jordan Decomposition

Unit – V The Radon – Nikodym theorem – Some applications of the Radon – Nikodym theorem - Measurability in a Product Space – The Product Measure and Fubini's theorem.

Text Book:

G.de Barra, Measure theory and Integration, Wiley Eastern Ltd (1987).

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Chapters:

Unit I : Chapter 2 : Sections 1,2 and 4 and Chapter 3 : Sections 3

Unit II : Chapter 3 : Sections 2,3,4 and Chapter 5 : Sections 5

Unit III : Chapter 5: Section 5 and Chapter 6 : Sections 1,2 , 3

Unit IV : Chapter 6: Sections 4 and Chapter 8 : Sections 1,2

Unit V : Chapter 8 : Sections 3,4 and Chapter10 : Sections 1,2

Reference Books:

1) H.L.Royden, Real Analysis, Prentice Hall of India, pvt., Ltd. (2004).
2) Robert G. Bartle,Donald R. Sherbert, Introduction to Real Analysis, John Wiley & Sons1982.
3) Tom M.Apostol. Methematical Analysis. Second Edition, 1974 Narosa Publishing House

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Title of the paper	:	**Graph Theory with Applications**		
Semester	:	**II**	**Contact Hours:6**	
Sub Code	:	**17PM23**	**Credits**	**:4**

Objectives:

To facilitate the students to understand the concepts of graph Theory,

appreciatory its Applications in real life situation and to involve in further research.

Unit - I Definition and Examples of a Graph – Simple Graphs - Graphs Isomorphism- The Incidence and Adjacency Matrices - Subgraphs – Vertex Degrees – Paths and Connection – Cycles - Trees - Cut Edges and Bonds – Cut Vertices – Cayley's Formula(Applications) -The Connector Problem.

Unit – II Connectivity – Blocks (Applications) - Construction of Reliable Communication Networks.

Unit – III Euler Tours - Hamilton Cycles (Applications) - The Chinese Postman Problem – The Travelling Salesman Problem.

Unit - IV Directed Graphs - Directed Paths - Directed Cycles (Applications) – A Job sequencing Problem - Designing an Efficient Computer Drum - Making a Road System One–Way - Ranking the Participants in a Tournament.

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Unit - V Flows - Cuts - The Max-Flow Min-Cut Theorem (Applications) – Menger's Theorems - Feasible Flows.

Text Book:-

J.A. Bondy and U.S.R. Murty. Graph Theory. The Macmillan Press LTD. (1976).

Chapters:

Unit I:	Chapters I	– Sections 1.1 to 1.7and
	Chapter II	- Sections 2.1 to 2.5
Unit II:	Chapters III	– Sections 3.1 to 3.3
Unit III:	Chapters IV	– Sections 4.1 to 4.4
Unit IV:	Chapters X	– Sections 10.1 to 10.7
Unit V:	Chapters XI	– Sections 11.1 to 11.5

Reference Books:-

1) John Clark. Derek Allan Holton.Graph Theory.University of Otago (1995).

2) Narsingh Deo. Graph Theory. Prentice Hall of India Pvt.,Ltd(2004)

3) S.A. Choudum. A First Course in Graph Theory.Macmillan Publishers India Limited (2011).

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Title of the paper	:	**Statistics**	
Semester	:	**II**	**Contact Hours: 6**
Sub Code	:	**17PM24**	**Credits : 4**

Objective:

To develop ability in Applying statistical methods in real life problems.

Unit – I Introduction – Set Theory – The Probability Set Function – Conditional Probability and Independence – Random Variables of the Discrete Type – Random Variables of the Continuous Type – Properties of the Distribution Function – Expectation of a Random Variable – Some Special Expectations – Chebyshev's Inequality.

Unit – II Distributions of Two Random Variables – Conditional Distributions and Expectations – The Correlation Coefficient – Independent Random Variables – Extension to Several Random Variables.

Unit– III The Binomial and Related Distributions – The Poisson Distribution – The Gamma and Chi-square Distributions – The Normal Distribution – The Bivariate Normal Distribution.

Unit – IV Sampling Theory – Transformations of Variables of the Discrete Type – Transformations of Variables of Continuous Type – The Beta, t and F Distributions – Extensions of the Change of Variables Technique – Distributions of Order Statistics – The Moment Generating Function Technique – The Distributions of $\overline{X}$ and nS^2/σ^2 – Expectations of Functions of Random Variables.

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Unit– V Convergence in Distribution – Convergnce in Probability – Limiting Moment Generating Functions – The Central Limit Theorem – Some Theorems on Limiting Distributions.

Text Book:

Robert V. Hogg and Allen T. Craig. Introduction to Mathematical Statistics, 5th Edition, Pearson Education (2004).

Chapters:

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

Reference Books:

1) John .E.Freund, M.T.J.Wilmore. Mathematical statistics,7th Edition Prentice Hall of India,(2000.)
2) R.S.N.Pillai, Bagavathi. Statistics. S.Chand & Company Ltd.,(2009).
3) S.P.Gupta. Statistical Methods.Sultan Chan & Sons (2004).

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Title of the paper	:	**Numerical Methods**		
Semester	:	**II**	**Contact Hours:6**	
Sub Code	:	**17PME2A**	**Credits**	**:4**

Objectives :

- To understand principles of Numerical methods and to apply them in solving Algebraic equations.

Unit – I Introduction- Bisection Method - Iteration Methods Based on First degree Equation - Iteration Methods Based on Second Degree Equation – Rate of Convergence – General Iteration Methods – System of Nonlinear Equations – Methods for Complex Roots.

Unit – II Introduction - Direct Methods – Error Analysis for Direct Methods – Iteration Methods – Eigen values and Eigen vectors – Power Method.

Unit – III Introduction - Lagrange and Newton Interpolations - Finite Difference Operators – Interpolating Polynomials Using Finite Differences – Hermite Interpolation – Piecewise and Spline Interpolation.

Unit – IV Introduction - Numerical Differentiation – Optimum Choice of Step Length – Extrapolation Methods – Numerical Integration – Methods based on Interpolation – Composite Integration Methods – Romberg Integration – Double Integration.

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Unit – V Introduction – Difference Equations – Numerical Methods – Runge - Kutta method.

Text Book :-

M.K. Jain , S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 4th Edition, New Age International PVT., LTD. Publishers (2003).

Chapters:

Unit I:	Chapters II	– Sections 2.1 to 2.8
Unit II:	Chapters III	– Sections 3.1 to 3.5 and 3.11
Unit III:	Chapters IV	– Sections 4.1 to 4.6
Unit IV:	Chapters V	– Sections 5.1 to5.4 and 5.6, 5.7 and 5.9 to 5.11
Unit V:	Chapters VI	– Sections 6.1 to 6.3

Reference Books:-

1) S. Arumugam , A. Thangapandi Isaac & A. Somasundaram , Numerical Methods, Scitech Publications (India) PVT., LTD (2001).

2) S.S.Sastry.Introductory methods of Numerical Analysis. Prentice Hall of Pvt., Ltd., (1988)

3) T.K. Manickavasagom Pillay & S. Narayanan, Numerical Analysis, 1st Edition, S. Viswanathan (Printers & Publishers) PVT., LTD. (1994).

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DEPARTMENT OF MATHEMATICS-PG
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Title of the paper	:	**Automata theory and Formal Languages**	
Semester	:	**II**	**Contact Hours:6**
Sub Code	:	**17PME2B**	**Credits :4**

Objective:

To study about Properties of Regular sets and Push down Automata.

Unit – I Strings, alphabets and languages – graphs and trees – Inductive proof – set notation –Relations.

Unit – II Finite state system – Basic definitions – non deterministic finite automata – Finite automata with moves – Regular Expression – Two way finite automata – finite Automata with output – Applications of finite automata.

Unit – III The pumping lemma for regular sets – closure properties of regular sets – The Myhill – Nerode theorem and Minimization of finite automata.

Unit – IV Motivation and Introduction – context free grammars – derivation trees – simplification of context free grammars – Chomsky normal form –Greibach normal form – The Existence of inherently ambiguous context free languages.

Unit – V Informal descriptions – Definitions – Pushdown automata and context free languages - The pumping Lemma for CFL's – closure properties of CLF's – Decision Algorithms for CLF's.

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Text Book:

John. E. Hopcroft, Jeffrey D.Ullman. Introduction to Automata Theory Languages and computation Narosa Publishing House, 1999.

Reference Books:

1) Automata and Languages, Alexander Meduna, Springer (2000).
2) Dr.M.K. Venkataraman, Dr.N.Sridharan, N.Chandrasekaran, Discrete Mathematics. The National Publishing Company(2009).
3) Shyamalendu Kandar, Automata Theory and Formal Languages Dorling Kindersley(India) Pvt.Ltd(20

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DEPARTMENT OF MATHEMATICS-PG

(w.e.f. 2017- 2018 Batch onwards)

Title of the paper :**Advanced Statistics**

Semester :**III** **Contact Hours:6**

Sub Code :**17PM31** **Credits** :**5**

Objective:

To learn the techniques of estimation, statistical hypothesis and the applications of statistical tests.

Unit– I

Point Estimation – Confidence Intervals for Means – Confidence Intervals for Differences of Means.

Unit – II

Tests of Statistical Hypotheses – Additional Comments About Statistical Tests – Chi-Square Tests.

Unit– III

Measures of Quality of Estimators – A Sufficient Statistics for a Parameter – Properties of a Sufficient Statistics – Completeness and Uniqueness – The Exponential Class of Probability Density Functions – Functions of a Parameter.

Unit – IV

Beyesian Estimation – Fisher Information and the Rao-Cramer Inequality – Limiting Distributions of Maximum Likelihood Estimators.

Unit – V

Certain Best Tests – Uniformly Most Powerful Tests – Likelihood Ratio Tests – The Sequential Probability Ratio Test.

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Text Book:

Robert V.Hogg and Allen T.Craig, *Introduction to Mathematical Statistics*, 5th Edition,Pearson Education 2004.

Chapters:

Unit I: Chapter 6: Sections 6.1 to 6.3

Unit II: Chapter 6: Sections 6.4 to 6.6

Unit III: Chapter 7: Sections 7.1 to 7.6

Unit IV: Chapter 8: Sections 8.1 to 8.3

Unit V: Chapter 9: Sections 9.1 to 9.4

Reference Books:-

1) Irwin Miller, Maryless Miller,*Mathematical Statistics with Applications* 7th Edition, Prentice – Hall of India Private Limited.

2) John E.Freund, Wilmore M.T.J,*Mathematical Statistics*, 7th Edition, Prentice Hall of India 2004.

3) Pillai R.S.N., Bagavathi, *Statistics*, S.Chand & Company Ltd.,2009.

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(w.e.f. 2017- 2018 Batch onwards)

Title of the paper :**Complex Analysis**
Semester :**III** **Contact Hours:6**
Sub Code :**17PM32** **Credits** :**5**

Objective :

To give Comprehensive idea of understanding Principles of Complex Analysis.

Unit – I

Complex Numbers – The Spherical Representation – Complex functions - Introduction to the Concept of Analytic Function – Limits and Continuity – Analytic Functions – Polynomials – Rational Functions – Elementary Theory of Power Series – Sequences – Series – Uniform Convergence – Power Series – Abel's Limit Theorem.

Unit – II

Analytic Functions as Mappings: Elementary Point Set Topology- Sets and Elements – Metric Spaces – Connectedness – Compactness – Continuous Functions – Topological Spaces. Conformality: Arcs and Closed Curves – Analytic Functions in Regions – Conformal Mapping – Length and Area. Linear Transformations: The Linear Group – The Cross Ratio – Symmetry – Oriented Circles – Families of Circles.

Unit – III

Complex Integration-Fundamental Theorems: Line Integrals – Rectifiable Arcs – Line Integrals as Functions of Arcs – Cauchy's Theorem for a Rectangle – Cauchy's Theorem in a Disk – Cauchy Integral formula: The Index of a point with respect to a Closed Curve – The Integral Formula – Higher Derivatives.

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Unit – IV

Local Properties of Analytical Functions – Removable Singularities – Taylor's Theorem – Zeros and Poles – The Local Mapping – The Maximum Principle – The General form of Cauchy's Theorem – Chains and Cycles – Simple Connectivity – Homology – The General Statement of Cauchy's Theorem – Proof of Cauchy's Theorem – Locally Exact Differentials.

Unit – V

The Calculus of Residues – The Residue Theorem – The Argument Principle – Evaluation of Definite Integrals – Harmonic Functions – Definition and Basic properties – The Mean Value Property – Poisson's Formula – Schwarz's Theorem – The Reflection Principle – Series and product developments – Power Series Expansions- Weierstrass's Theorem – The Taylor Series – The Laurent Series.

Text Book:

Lars V.Ahlfors, *Complex Analysis*, 3rd Edition, McGraw – Hill Book Company, 1979.

Chapters:

Unit I : Chapter 1: Sections 2.4
Chapter 2: Sections 1.1 to 1.4, 2.1 to 2.5

Unit II : Chapter 3: Sections 1.1 to 1.6, 2.1 to 2.4, 3.1 to 3.5

Unit III : Chapter 4: Sections 1.1 to 1.5, 2.1 to 2.3

Unit IV : Chapter 4: Sections 3.1 to 3.4, 4.1 to 4.6

Unit V : Chapter 4: Sections 5.1 to 5.3, 6.1 to 6.5
Chapter 5: Sections 1.1to 1.3

Reference Books:-

1) Edward B. Saff, Arthur David Snider,*Fundamentals of Complex Analysis with Applications* Published by Dorling Kindersley (India) Pvt. Ltd., 2011

2) Karunakaran V, *Complex Analysis*, Narosa Publishing House, 2002.

3) Ponnusamy. S, *Foundations of Complex Analysis*, Narosa Publishing House Pvt.,Ltd 1997.

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(w.e.f. 2017- 2018 Batch onwards)

Title of the paper	**:Mechanics**	
Semester	**:III**	**Contact Hours:6**
Sub Code	**:17PM33**	**Credits :4**

Objective:

To study the D'Alembert's , Hamilton's Principles and the Two- Body Central Force Problem.

Unit - I

Mechanics of a particle – Mechanics of a system of particles - Constraints – D'Alembert's principle and Lagrange's equations – Velocity dependent potentials and the dissipation function - Simple applications of the Lagrangian formulation.

Unit – II

Hamilton's principle – Some techniques of the calculus of variations.

Unit- III

Derivation of Lagrange's equations from Hamilton's principle – Extension of Hamilton's principle to nonholonomic systems – Advantages of a variational principle formulation – Conservation theorems and symmetry properties.

Unit - IV

Reduction to the equivalent one-body problem – The equations of motion and first integrals – The equivalent one–dimensional problem and classification of orbits – The virial theorem – The differential equation for the orbit and integrable power–law potentials – Conditions for closed orbits (Bertrand's theorem).

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Unit - V

The Kepler Problem: Inverse square law of force – The motion in time in the Kepler problem – The Laplace-Runge–Lenz vector.

Text Book:-

Herbert Goldstein,*Classical Mechanics*,2nd Edition**,** Narosa Publishing House 2001 .

Chapters :

Unit - I : Chapter1: Sections 1.1to 1.6
Unit - II: Chapter2: Sections 2.1 & 2.2
Unit –III : Chapter2: Sections 2.3 to 2.6
Unit –IV : Chapter3: Sections 3.1 to 3.6
Unit - V : Chapter3: Sections 3.7 to 3.9

Reference Books: -

1) Gupta,Kumar,Sharma,*Classical Mechanics*,A Publication of Progati Prakashan, Meerut,2010.
2) Sankara Rao K.,*Classical Mechanics*, Prentice Hall of India Pvt., Ltd,2005.
3) Upadhaya J.C.,*Classical Mechanics*, Himalaya Publishing House 2003 **.**

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(w.e.f. 2017- 2018 Batch onwards)

Title of the paper : **Topology**

Semester : **III** **Contact Hours:6**

Sub Code : **17PM34** **Credits** :**4**

Objective:

To study Spaces like Topological Spaces, Connected and Compact Spaces.

Unit - I

Topological Spaces - Basis for a Topology – The Order Topology – The Product Topology on X x Y – The Subspace Topology – Closed Sets and Limit Points .

Unit - II

Continuous Functions – The Product Topology – The Metric Topology - The Metric Topology(continued) .

Unit - III

Connected Spaces – Connected Subspaces of the Real Line.

Unit- IV

Compact Spaces – Compact Subspaces of the Real Line – Limit Point Compactness.

Unit – V

The Countability Axioms – The Separation Axioms – Normal Spaces -The Urysohn Lemma – The Urysohn Metrization Theorem.

Text Book:-

James R. Munkres, *Topology* – Second Edition, Prentice- Hall of

India Private Limited, 2011.

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Chapters :

Unit - I : Chapter2: Sections 12 to 17
Unit - II : Chapter 2: Sections 18 to 21
Unit -III : Chapter3: Sections 23 & 24
Unit –IV : Chapter3: Sections 26 to 28
Unit - V : Chapter4: Sections 30 to 34

Reference Books:-

1) Colin Adams, Robert Franzosa, *Introduction to Topology, Pure and Applied* , Published by Dorling Kindersley Pvt.,Ltd, 2009.

2) Khanna M.L, *Topology,* 8th Edition, Jai Prakash Nath & Co.,Merrut,1995.

3) Simmons G.F, *Introduction to Topology and Modern Analysis,*Tata McGraw Hill Education Pvt.,Ltd-2010.

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(w.e.f. 2017- 2018 Batch onwards)

Title of the paper :**Fuzzy Sets & Logic**
Semester :**III** **Contact Hours:6**
Sub Code :**17PME3A** **Credits :4**

Objective :

To Introduce the basic ideas of Fuzzy Mathematics.

Unit – I

Introduction ,Crisp Sets: An Overview, The Notation of Fuzzy Sets, Basic Concepts of Fuzzy Sets, Classical Logic: An Overview, Fuzzy Logic.

Unit – II

General Discussion, Fuzzy Complement, Fuzzy Union , Fuzzy Intersection, Combinations of Operations, General Aggregation Operations.

Unit – III

Crisp and Fuzzy Relations, Binary Relations, Binary Relations On a Single Set, Equivalence and Similarity Relations.

Unit – IV

Compatibility or Tolerance Relations, Orderings.

Unit – V

Morphisms, Fuzzy Relation Equations.

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Text Book: –

George J.Klir and Tina.A.Folger, *Fuzzy Sets,Uncertainty and Information* Prentice Hall of India, 2013.

Chapters:–

Unit I : Chapter 1: sections 1 .1 to 1.6

Unit II : Chapter 2: sections 2.1 to 2.6

Unit III: Chapter 3: sections 3. 1 to 3.4

Unit IV: Chapter 3: sections 3.5 and 3. 6

Unit V : Chapter 3: sections 3.7 and 3.8

Reference Books:-

1) Bhargava A.K *Fuzzy Set Theory Fuzzy Logic and Their Applications,* S.Chand & Company Pvt. Ltd.2013.

2) Chennakesava,R.Alavala, *Fuzzy Logic and Neural Networks Basic Concepts & Applications,*New Age International Publishers 2008.

3) George J.Klir and Boyuan, *Fuzzy sets Fuzzy Logic, Theory and Applications,* Prentice Hall of India , 2002.

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(w.e.f. 2017- 2018 Batch onwards)

Title of the paper	**:Stochastic Processes**	
Semester	**: III**	**Contact Hours:6**
Sub Code	**: 17PME3B**	**Credits :4**

Objective:

To Create awareness and interest in Stochastic Process and gain knowledge of applied probability in Stochastic Process.

Unit – I

Generating Functions-Laplace Transforms-Laplace(stieltjes)-Transform of a Probability Distribution of a Random Variable-Classification of Distributions.

Unit – II

Introduction-Specification of Stochastic Processes and Stationary Processes – Martingales.

Unit – III

Definition and Examples- Higher Transition Probabilities-Generalization of Independent Bernoulli Trials: Sequence of Chain-Dependent Trials-Classification of States and Chains-Determination of Higher Transition Probabilities- Stability of a Markov System.

Unit – IV

Graph Theoretic Approach –Markov Chain with Denumerable Number of States-Reducible Chains- Statistical Inference for Markov Chains- Markov Chains with Continuous State Space- Non Homogeneous Chains.

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Unit– V

Poisson Process-Poisson Process and related distributions-Generalisation of Poisson process-Birth and Death Process – Markov processes with discrete State Space (Continuous Time Markov Chains)

Text Book :-

Medhi. J. *Stochastic Processes*,2nd Edition, New Age International Publishers,1984.

Chapters:-

Unit I :	Chapter 1: Sections 1 to 4
Unit II :	Chapter 2: Sections 1 to 4
Unit III :	Chapter 3: Sections 1 to 6
Unit IV :	Chapter 3:Sections 7 to 12
Unit V :	Chapter 4: Sections 1 to 5

Reference Books :-

1) Basu K. (I I S) *Introduction to Stochastic Process*,Narosa Publishing House.2003.

2) Pradip Kumar ghosh *Theory of Probability and Stochastic Process*, University Press(India)Pvt.,Ltd,2010.

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(w.e.f. 2017- 2018 Batch onwards)

Title of the paper :**Advanced Topology**
Semester :**IV** **Contact Hours:6**
Sub Code : **17PM41** **Credits** :**5**

Objective:

To facilitate advanced topological concepts and their relevant fields to the students .

Unit – I

Local Compactness – The Tychonoffy Theorem – The Stone-Cech Compactification.

Unit – II

Local Finiteness – The Nagata – Smirnov Metrization Theorem.

Unit – III

Complete Metric Spaces – A Space- Filling Curve – Compactness in Metric Spaces.

Unit – IV

Pointwise and Compact Convergence – Ascoli's Theorem.

Unit– V

Baire Spaces – A Nowhere - Differentiable Function.

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Text Book:

James.R.Munkres, *Topology*, Second Edition Printice – Hall of India Private Ltd., New Delhi, 2011.

Chapters:

Unit I : Chapter 3 : Section 29
Chapter 5 : Sections 37 and 38

Unit II : Chapter 6 : Sections 39, 40 and 42

Unit III : Chapter7 : Sections 43 to 45

Unit IV : Chapter7 : Sections 46 and 47

Unit V : Chapter 8 : Sections 48 and 49

Reference Books:

1) Colin Adams, Robert Franzosa, *Introduction to Topology , pure and Applied*, Published by Dorling Kindersley Pvt , Ltd ,2009.
2) Khanna M.L.,*Topology*, 8th Edition,Jai Prakash Nath & Co.,Merrut,1995.
3) Simmons G.F.,*Introduction to Topology and Modern Analysis*, Tata McGraw Hill Education Pvt.,Ltd-2010.

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(w.e.f. 2017- 2018 Batch onwards)

Title of the paper :**Combinatorial Mathematics**

Semester :**IV** **Contact Hours:6**

Sub Code :**17PM42** **Credits** :**4**

Objective :

To learn Combinatorial techniques for solving enumeration problems.

Unit– I

Introduction, rules of sum and product, Permutations and Combinations, Distributions of Distinct Objects, Distributions of Non Distinct Objects, Generating Functions –Introduction, Generating Functions for Combinations.

Unit – II

Enumerators for Permutations, Distributions of Distinct Objects into Non distinct cells, Partitions of Integers. Recurrence Relation-Introduction- Linear Recurrence Relations with Constant Coefficients.

Unit – III

Solution by the Technique of Generating Functions, A Special Class of Nonlinear Difference Equations, Recurrence Relation with Two Indices, The principle of Inclusion and Exclusion-Introduction- The principle of Inclusion and Exclusion, The General Formula- Derangements.

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Unit – IV

Permutations with Restrictions on Relative Positions- Polya's Theory of Counting- Equivalence Classes under a Permutation Group, Equivalence Classes of Functions- Weights and Inventories of Functions- Polya's Fundamental Theorem.

Unit – V

Block Designs- Introduction – Complete Block Designs- Orthogonal Latin Squares.

Text Book:-

Liu. C.L. *Introduction to Combinatorial Mathematics*, McGraw Hill, 1968

Chapters:

Unit I :	Chapter 1: Sections 1.1 to 1.6 Chapter 2: Sections 2.1 & 2.2
Unit II :	Chapter 2: Sections 2.3 to 2.5 Chapter 3: Sections 3.1 & 3.2
Unit III:	Chapter 3: Sections 3.3 to 3.5 Chapter 4: Sections 4.1 to 4.4
Unit IV:	Chapter 4: Section 4.5 Chapter 5: Sections 5.3 to 5.6
Unit V :	Chapter 14: Sections 14.1 to 14.3

Reference Books:-

1) APTE. D.P. *Probability And Combinatorics Excel Books*,2007.

2) David A.Santos *Probability An Introduction* .
Jones and Bartlett India Pvt.Ltd, First Indian Edition,2011.

3) Vasudev. C.,T*heory and Problems of Combinatorics*,New Age International (P) Limited,2008.

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(w.e.f. 2017- 2018 Batch onwards)

Title of the paper :**Functional Analysis**
Semester :**IV** **Contact Hours:6**
Sub Code :**17PM43** **Credits** :**4**

Objective :

To study the concepts about Banach and Hilbert Spaces and enabling to learn Approximation Theory in Topological space.

Unit – I

The definition and examples of Banach Spaces- Continuous linear transformation –The Hahn Banach theorem.

Unit - II

The Natural imbedding of N and N** - The Open Mapping Theorem –The Conjugate of an Operator.

Unit – III

The definition and some simple Properties - Orthogonal Complements – Orthonormal Sets.

Unit - IV

The Conjugate Space H* - The Adjoint of an Operator- Self Adjoint Operators- Normal and Unitary Operators - Projections.

Unit - V

The Weierstrass Approximation Theorem - The Stone Weierstrass Theorems - Locally Compact Hausdorff Spaces – The Extended Stone–Weierstrass Theorems

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Text Book:-

George.F.Simmons,*Introduction to Topology and Modern Analysis,* Tata Mc Graw– Hill Publishing Company Limited, 2004 .

Chapters:-

Unit –I :	Chapter - 9	Sections 46 to 48
Unit – II :	Chapter - 9	Sections 49 to 51
Unit – III :	Chapter -10	Sections 52 to 54
Unit – IV :	Chapter– 10	Sections 55 to 59
Unit – V :	Chapter- 7	Sections 35 to 38

Reference Books:-

1) Balmohan Vishnu Limaye,*Functional Analysis*, 3rd Edition, Wiley Eastern Limited,1986 .

2) Choudhary Sudarsan Nanda. B.*Functional Analysis with Application*,New Age Internation Publishers,2009.

3) Ponnusamy .S .*Foundations of Functional Analysis* Narosa Publishing House,2012.

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(w.e.f. 2017- 2018 Batch onwards)

Title of the paper :**Operations Research**
Semester :**IV** **Contact Hours:6**
Sub Code :**17PM44** **Credits** :**5**

Objective :

To study the relationship between Networks and Linear Programming and solving Networks by many Algorithms and computing the Queueing Models and to learn several Algorithms for Non –Llinear Programming techniques.

Unit- I

Network Definitions - Minimal Spanning Tree Algorithm – Shortest Route Problem - Examples of the Shortest –Route Applications - Shortest Route Algorithms- Maximal Flow Model - Enumeration of Cuts – Maximal Flow Algorithm.

Unit – II

Minimum Cost Capacitated Flow Problem -Network Representation -Linear Programming Formulation -Capacitated Network Simplex Algorithm –CPM and PERT- Networks Representations – Critical Path Computations - Construction of the Time Schedule.

Unit - III

Elements of the Queueing Model - Role of Exponential Distributions - Pure Birth and Death Models-Pure Birth Model- Pure Death Model - Generalized Poisson Queueing Model - Specialized Poisson Queues – Steady – State Measures of Performance – Single – Server Models – Multiple –Server Models – Machine Servicing Model (M/M/R) : (GD/K/K), $P < K$.

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Unit – IV

Unconstrained Problems - Necessary and Sufficient Conditions - The Newton-Raphson Method - Constrained Problems - Equality Constraints - Inequality Constraints.

Unit - V

Unconstrained Algorithms - Direct Search Method -Gradient Method-. Constrained Algorithms - Separable Programming - Quadratic Programming-Geometric Programming-Stochastic Programming -Linear Combinations Method.

Text Book:-

Hamdy A. Taha, *Operations Research- An Introduction*,7th Edition, Prentice – Hall of India PVT.,LTD. 2004.

Chapters:-

Unit - I Chapter 6: Sections 6. 1, 6.2, 6.3(6.3.1, 6.3.2) 6.4(6.4.1, 6.4.2)

Unit – II Chapter 6: Sections 6.5 (6.5.1, 6.5.2, 6.5.3) 6.6 (6.6.1, 6.6.2, 6.6.3)

Unit –III Chapter 17: Sections 17.2, 17.3, 17.4(17.4.1, 17.4.2), 17.5 17.6 (17.6.1, 17.6.2, 17.6.3, 17.6.4)

Unit – IV Chapter 20: Sections 20.1(20.1.1, 20.1.2) 20.2(20.2.1, 20.2.2)

Unit – V Chapter 21: Sections 21.1 (21.1.1, 21.1.2) 21.2(21.2.1, 21.2.2, 21.2.3, 21.2.4, 21.2.5)

Reference Books :-

1) Hamdy A.Taha,*Operations Research* ,8th Edtion, Prentice Hall of India Private Limited ,2008

2) Kanti Swarup, P.K.Gupta & Man Mohan,*Operations Research*, 12th Edition,Sultan Chand & Sons, Educational Publishers, New Delhi ,2011

3) Prem Kumar Gupta, D.S. Hira,*Operations Research*, S.Chand & Company Ltd. 2011.

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(w.e.f. 2017- 2018 Batch onwards)

Title of the paper :**Project**
Semester :**IV** **Contact Hours:6**
Sub Code : **17PMPR** **Credits** :**5**

Objective:

The postgraduate students of Mathematics should acquire independent judgment and firsthand experience. To achieve this, they should develop their creative ideas in real life Mathematics . The project in their final semester helps them to develop the above said skills and also helps them in their career as research scholars and teachers. The project aims at arousing genuine passion and acumen in their subject.

In this project, the student will concentrate mainly on a work aspect related to the subjects they have learnt. The length of the project report should be not less than 50 pages in the standard format.

Students will be guided by the faculty.

Internal - Project : 20 marks

External- Project Report & Viva Voce: 80 marks

Total : 100 marks