M.Sc MATHEMATICS

[CBCS Revised]

(With effect from 2015 onwards)

Courses of Study

Scheme of Examinations

And Syllabi

Post Graduate and Research Department of Mathematics

Nehru Memorial College (Autonomous)

Puthanampatti -621007

Trichy District

PG & RESEARCH DEPARTMENT OF MATHEMATICS

NEHRU MEMORIAL COLLEGE (AUTONOMOUS)

PUTHANAMPATTI - 621007

M.Sc., PROGRAMME IN MATHEMATICS (CBCS)

(For the candidate to be admitted form the year 2015 onwards)

Semester	Courses	No. of Credits
I	5 Core courses	23
II	4 Core courses 1 Core Elective course	23
III	3 Core courses 1 Core Elective course 1 Open Elective course	22
IV	3 Core courses 2 Core Elective courses	22
TOTAL	**20 courses**	**90 credits**

NEHRU MEMORIAL COLLEGE (AUTONOMOUS), PUTHANAMPATTI-621 007
M.Sc Mathematics Course Structure under CBCS Pattern 2015

Sem	Sub. Code	Course	Subject Title	Hrs/ wk	Credits	Internal	External	Total
I	15PM101	CC 1	Linear Algebra	6	5	40	60	100
	15PM102	CC 2	Real Analysis	6	5	40	60	100
	15PM103	CC 3	Ordinary Differential Equations	6	5	40	60	100
	15PM104	CC 4	Integral Equations, Calculus of Variations and Fourier Transforms	6	4	40	60	100
	15PM105	CC 5	Graph Theory	6	4	40	60	100
			TOTAL	**30**	**23**	**200**	**300**	**500**
II	15PM206	CC 6	Abstract Algebra	6	5	40	60	100
	15PM207	CC 7	Complex Analysis	6	5	40	60	100
	15PM208	CC 8	Topology	6	5	40	60	100
	15PM209	CC 9	Partial Differential Equations	6	4	40	60	100
		OEC	**(open toall)	6	4	40	60	100
			TOTAL	**30**	**23**	**200**	**300**	**500**
III	15PM311	CC 10	Functional Analysis	6	5	40	60	100
	15PM312	CC 11	Measure and Integration	6	5	40	60	100
	15PM313	CC 12	Number Theory	6	4	40	60	100
		CEC 1	*	6	4	40	60	100
		CEC 2	*	6	4	40	60	100
			TOTAL	**30**	**22**	**200**	**300**	**500**
IV	15PM416	CC 13	Differential Geometry	6	5	40	60	100
	15PM417	CC 14	Stochastic Process	6	4	40	60	100
	15PM420P	CC 15	Project Work	6	5	40	60	100
		CEC 3	*	6	4	40	60	100
		CEC 4	*	6	4	40	60	100
			TOTAL	**30**	**22**	**200**	**300**	**500**
			GRAND TOTAL	**120**	**90**	**800**	**1200**	**2000**

***Candidates has to choose any one of the Core Elective Courses(CEC) offered by our department.**

**** Candidates has to choose any one of the Open Elective Courses(OEC) offered by our /other department.**

CORE COURSES (CC)

Course	Title of the Courses	Lecture Hours	Tutorial Hours	Practical Hours	Credit	Prerequisite(Exposure)
CC1	Linear Algebra	4	2	0	5	Algebra-B. Sc (Maths) Level
CC2	Real Analysis	4	2	0	5	Sequences and Series& Real Analysis- B. Sc (Maths) Level
CC3	Ordinary Differential Equations	4	2	0	5	Differential Equation- B. Sc (Maths) Level
CC4	Integral Equations, Calculus of variations and Fourier Transforms	4	2	0	4	Differential Equation -B. Sc (Maths) Level
CC5	Graph Theory	4	2	0	5	Graph Theory - B. Sc (Maths) Level
CC6	Abstract Algebra	4	2	0	5	CC1
CC7	Complex Analysis	4	2	0	5	CC2
CC8	Topology	4	2	0	5	CC2
CC9	Partial Differential Equations	4	2	0	4	CC3
CC10	Functional Analysis	4	2	0	5	CC1,CC2 ,CC7& CC8
CC11	Measure and Integration	4	2	0	5	CC2,CC8 & CC10
CC12	Number Theory	4	2	0	4	CC1 & CC6
CC13	Differential Geometry	4	2	0	5	CC2
CC14	Stochastic Process	4	2	0	4	Probability &Statistics – B. Sc (Maths) Level
CC15	Project Work	4	2	0	5	CC1-CC15

CORE ELEECTIVE COURSES (CEC)

Course	Title of the Courses	Lecture Hours	Tutorial Hours	Practical Hours	Credit	Prerequisite(Exposure)
CEC1A 15PM314 b	Fluid Dynamics	4	2	0	4	Dynamics- B. Sc (Maths) Level
OEC1B 15PM314 a	Cryptography	4	2	0	4	Algebra- B. Sc (Maths) Level&CC1
CEC2A 15PM315 b	Fuzzy Mathematics	4	2	0	4	Algebra- B. Sc (Maths) Level
CEC2B 15PM315 a	Combinatorics	4	2	0	4	Algebra- B. Sc (Maths) Level
CEC3A 15PM418 a	Numerical Analysis	4	2	0	4	Numerical Analysis- B. Sc (Maths) Level
CEC3B 15PM418 b	Optimization Techniques	4	2	0	4	OperationResearch- B. Sc (Maths) Level
CEC4A 15PM419 a	Classical Dynamics	4	2	0	4	Mechanics–B. Sc(Maths) Level
CEC4C 15PM419 c	Mathematical Probability	4	2	0	4	Probability & Statistics- B. Sc (Maths) Level
CEC4B 15PM419 b	Coding Theory	4	2	0	4	Algebra- B. Sc (Maths) Level

OPEN ELEECTIVE COURSES (OEC)(Courses Offered to Other Department)

Course	Title of the Courses	Lecture Hours	Tutorial Hours	Practical Hours	Credit	Prerequisite (Exposure)
OEC1 15PM210b	Mathematical Modeling and Simulation	4	2	0	4	+2 Level Mathematics
OEC2 15PM210c	Statistics	4	2	0	4	+2 Level Mathematics

NEHRU MEMORIAL COLLEGE
(AUTONOMOUS)
Puthanampatti, Trichy Dist.

SYLLABUS REVISION 2014-2015

Department : Mathematics

Academic Programme offered : PG Programme

Year of Implementation : 2015-2016

OBE Elements for M.Sc Mathematics programme.

Programme Educational Objectives (PEO)

PEO 1: **Technical Proficiency:**

The program gives success in getting employment in different areas, such as Government, public and private sectors.

PEO 2: **Professional Growth:**

As mathematics is mother of all sciences, its impact is very wide covering all the areas of research and development.

PEO 3: **Management Skills:**

This program helps each individual in developing personality skills like time management, crisis management, stress management, interviews and working as a team and group.

PEO4: **Ethical Skills:**

This program makes the individual to understand and appreciate professional ethics, community living and Nation Building initiatives.

Program Outcome (PO)

PO1: Apply knowledge and principle of Mathematics, in all the fields of learning including higher research and the same to the needs of Employer/Institution/Society.

PO2: Gain analytical skills in the field of Mathematics.

PO3: Develop the logical thinking skills

PO3: Understand the concepts of real and complex analysis

PO4: Use the knowledge of pure and applied mathematics to solve complex mathematical problems

PO5: Innovate and invent novel ideas to model the real world problems.

PO6: Crack the exams approved by UGC namely CSIR – NET (JRF/Lectureship) and SET.

PROGRAMME SPECIFIC OUTCOME (PSO)

PSO 1: Connect Mathematics to real life problems in their lives.

PSO 2: Do intensive research in pure and applied mathematics.

PSO 3: Analyze problems of industry and society

PSO 4: Model and provide solutions to scientific and real life situations.

PSO 5: Prepare for a career in which critical thinking is a central feature.

CORE COURSES (CC)

(NMC - M.SC Mathematics Syllabus - For the candidates admitted for the academic year 2015 onwards)

Code	Course	Title	Hours/Week	Semester	Credits
15PM101	**CC1**	**Linear algebra**	**6**	**1**	**5**
Cognitive Level		**K -1** Acquire/Remember **K -2** Understand **K -3** Apply **K -4** Evaluate **K -5** Analyze			
Course Objectives		Aim of this course is to • give the students a thorough knowledge of the various aspects of Linear Algebra • train the students in problem solving as a preparatory for competitive exams			
Employability and Skill Development		**Local, National, Regional and Global need**		Problem Solving & Participative Learning	

UNIT I

Linear Transformations **–** The Algebra of Linear Transformations – Isomorphism – Representations of Transformations by Matrices.

UNIT II

Determinants**:** Commutative Rings – Determinants Functions – Permutations and the uniqueness of Determinants – Additional properties of Determinants.

UNIT III

Canonical Forms – Characteristic Values-Invariant Subspaces – Simultaneous Triangulation; Simultaneous Diagonalization.

UNIT IV

Direct-sum Decompositions – Invariant Direct sums – The Primary Decomposition Theorem.

UNIT V

Cyclic subspace and Annihilators – Cyclic Decompositions and the Rational Form – The Jordan Form.

TEXT BOOK:

Kenneth Hoffman & Ray Kunze, Linear Algebra, Second Edition, Prentice Hall of India Pvt. Ltd, 2000.
UNIT I: 3.1-3.5, UNIT II: 5.1-5.4, UNIT III: 6.1. – 6.5, UNIT IV: 6.6 – 6.8,
UNIT V: 7.1-7.4.

REFERENCE BOOKS:

1) I.N.Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.
2) I.S.Luther & I.B.S Passi, Algebra, Vol. I Groups, (1996), Vol. II – Rings, (1999), Narosa Publishing House.
3) N.Jacobson, Basic Algebra, Vol. I & II. Hindustan Publishing Company, 1980.

Course Outcomes	On completion of the course, students should be able to CO 1: apply the knowledge of bases and dimension of vector spaces and linear transformation. CO2: understand the operations on matrices, matrix of linear transformation and properties of determinant. CO3: evaluate the eigen values and the eigen vectors of linear transformations. CO4: demonstrate on applying the Jordan canonical forms to vector spaces.

(NMC - M.SC Mathematics Syllabus - For the candidates admitted for the academic year 2015 onwards)

Code	Course	Title	Hours/week	Semester	Credits
15PM102	**CC2**	**Real Analysis**	**6**	**1**	**5**
Cognitive Level		**K – 1** Acquire/Remember **K – 2** Understand **K – 3** Apply **K - 4** Evaluate **K - 5** Analyze			
Course Objectives		**The Course aims to** • understand the basics of metric spaces • lay the foundation for the subsequent study of advanced real analysis, complex analysis and functional analysis.			
Employability		**Global need**		Problem Solving & Participatory Learning	

UNIT I

Basic topology, Numerical Sequences and Series: Metric Spaces – Compact sets – Perfect sets – Connected sets – Convergent sequences – Subsequences – Cauchy's sequences.

UNIT II

Continuity: Limits of functions – Continuous functions – Continuity and Compactness – Continuity and Connectedness – Discontinuities –Monotonic functions – Infinite limits and limits at infinity.

UNIT III

Differentiation: Derivative of real function – Mean value theorem –Continuity of derivatives – derivatives of higher order- Taylor's theorem – Differentiation of Vector valued functions.

UNIT IV

Riemann -Stieltjes Integral: Definition and Existence – Properties – Integration and Differentiation – Integration of Vector valued functions.

UNIT V

Sequences and Series of Functions: Uniform Convergence and Continuity – Uniform Convergence and Differentiation – Equi - continuous families of functions – The Stone-Weierstrass Theorem.

TEXT BOOK

Walter Rudin, Principles of Mathematical Analysis, Third Edition, McGraw Hill, 1976.

UNIT I: Ch 2 (Sections 2.15 – 2.47), Ch 3 (Sections 3.1 – 3.14)
UNIT II: Ch 4
UNIT III: Ch 5
UNIT IV: Ch 6
UNIT V: Ch 7

REFERENCE BOOKS

1. Tom Apostal, Mathematical Analysis, Narosa Publishing House, New Delhi – 1985.
2. A.J.White, Real Analysis: An Introduction, Addition Wesley Publishing Co.inc. 1968.

Course Outcomes	On completion of the course, students should be able to CO1: describe the concepts of sets and functions, metric spaces, continuity and connectedness. CO2: demonstrate on sequences and series. CO3: demonstrate on applying Baire Category Theorem, Banach Contraction Principle . CO4: analyze Cauchy sequences, complete metric spaces and connected metric spaces.

(NMC - M.SC Mathematics Syllabus - For the candidates admitted for the academic year 2015 onwards)

Code	Course	Title	Hours/Week	Semester	Credits
15PM103	**CC3**	**Ordinary Differential Equations**	**6**	**1**	**5**
Cognitive Level		**K – 1** Acquire/Remember **K – 2** Understand **K – 3** Apply **K - 4** Evaluate **K - 5** Analyze			
Course Objectives		**The Course aims to** • gain the knowledge of the methods of solving ordinary differential equations, special functions and nonlinear autonomous system of equations.			
Employability and Skill Development		**Global need**		Problem Solving & Participatory Learning	

UNIT I

Second Order Linear Equations And Power Series Method: The general solution of the homogeneous equation – The use of a known solution to find another – method of variation of parameters – A review of Power Series – Series solution of first order equations – Ordinary points.

UNIT II

Power Series Solutions And Special Functions: Singular Points – Regular Singular Points - Gauss's Hyper Geometric Equation – The point at infinity.

UNIT III

Some Special Functions Of Mathematical Physics: Legendre polynomials – Properties of Legendre Polynomials – Bessel Functions – The Gamma Function – Properties of Bessel Functions.

UNIT IV

System of First Order Equations: Linear Systems – Homogeneous linear system with constant co-efficient – The method of successive approximations – Picard's Theorem.

UNIT V

Non-Linear Equations: Autonomous System : The phase plane and its phenomena – Types of Critical points – Stability – Critical points and stability for linear systems – Stability by Liapunov's direct method – Simple critical points of non-linear systems.

TEXT BOOK

G.F. Simmons, Differential Equations with Applications and Historical Notes, TMH, New Delhi, 1984.

UNIT I: Ch 3(15, 16, 19) & Ch 5(25, 26, 27) UNIT II: Ch 5(28- 31)
UNIT III: Ch 6(32-35) UNIT IV: Ch 7(37& 38) & Ch 11(55&56) UNIT V: Ch 8(40- 44).

REFERENCE BOOK

1. W.T. Reid. Ordinary Differential Equations, John Wiley and Sons, New York, 1971

Course Outcomes	On completion of the course, students should be able to CO1:describe the methods of solving first and second order ODE and non linear autonomous system of ODE. CO2: understand the special functions of Mathematical Physics and the concept of stability and critical points of linear system of equations. CO3: evaluate the power series solution of ODE. CO4: demonstrate on applying Picard's theorem to find the solution of ODE's.

(NMC - M.SC Mathematics Syllabus - For the candidates admitted for the academic year 2015 onwards)

Code	Course	Title	Hours/Week	Semester	Credits
15PM104	**CC4**	**Integral Equations, Calculus of Variations and Fourier Transforms**	**6**	**1**	**4**
Cognitive Level		**K – 1** Acquire/Remember **K – 2** Understand **K – 3** Apply **K - 4** Evaluate **K - 5** Analyze			
Course Objectives		**The Course aims to** • introduce the concepts of integral equations, calculus of variations, linear integral equations, method of successive approximations, variational problems with fixed boundaries, variational problems with moving boundaries and Fourier Transform.			
Employability and Skill Development		**Global need**	Problem Solving & Participatory Learning		

UNIT I

Linear Integral Equations: Definition, Regularity Conditions – Special kind of Kernels – Eigen values and Eigen Functions – Convolution Integral – The Inner and Scalar Product of Two Functions –Reduction to a system of Algebraic Equation – Examples – Fredholm Alternative – Examples – An Approximate Method.

UNIT II

Method of Successive Approximations**:** Iterative Scheme – Examples – Volterra Integral Equation – Examples – Some Results about the Resolvent Kernel – Classical Fredholm Theory: The method of Solution of Fredholm - Fredholm's First Theorem – Second Theorem – Third Theorem (Statement only).

UNIT III

Variational Problems with Fixed Boundaries: The concept of variation and its properties - Euler's equations – variational problems for functionals of the form – Functionals Dependent on Higher order derivatives – Functions dependent on Functions of several Independent Variables – Variational problems in parametric Form.

UNIT IV

Variational Problems with Moving Boundaries: Functional of the form $I\left[y(x)\right]=\int_{x_1}^{x_2} F(x,y,y')dx$ - Variational Problem with a movable Boundary for a Functional Dependent on Two functions – One sided variations – Sufficient conditions for an extremum field of extremals : – Jacobi condition – Weirstrass Function – Legendre condition.

UNIT V

Fourier Transform: Fourier sine and cosine transforms-Properties, convolution-solving integral Equations-Finite Fourier transform-finite Fourier sine and cosine transform-Fourier integral theorem parseval Identity. Hankel transform: Definition-Inverse formula-Linearity property-Hankel transform of the derivatives of the function-Hankel transform of differential operation.

TEXT BOOKS

1. Ram. P. Kanwal, Linear Integral Equations Theory and Technique, Academic press 1971.
2. A.S. Gupta, Calculus of Variations with Application, Prentice-Hall of India Pvt. Ltd., New Delhi, 1997.
3. A.R. Vasistha, R.K. Gupta, Integral Transforms, Krishna Prakashan Media Pvt. Ltd., India 2002.

UNIT I: Ch 1 and 2 of (1). UNIT II: Ch 3 and 4 of (1) UNIT III: Ch 1(1.1 - 1.6) Of (2) UNIT IV: Ch 2(2.1- 2.3) &Ch 3(3.1 to 3.4) of (2) UNIT V: Ch 7 and 9 of (3)

REFERENCE BOOKS

1. F.G.Tricomi, Integral Equations, Dover Publications Inc, New York, 1897.
2. Bruce Van Brunt, Calculus of Variations, Springers, 2006.
3. L. Elsgolts, Differential equations and the calculus of variations, Mir Publishers, Moscow 1970.

Course Outcomes	On completion of the course, students should be able to CO1: solve the linear integral equations . CO2: find the solutions of Volterra and Fredholm integral equations. CO3: demonstrate on variational problems on moving boundaries and fixed boundaries. CO4: find the Fourier transform and Hankel transform of various functions.

(NMC - M.SC Mathematics Syllabus - For the candidates admitted for the academic year 2015 onwards)

Code	Course	Title	Hours/week	Semester	Credits
15PM105	**CC5**	**Graph Theory**	**6**	**1**	**4**
Cognitive Level		**K1** – Acquire/Remember **K2** – Understand **K3** – Apply **K4** – Evaluate **K5** – Analyze			
Course Objectives		**The Course aims to** • provide the basic concepts of graph theory such as trees, Eulerian graphs, matching, vertex colorings, edge colorings, planarity.			
Employability		**Global need**		Problem Solving & Participatory Learning	

UNIT I

Graphs and simple graphs – Graph isomorphism – The Incidence and adjacency Matrices – Sub graphs – Vertex Degrees – Path and Connection – Cycles – Trees – Cut Edges and Bonds – Cut Vertices.

UNIT II

Connectivity – Blocks - Euler tours – Hamilton Cycles.

UNIT III

Matchings: Matchings and Coverings in Bipartite Graphs –Edge Chromatic Number – Vizing's Theorem.

UNIT IV

Independent sets – Ramsey's Theorem – Chromatic Number – Brook's Theorem – Chromatic Polynomials.

UNIT V

Plane and planar Graphs – Dual graphs –Euler's Formula – The Five –colour Theorem and the Four-Colour Conjecture.

TEXT BOOK

J.A.Bondy and U.S.R. Murthy, Graph Theory and Applications, Macmillan, London, 1976.

UNIT I Ch 1 (1.1 – 1.7) & Ch 2 (2.1 – 2.3) UNIT II Ch 3 (3.1& 3.2) & Ch 4 (4.1 & 4.2) UNIT III Ch 5 (5.1& 5.2) & Ch 6 (6.1-&6.2) UNIT IV Ch 7 (7.1 & 7.2) & Ch 8 (8.1, 8.2 & 8.4) UNIT V Ch 9 (9.1 – 9.3 & 9.6)

REFERENCE BOOKS

1. J. Clark and D.A.Holton, a First look at Graph Theory, Allied Publishers, New Delhi, 1995.
2. R. Gould, Graph Theory, Benjamin/Cummings, Menlo Park, 1989.
3. A. Gibbons, Algorithmic Graph Theory, Cambridge University Press, Cambridge, 1989.
4. R.J. Wilson and Watkins, Graphs: An introductory Approach, John Wiley and Sons, New York, 1989.
5. S.A. Choudum, a First Course in Graph Theory, MacMillan India Ltd. 1987.

Course Outcomes	On completion of the course, students should be able to CO1: understand the definitions namely, cut vertex, bridge, blocks and automorphism group of a graph. CO2: study the properties of trees and connectivity. CO3: identify Eulerian graphs and Hamiltonian graphs. CO4: understand the concepts planarity including Euler identity, matchings and colorings.

(NMC - M.SC Mathematics Syllabus - For the candidates admitted for the academic year 2015 onwards)

Code	Course	Title	Hours/Week	Semester	Credits
15PM206	**CC6**	**Abstract Algebra**	**6**	**2**	**5**
Cognitive Level		**K – 1** Acquire/Remember **K – 2** Understand **K – 3** Apply **K - 4** Evaluate **K - 5** Analyze			
Course Objectives		**The Course aims to** • gain the .knowledge of advanced concepts of group theory and ring theory. • learn extension fields, elements of Galois theory and various forms of linear transformations			
Employability		**Global need**		Problem Solving & Participatory Learning	

UNIT I

Group theory: Another counting principle, Sylow's theorem, Direct Products, Finite Abelian groups.

UNIT II

Ring theory: Euclidean Rings, A particular Euclidean Ring, Polynomial Rings, Polynomials over the Rational Field, Polynomial Rings over commutative Rings.

UNIT III

Vector spaces and modules: Dual spaces, Inner product spaces, Modules.

UNIT IV

Fields: Extension Fields, Roots of polynomials, More about Roots, The Elements of Galois's theory.

UNIT V

Linear transformations: Characteristic Roots, Matrices, and Canonical Forms: Triangular Form, Nilpotent Transformations, Hermitian, Unitary and Normal Transformations.

TEXT BOOK

N. Herstein, Topics in Algebra, second Edition John Wiley and sons Pvt. Ltd., 1975.

UNIT I**:** Ch2 (2.11 - 2.14) UNIT II: Ch3 (3.7 - 3.11) UNIT III: Ch4 (4.3 - 4.5)

UNIT IV: Ch5 (5.1, 5.3, 5.5& 5 .6) UNIT V: Ch6 (6.2, 6.3, 6.4 & 6.10).

REFERENCE BOOKS

1) Serge Lang, Algebra, Revised Third Edition, Springer Verlag, 2002.

2) Kenneth Hoffman and Ray Kunze, Linear Algebra, Second Edition ,Prentice-Hall of India pvt.Ltd.,New Delhi,1975.
3) David S.Dummit and Richard M.Foote, Abstract Algebra, Wiley and Sons. Third Edition, 2004.

Course Outcomes	On completion of the course, students should be able to CO 1: understand Sylow's theorem and its applications and Galois theory and its applications CO 2: apply suitable methods to find the roots of the polynomials CO 3: analyze linear transformations. CO 4: evaluate characteristic roots of the matrix

(NMC - M.SC Mathematics Syllabus - For the candidates admitted for the academic year 2015 onwards)

Code	Course	Title	Hours/Week	Semester	Credits
15PM207	**CC7**	**Complex Analysis**	**6**	**2**	**5**
Cognitive Level		**K1** – Acquire/Remember **K2** – Understand **K3** – Apply **K4** – Evaluate **K5** – Analyze			
Course Objectives		**The Course aims to** • provide a transition from undergraduate elementary results to postgraduate advanced topics • enable the learners to understand and evaluate the definite integrals. • give a deeper understanding in the advanced topics such as singularities and maximum Principle. .			
Employability		**Global need**		Problem Solving & Participative Learning	

UNIT I

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.

UNIT II

Fundamental theorems in complex integration: Line integrals – Rectifiable Arcs – Line integrals as functions of Arcs – Cauchy's theorem for a rectangle – Cauchy's theorem in a disk; Cauchy's integral formula: The index of a point with respect to a closed curve – The integral formula – Higher derivatives.

UNIT III

Local Properties of Analytic Functions: Removable singularities – Taylor's theorem – Integral representation of the nth term - Zeros and poles – Algebraic order of f (Z) – Essential singularity – The local mapping – The open mapping theorem – The maximum principle.

UNIT IV

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 – Multiply connected regions; The calculus of residues; The reside theorem – The Argument principle – Evaluation of definite integrals.

UNIT V

Harmonic Functions: Definition and Basic properties – The mean – value property – Poisson's Formula – Schwarz's theorem – The reflection principle; power series expansions – Weierstrass' theorem – The Taylor series – The Laurent series.

TEXT BOOK(S):

Lars V. Ahlfors, Complex Analysis, 3rd edition, M C Graw-Hill Book Company, Tokyo, 1979.

UNIT I: Ch 3 (1.1- 1.6, 2.1 - 2.4 & 3.1 - 3.3) UNIT II: Ch 4 (1.1 - 1.5& 2.1-2.3)

UNIT III:Ch 4 (3.1- 3.4) UNIT IV:Ch 4 (4.1 - 4.7, 5.1- 5.3) UNIT V:Ch 4 (6.1 - 6.5) & Ch 5 (1.1 - 1.3)

REFERENCES BOOKS:

1. Serge Lang, Complex Analysis, Addison Wesley, 1977.
2. S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, 1997.

Course Outcomes	On completion of the course, students should be able to CO1: acquire the knowledge of analytic functions and Mobius transformation. CO2: understand the concept of complex integration. CO3: demonstrate on Cauchy theorems and open mapping theorem. CO4: classify the singularities and evaluate the residue

(NMC - M.SC Mathematics Syllabus - For the candidates admitted for the academic year 2015 onwards)

Code	Course	Title	Hours/Week	Semester	Credits
15PM208	**CC8**	**Topology**	**6**	**2**	**5**
Cognitive Level		**K – 1** Acquire/Remember **K – 2** Understand **K – 3** Apply **K - 4** Evaluate **K - 5** Analyze			
Course Objectives		**The Course aims to** • enable the students to learn about the essentials of topological spaces and their properties in terms of continuity, connectedness, compactness etc.			
Employability		**Global need**	Problem Solving & Participative Learning		

UNIT I

Topological spaces – Basis for a topology – The order topology – The product topology on XxY – The subspace topology – Closed sets and limit points.

UNIT II

Continuous functions – the product topology – The metric topology.

UNIT III

Connectedness: Connected subspaces of the Real line – Components and local connectedness.

UNIT IV

Compactness: Compact sunspaces of the Real line – Limit point compactness – Local compactness.

UNIT V

The Countability Axioms – The separation Axioms – Normal spaces – The Urysohn Lemma – The Urysohn metrization theorem – The Tietz extension theorem.

TEXT BOOK(S):

James R. Munkres, Topology (2^{nd} edition), Peassen Education pvt. Ltd., New Delhi-2002 (Third Indian Reprint)

UNIT I: Ch 2 (12 - 17) UNIT II: Ch 2 (18 - 21) UNIT III: Ch 3(23 - 25)

UNIT IV: Ch 3 (26 - 29) UNIT V: Ch 4 (30 - 35)

REFERENCES BOOKS

1. G.F. Simmons, Introduction to topology & Modern Analysis, M.C. Graw Hill Company, 1963.

2. James Dugundji, Topology, Prentice Hall of India Pvt Ltd, 1975.

Course Outcomes	On completion of the course, students should be able to CO1: develop their abstract thinking skills CO2: provide precise definitions and appropriate examples and counter examples of fundamental concepts in general topology. CO3: acquire knowledge about various types of topological spaces and their properties CO4: appreciate the beauty of the mathematical results like Ury Zohn's Lemma and understand the dynamics of the proof techniques.

(NMC - M.SC Mathematics Syllabus - For the candidates admitted for the academic year 2015 onwards)

Code	Course	Title	Hours/Week	Semester	Credits
15PM209	**CC9**	**Partial Differential Equations**	**6**	**2**	**4**
Cognitive Level	**K – 1** Acquire/Remember **K – 2** Understand **K – 3** Apply **K - 4** Evaluate **K - 5** Analyze				
Course Objectives	**The Course aims to** • help the students to understand linear and non linear partial equations and solving them using Charpit's and Jacobi's methods, methods of separation of variables and by method of integral transforms. the study of Laplace equation, wave equation and diffusion equation and their classifications.				
Employability and Skill Development		**National need**	Problem Solving & Participative Learning		

UNIT I

First Order PDE – Curves and Surfaces – Genesis of First Order PDE – Classification of Integrals – Linear Equations of the First order – Pfaffian Differential Equations – Compatible Systems – Charpit's Method – Jacobi's Method.

UNIT II

Integral Surfaces Through a Given Curve – Quasi-linear Equations – Non-linear First order PDE.

UNIT III

Second order PDE: Genesis of second order PDE – Classification of second order PDE – One-Dimensional wave Equation – Vibrations of an Infinite string – Vibrations of a Semi-infinite string – Vibrations of a string of Finite length (Method of Separation of variables).

UNIT IV

Laplace's Equation: Boundary Value Problems – Maximum and Minimum principles –The Cauchy Problem – The Dirichlet problem for the Upper Half Plane - The Neumann Problem for the Upper Half Plane – The Dirichlet Interior problem for a circle – The Dirichlet Exterior problem for a circle – The Neumann problem for a circle – The Dirichlet problem for a Rectangle – The Harnack's Theorem – Laplace's Equation – Green's Function.

UNIT V

Heat Conduction Problem – Heat Conduction Infinite Rod Case – Heat conduction Finite Rod case – Duhamel's principle – Wave Equation – Heat Conduction Equation.

TEXT BOOK

T. Amarnath, an Elementary Course in Partial Differential Equations, Narosa1997.

UNIT I**:** Ch 1 (1.1-1.8) UNIT II**:** Ch 1 (1.9-1.11) UNIT III**:** Ch 2 (2.1– 2.3.5) except 2.3.4.
UNIT IV: Ch 2 (2.4 – 2.4.11) UNIT V**:** Ch 2 (2.5 – 2.6.2).

REFERENCE BOOKS

I.C. Events, Partial Differential Equations, Graduate studies in Mathematics, vol 19, AMS, 1998.

Course Outcomes	On completion of the course, students should be able to CO1: recollect the first order and second order partial differential equations and their solution. CO2: understand the linear partial differential equations with constant and variable coefficients, boundary value problems and application of calculus of variations. CO3: gain good knowledge in applying Charpit's and Jacobi's methods, method of separation of variables and the method of integrals to obtain solutions of partial differential equations. CO4: demonstrate on the canonical forms of second order PDEs and bounded value problems by Dirichlet and Neumann.

(NMC - M.SC Mathematics Syllabus - For the candidates admitted for the academic year 2015 onwards)

Code	Course	Title	Hours/Week	Semester	Credits
15PM311	**CC10**	**Functional Analysis**	**6**	**3**	**5**
Cognitive Level		**K1** – Acquire/Remember **K2** – Understand **K3** – Apply **K4** – Evaluate **K5** – Analyze			
Course Objectives		The Course aims to • learn the concepts of normed Spaces, inner product spaces, linear operator, linear operator on Hilbert spaces and compact operators.			
Employability		**Global need**		Problem Solving & Participative Learning	

UNIT I

Banach Spaces: The definition and some examples – Continuous linear transformations – Hahn-Banach theorem – The natural imbedding of N in N** - The Open mapping theorem – The Conjugate of an Operator**.**

UNIT II

Hilbert Spaces: The definition and some simple properties – Orthogonal Complements – Orthonormal sets – The Conjugate space H* - The adjoint of an operator – Self-adjoint operators – Normal and Unitary operators – Projections.

UNIT III

Finite Dimensional Spectral theory: Matrices – Determinants and the spectrum of an operator – The spectral theorem – A survey of the situation.

UNIT IV

General preliminaries on Banach Algebras: The definition and some examples – Regular and singular elements – Topological divisors of zero – The spectrum – The formula for the spectral radius – The radical and semi-simplicity.

UNIT V

The structure of commutative Banach Algebras: The Gelfand mapping – Applications of the formula $r(x) = \text{Lim } \|x^n\|^{1/n}$ – Involutions in Banach Algebras – The Gelfand –Neumark theorem.

TEXT BOOK

1. G. F. Simmons, Introduction to topology and Modern Analysis, TMH edition 1963.

UNIT I: Ch 9 UNIT II: Ch 10 UNIT III: Ch 11 UNIT IV: Ch 12 UNIT V: Ch 13

REFERENCE BOOKS

1.Walter Rudin, Functional Analysis, TMH edition, 1964.
2. B. V. Limaye, Functional Analysis, Wiley Eastern limited, Bombay, second print, 1985.
3.K. Yosida, Functional Analysis, Springer Verlag, 1964.
4.Laurent Schwarz, Functional Analysis, Courant Institute of Mathematical sciences, New York University, 1864.

Course Outcomes	On completion of the course, students should be able to CO1: understand the concept of Normed Spaces CO2: apply the idea of linear operators and compact operators CO3: evaluate Ortho normal basis CO4: demonstrate spectral theory

(NMC - M.SC Mathematics Syllabus - For the candidates admitted for the academic year 2015 onwards)

Code	Course	Title	Hours/Week	Semester	Credits
15PM312	**CC11**	**Measure and Integration**	**6**	**3**	**5**
Cognitive Level		**K1** – Acquire/Remember **K2** – Understand **K3** – Apply **K4** – Evaluate **K5** – Analyze			
Course Objectives		Aim of this course is to • introduce the concepts of measure on real line, integration of non-negative functions, abstract measure spaces, L^p Spaces, Signed measure.			
Employability		**Global need**		Problem Solving & Participative Learning	

UNIT I

Measure on Real line - Lebesgue outer measure - measureable sets-Regularity measureable Function- Borel and Lebesgue measurability.

UNIT II

Integration of non-negative functions-the general integral, integration of series, Riemann and Lebesgue integrals.

UNIT III

Abstract measure spaces - Measures and outer measures, completion of a measure, measure spaces, Integration with respect to a measure.

UNIT IV

L^P spaces - convex functions, Jenson's inequality, inequalities of Holder and Minkowski, completeness of $L^P(\mu)$.

UNIT V

Signed measure - Hahn decomposition, measurability in a product spaces, Fubini's theorem.

TEXT BOOK

De Barra, Measure Theory and Integration, New Age International Pvt Limited.
UNIT I: Ch 2(2.1-2.5) UNIT II: Ch3 (3.1-3.4) UNIT III: Ch 5(5.1 – 5.6)
UNIT IV: Ch 6(6.1 – 6.5) UNIT V: Ch 8(8.1 & 8.2) & Ch10 (10.1 & 10.2)

REFERENCE BOOKS

1) M.E.Munroo addition-Measure and Integration, Wesley, Second Edition Publishing Company, 1971.
2) H.L.Royden, Real Analysis, PHI, Third Edition, 1989.
3) R. G.Bartle, Elements of Real Analysis, John Wiley, 1976.

Course Outcomes	On completion of the course, students should be able to CO 1: acquire the concept of Lebesgue measure, measurable set. CO 2: understand the concept of integration of non negative functions. CO 3: demonstrate on Jenson's inequality and Hahn decomposition theorem and Fubini's theorem. CO 4: analyze the properties of L^p spaces.

(NMC - M.SC Mathematics Syllabus - For the candidates admitted for the academic year 2015 onwards)

Code	Course	Title	Hours/week	Semester	Credits
15PM313	**CC12**	**Number Theory**	**6**	**2**	**4**
Cognitive Level	**K – 1** Acquire/Remember **K – 2** Understand **K – 3** Apply **K - 4** Evaluate **K - 5** Analyze				
Course Objectives	**The Course aims to** • learn the concepts of divisibility, congruence**,** quadratic reciprocity and quadratic forms, some function of number Theory, some Diophantine equations.				
Employability and Skill Development	**Global need**		Problem Solving & Participative Learning		

UNIT I

Divisibility: Introduction-Divisibility-Primes-The Bionomical Theorem.

UNIT II

Congruence-Solutions of Congruence-The Chinese Remainder Theorem-Techniques of Numerical Calculation-Prime Power Module-Primitive roots and Power Residue.

UNIT III

Quadratic Reciprocity and Quadratic Forms: Quadratic Residues- Quadratic Reciprocity-The Jacobi Symbol-Binary Quadratic Forms.

UNIT IV

Some Function of Number Theory: Greatest integer Function-Arithmetic Functions –The Mobius Inversion Formula-Recurrence Functions.

UNIT V

Some Diophantine Equations: The Equation ax+ by=c –Simultaneous Linear Equations-Pythagorean Triangles-Assorted Examples.

TEXT BOOK

Ivan Nivan, Herbert S.Zuckerman and Hugh L.Montgomery, An Introduction to the theory of Numbers, Fifth edition., John Wiley and Sons Inc,2009.

UNIT I: Ch 1 UNIT II: Ch 2(2.1-2.4, 2.6 &2.8) UNIT III: Ch 3(3.1-3.4)

UNIT IV: Ch 4(4.1-4.4) UNIT V: Ch 5(5.1-5.4)

REFERENCE BOOKS

1. David M.Burton, Elementary of Number theory, W.M.C Brown Publishers, Dubuque, Lawa, 1989.
1. William.J.Leveque, Fudamentals of Number theory, Addison-Wesley Publishing Company, Phillipines, 1977.
3. Tom.M.Apostal-Introduction to Analytic Number theory, Narosa, New Delhi.

Course Outcomes	On completion of the course, students should be able to CO1: attain a broad understanding of divisibility, congruence, greatest common divisor, least common multiple and factoring. CO2: understand certain number theoretic functions and their properties. CO3: apply the law of Quadratic Reciprocity and other methods to classify numbers as primitive roots, quadratic residues and quadratic non-residue. CO4: acquire the mathematical skills required to solve the system of Diophantine equation using Chinese Reminder theorem and Euclidean algorithm.

(NMC - M.SC Mathematics Syllabus - For the candidates admitted for the academic year 2015 onwards)

Code	Course	Title	Hours/Week	Semester	Credits
15PM416	**CC13**	**Differential Geometry**	**6**	**4**	**5**
Cognitive Level		**K1** – Acquire/Remember **K2** – Understand **K3** – Apply **K4** – Evaluate **K5** – Analyze			
Course Objectives		Aim of this course is to • make the student to learn about tangent spaces, surfaces, Gauss map, Geodesics on surfaces and curvature of plane curves.			
Employability and Skill Development		**Global need**	Problem Solving & Participative Learning		

UNIT I

Space Curves: Definition of a Space Curve – Arc length – Tangent – normal and Binormal Curvature and Torsion – Contact between curves and Surfaces –Tangent Surface – Involutes and Evolutes – Intrinsic equations – Fundamental existence Theorem for space curves – Helices.

UNIT II

Intrinsic Properties of a Surface: Definition of a surface – Curves on a surface – Surface of revolution – Helicoids – Metric – Direction Co-efficient – Families of curves – Isometric correspondence – Intrinsic properties.

UNIT III

Geodesics: Geodesics – Canonical geodesic equations – Normal property of geodesics – Existence theorems.

UNIT IV

Geodesic parallels – Geodesic curvature – Gauss-Bonnet Theorem – Gaussian curvature – Surface of constant curvature.

UNIT V

Non-Intrinsic Properties of a Surface: The second fundamental form – Principal curvature – Lines of curvature – Developable – Developable associated with space curves and with curves on surface – Minimal Surfaces – Ruled Surfaces.

TEXT BOOK

2. T. J. Willmore, An Introduction to Differential Geometry, Oxford University Press, 17th Impression, New Delhi 2002, Indian print.
   UNIT I: Ch 1 (1-9) UNIT II: Ch 2 (1-9) UNIT III: Ch 2 (10-13)
   UNIT IV: Ch 2 (14-18) UNIT V: Ch 3 (1-8)

REFERENCE BOOKS

1. D. T. Struik Lectures on classical Foundations of Differential Geometry, Addison Wesley, Mass 1950.
2. S. Kobayashi and K. Nornizu, Foundations of Differential Geometry, Interscience publishers, 1963.
3. Wihelm Klingenberg, A course in Differential Geometry, Graduate Texts in Mathematics, Springer Verlag, 1978.
4. J. A. Thorpe, Elementary topics in Differential Geometry, under graduate Texts in Mathematics, Springer Verlag, 1979.

Course Outcomes	On completion of the course the student will be able to CO1: understand the concept of Graphs and Level sets-Vector fields CO2: analyze surfaces and Vector field on surfaces CO3: understand Gauss map-Geodesics. CO4: apply Parallel Transport and Weingarten map.

(NMC - M.SC Mathematics Syllabus - For the candidates admitted for the academic year 2015 onwards)

Code	Course	Title	Hours/Week	Semester	Credits
15PM417	**CC14**	**Stochastic Processes**	**6**	**4**	**4**
Cognitive Level		**K1** – Acquire/Remember **K2** – Understand **K3** – Apply **K4** – Evaluate **K5** – Analyze			
Course Objectives		**The Course aims to** • learn the concepts of stochastic Process, Markov chains, Markov process with discrete state space, renewal processes and theory, stochastic process in queuing and reliability			
Employability and Skill Development		**National need**	Problem Solving & Participative Learning		

UNIT I

Stochastic Process: Some Notions – Introduction - Specifications of Stochastic Process – Stationary process - Markov Chains – Definition and examples -Higher transition probabilities – Generalization of independent Bernoulli trials – Sequence of chain – dependent trials.

UNIT II

Markov Chains – Classifications of States and Chains – Determination of higher transition probability – Stability of a Markov System – Markov chain with Denumerable Number of states – Reducible Chains.

UNIT III

Markov Processes with Discrete state space: Poisson Process and its Extensions – Poisson Process – Poisson Process and Related Distributions – Generalization of Poisson process – Birth and Death Process – Markov Processes with Discrete state space (Continuous time Markov Chains).

UNIT IV

Renewal Processes and Theory: Renewal Process – Renewal Processes in Continuous Time – Renewal Equation – Stopping Time – Wald's Equation – Renewal Theorems.

UNIT V

Stochastic process in queueing and reliability – Queueing Systems: general concepts, the Queueing model M/M/1 model non- morkovian queueing models, the model GI/M/I

TEXT BOOK:

1 J. Medhi, Stochastic Processes, Second edition, New Age International (P) Ltd, New Delhi.
UNIT I: Ch 2 (2.1-2.3) & Ch 3 (3.1-3.3) UNIT II: Ch 3 (3.4-3.6, 3.8, 3.9)
UNIT III: Ch 4 (4.1-4.5) UNIT IV: Ch 6 (6.1-6.5) UNIT V: Ch 10: (10.1-10.3, 10.7, 10.8.)
(Except 10.2.2, 10.2.3, 10.7.2.1, 10.7.3.2, 10.7.3.3, 10.7.3.4, 10.8.2)

REFERENCE BOOKS

1. Samuel Karlin, Howard M. Taylor, A first course in Stochastic Processes , Second Edition, Academic Press, 1981.
2. Narayan Bhat, Elements of Applied Stochastic Processes, Second edition, John wiley, 1984.
3. S.K.Srinivasan and K.Mehta, Stochastic Processes, TMH, 1976.
4. N.U.Prabhu, Stochastic Processes, Macmillan (NY), 1965.

Course Outcomes	On completion of the course, students should be able to CO1: understand the concept of various specifications of Stochastic Processes. CO2: apply the idea of Markov chain and Markov Processes to real life problems. CO3: demonstrate on renewal equation, stopping time and renewal theorem. CO4: apply the idea of queuing model to real life problems .

CORE ELECTIVE COURSES(CEC)

(NMC - M.SC Mathematics Syllabus - For the candidates admitted for the academic year 2015 onwards)

Code	Course	Title	Hours/Week	Semester	Credits
15PM314 b	CEC1A	Fluid Dynamics	6	3	4
Cognitive Level		**K – 1** Acquire/Remember **K – 2** Understand **K – 3** Apply **K - 4** Evaluate **K - 5** Analyze			
Course Objectives		**The Course aims to** • give an introduction to the behavior of fluid in motion • give a feel of the applications of complex analysis in the analysis of flow of fluids.			
Employability and Skill Development		**Global need**	Problem Solving & Participative Learning		

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UNIT I

Kinematics of Fluids in Motion: Real Fluids and Ideal Fluids – Velocity of a fluid at a point – Streamlines and Path lines : Steady and Unsteady flows – The Velocity Potential – The vorticity vector – Local and Particle rates of change – The equation of continuity – Worked Examples – Acceleration of a fluid.

UNIT II

Equations of Motion of a Fluid: Pressure at a point in a fluid at rest – Pressure at a point is a moving fluid – Euler's Equations of motion – Bernoulli's equation - Discussion of the case of steady motion under Conservative Body Forces – Some Potential theorems – Impulsive motion.

UNIT III

Some Three-dimensional Flows: Sources, sinks and doublets – Images in rigid infinite plane – Images in solid spheres - Axisymmetric flour; Stoke's stream function.

UNIT IV

Some Two-dimensional Flows: The Stream function – The complex potential for two dimensional, irrotational, incompressible flow – Complex velocity potentials for standard two dimensional flows – some worked examples – Two dimensional image systems – The Milne Thomson circle theorem – The theorem of Blasis.

UNIT V

Viscous Flow: Stress components in a Real Fluid – Relations between Cartesian components of stress - Translational Motion of Fluid element – The Rate of Strain Quadric and Principal Stresses – Some Further properties of the Rate of Strain Quadric - Stress Analysis in Fluid Motion – Relations between stress and Rate of strain – The Co-efficient of viscosity and Laminar Flow – The Navier – Stokes Equations of Motion of a viscous Fluid-Some solvable problems in Viscous flow.

TEXT BOOK:

F. Chorlton, Text Book of Fluid Dynamics, CBS Publishers & Distributors, Delhi 1985.
UNIT I **:** Ch 2 (2.1 – 2.9), UNIT II: Ch 3 (3.1, 3.2, 3.4 – 3.8 & 3.11)
UNIT III**:** Ch 4 (4.2 – 4.5), UNIT IV: Ch 5 (5.1 – 5.9), UNIT V: Ch 8 (8.1 – 8.10)

REFERENCE BOOKS

1.H. Schlichting, Boundary Layer Theory, Me Grow Hill Co, New York, 1979.
2.R.K. Rathy, An Introduction to Fluid Dynamics, Oxford and IBH Pub. Co., New Delhi, 1976.
3.William F. Hughes and John A. Brighton, Fluid Dynamics (Schaum's Outlines), 2nd Ed., TMH, 1967.
4.J.D. Anderson, Computational Fluid Dynamics, the Basics with Applications, TMH, 1995.
5. A. J. Chorin and A. Marsden, A Mathematical Introduction to Fluid Dynamics, Springer verlag, New Delhi, 1993

Course Outcomes	On completion of the course, students should be able to CO1: understand the behavior of fluids in motion. CO2: understand the potential theorems of fluid flow CO3: apply the concept of complex analysis in the analysis of the flow of liquids. CO4: analyze the concept of sources, sinks & doublets and two dimensional flows.

(NMC - M.SC Mathematics Syllabus - For the candidates admitted for the academic year 2015 onwards)

Code	Course	Title	Hours/week	Semester	Credits
15PM314a	**CEC1B**	**Cryptography**	**6**	**3**	**4**
Cognitive Level	**K – 1** Acquire/Remember **K – 2** Understand **K – 3** Apply **K - 4** Evaluate **K - 5** Analyze				
Course Objectives	**The Course aims to** • learn the concepts of Encryption Schemes, Prime Number Generation, Factoring, Discrete Logarithms.				
Employability and Skill Development	**Global need**		Problem Solving & Participative Learning		

UNIT I

Encryption Schemes -Symmetric and Asymmetric Cryptosystems - cryptanalysis - Alphabets and words -Permutations, Block ciphers -Multiple Encryption.

UNIT II

Probability –conditional Probability –Birthday Paradox – Perfect Secrecy- Vernam one – Time Pad –Random Numbers –Pseudorandom Numbers.

UNIT III

Prime Number Generation: Trial Division –Fermat Test – Carmichael Numbers – miller – Rabin Test –Random Primes. .

UNIT IV

Factoring: Trail Division – P-1 Method –Quadratic Sieve – Analysis of the Quadratic Sieve – Effienciency of other Factoring Algorithms.

UNIT V

Discrete Logarithms**:** The DL problems – Enumeration – shanks Baby Step Giant – Step Algorithm – The Pollard P – Algorithm – the pohlig – Hellman Algorithm – Index Calculus.

TEXT BOOK

Johannes A.Buchmann, Introduction to Cryptography, second edition, Springers.

. UNIT I: Ch 3 (3.1-3.7) UNIT II: CH 4 UNIT III: Ch 7

UNIT IV: Ch 9 UNIT V: Ch 10 (10.1 -10.6)

REFERENCE BOOKS

1. William Stallings, Cryptography and Network Security, Principles and Practices, Fourth Edition, Prentice Hall of India.

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Course Outcomes	On completion of the course, students should be able to CO1:understand the basic concepts of cryptography. CO2: analyze encryption and multiple encryption. CO3: apply Fermat test, Miller and Rabin test for prime number generation. CO4: evaluate the DL problems.

(NMC - M.SC Mathematics Syllabus - For the candidates admitted for the academic year 2015 onwards)

Code	Course	Title	Hours/Week	Semester	Credits
15PM315b	**CEC2A**	**Fuzzy Mathematics**	**6**	**3**	**4**
Cognitive Level	**K – 1** Acquire/Remember **K – 2** Understand **K – 3** Apply **K - 4** Evaluate **K - 5** Analyze				
Course Objectives	**The Course aims to** • help the student to gain the knowledge of the basics of fuzzy set theory, operations on fuzzy sets, fuzzy numbers, fuzzy relation, fuzzy graphs and fuzzy logic.				
Employability and Skill Development	**Global need**	Problem Solving & Participative Learning			

UNIT 1: FUZZY SET THEORY

Fuzzy set, Type of Fuzzy sets, General definitions and properties of Fuzzy sets, General theorems, Solved examples.

UNIT 2: OPERATIONS ON FUZZY SETS

Introduction, Some important theorems, Extension Principle for Fuzzy sets, Fuzzy Complements-Some important theorems.

UNIT 3: FUZZY NUMBERS

Algebraic operations with Fuzzy numbers, Binary operation of two Fuzzy numbers, Extended operations for L.R representation of Fuzzy sets, Fuzzy Arithmetic, Fuzzy equations.

UNIT 4: FUZZY RELATIONS AND FUZZY GRAPHS

General definitions, Projections and Cylindrical Fuzzy relations, Composition, Properties of Min-Max composition , Binary relation on a single set , Solved examples, Compatibility relation , Fuzzy graph , Fuzzy morphisms, Fuzzy relation equations.

UNIT 5: FUZZY LOGIC

An overview of classical logic, Connectives, Types of sentences, Truth values and Truth table, Tautology, Algebra of Statements, Validity of Arguments, Logical identities of Crisp logic ,Well formed formulas Predicates and Quantifiers ,Quantifiers and logical operators ,Normal form, Fuzzy logic ,Fuzzy Connectives ,Fuzzy inference.

Text Book:

SUDHIR ,K.PUNDIR & Dr.RIMPLEPUNDIR "Fuzzy sets and their Application".
UNIT 1: Ch 1(1.16-1.19) ,UNIT 2: Ch 2(2.1-2.5)
UNIT 3: Ch 3(3.2-3.4,3.6-3.9) UNIT 4: Ch 4(4.1-4.6,4.8,4.9)
UNIT 5: Ch 7(7.1-7.15)

Reference Book:

1. George J.Klir and B.Yuan.Fuzzy sets and Fuzzy Logic , Prentice Hall of India New Delhi,2004.
2. H.J.Zimmermann, Fuzzy set Theory and its Applications, Allied Publishers Ltd,New Delhi,1991.

Course Outcomes	On completion of the course, students should be able to CO1: to know the basic Mathematical elements of the theory of fuzzy sets CO2: gain Knowledge about the fuzzy arithmetic and fuzzy number CO3: to understand the difference and similarities between fuzzy sets and classical set theories. CO4: apply the fuzzy logic in real life situation

(NMC - M.SC Mathematics Syllabus - For the candidates admitted for the academic year 2015 onwards)

Code	Course	Title	Hours/Week	Semester	Credits
15PM315a	**CEC2B**	**Combinatorics**	**6**	**3**	**4**
Cognitive Level	**K1** – Acquire/Remember **K2** – Understand **K3** – Apply **K4** – Evaluate **K5** – Analyze				
Course Objectives	**The Course aims to** • learn the concepts of permutations and combinations, generating function, recurrence relation, the principle of inclusion and exclusion.				
Employability and Skill Development	**Global need**	Problem Solving & Participative Learning			

UNIT I

Permutations and combinations-distributions of distinct objects –distributions of non distinct objects - Stirlings formula.

UNIT II

Generating functions-generating function for combinations-Enumerators for permutations-distributions of distinct objects into non-distinct cells-partitions of integers-the Ferrers graphs-elementary relations

UNIT III

Recurrence relations-linear recurrence relations with constant coefficients solutions by the technique of generating functions –special class of nonlinear difference equations- recurrence relations with two indices.

UNIT IV

The principle of inclusion and exclusion-general formula-permutations with restriction on relative position-derangements-the rook polynomials-permutations with forbidden positions.

UNIT V

Polya's theory of counting-equivalence classes under a permutation group Burnside theorem-equivalence classes of functions-weights and inventories of functions-Polya's fundamental theorem-generation of Polya's theorem.

TEXT BOOK

C.L. Liu, Introduction to Combinatorial Mathematics, TMH, New Delhi.

UNIT I: Ch 1 UNIT II: Ch 2 UNIT III: Ch 3 UNIT IV: Ch 4 UNIT V: Ch 5

REFERENCE BOOKS

1. Marshall Hall.Jr., Combinatorial Theory.
2. H.J.Rayser, Combinatorial mathematics, Carus, Mathematical Monograph.No.14

Course Outcomes	On completion of the course, students should be able to CO1: understand the basic concepts of permutation and combination . CO2: analyze the principle of inclusion and exclusion for counting the number of elements in the union of two finite sets . CO3: apply the Polya's theorem for counting. CO4: acquire the knowledge of recurrence and linear recurrence relations with constant co-efficient .

NMC - M.SC Mathematics Syllabus - For the candidates admitted for the academic year 2015 onwards)

Code	Course	Title	Hours/Week	Semester	Credits
15PM418a	**CEC3A**	**Numerical Analysis**	**6**	**4**	**4**

Cognitive Level	**K1** – Acquire/Remember **K2** – Understand **K3** – Apply **K4** – Evaluate; **K5** – Analyze	
Course Objectives	**The Course aims to** • know the theory behind various numerical methods. • apply these methods to solve mathematical problems.	
Employability and Skill Development	**National need**	Problem Solving & Participative Learning

UNIT I

Transcendental and Polynomial Equations: Rate of convergence – Iterative Methods – Polynomial Equations: Bridge – Vista method, Barstow's method, Graffe's root squaring method.

UNIT II

System of Linear Algebraic Equations and Eigen Value Problems: Error Analysis of direct and iteration methods – Finding Eigen values and Eigen vectors – Jacobi and Power methods.

UNIT III

Interpolation and Approximation**:** Hermit Interpolations – Piecewise and Splice Interpolation – Vicariate Interpolation – Approximation – least square approximation.

UNIT IV

Differentiation and Integration: Numerical Differentiation – optimum choice of step – length Extrapolation methods – Partial Differentiation – Methods based on undetermined coefficients – Gauss Methods.

UNITV

Ordinary Differential Equations: Local truncation error – Euler, Backward Euler, Midpoint, Taylor's Method and second orders Runge – kutta method – stability analysis.

TEXT BOOK

M.K.Jain, S.R.K.Iyengar and R.K.Jain, "Numerical Methods for Scientific and Engineering Computation" III Edition, Wiley Eastern Ltd., 1993.

UNIT I: Ch 2 (2.5-2.8) UNIT II: Ch 3 (3.1 - 3.5) UNIT III: Ch 4(4.5 - 4.9)
UNIT IV: Ch 5 (5.2 - 5.5 & 5.8) UNIT V: Ch 6 (6.2, 6.3 & 6.6).

REFRRENCE BOOKS

1. Kendall E. Atkinson, "An Introduction to Numerical Analysis. II Edition, John Wiley & sons 1988.
2. M.K.Jain, Numerical Solution of Differential Equations, II Edition New Age International Pvt Ltd 1983.
3. Samuel. D.Conte, Carl De Boor, Elementary Numerical Analysis. McGraw – Hill International Edition., 1983.

Course Outcomes	On completion of the course, students should be able to CO 1: obtain the solutions of transcendental and polynomial equations. CO 2 : apply direct methods and iteration methods for solving system of equations. CO 3 : apply Hermit interpolation, piecewise and spline interpolation. CO 4 : solve problems using interpolation and ordinary differential equations using numerical methods.

(NMC - M.SC Mathematics Syllabus - For the candidates admitted for the academic year 2015 onwards)

Code	Course	Title	Hours/Week	Semester	Credits
15PM418b	**CEC2B**	**Optimization Techniques**	**6**	**4**	**4**
Cognitive Level	**K1** – Acquire/Remember **K2** – Understand **K3** – Apply **K4** – Evaluate **K5** – Analyze				
Course Objectives	**The Course aims to** • provide the knowledge of various optimization techniques like integer programming, dynamic programming, decision theory and games, inventory models, non-linear Programming algorithms				
Employability and Skill Development	**National need**	Problem Solving & Participative Learning			

UNIT I

Integer Programming

UNIT II

Dynamics (Multistage) Programming

UNIT III

Decision Theory and Games.

UNIT IV

Inventory Models

UNIT V

Non-Linear Programming algorithms

TEXT BOOK

Hamby A. Taha, Operations Research (4th End), McGraw Hill Publications, New Delhi.2002.

Unit I: Ch 8 (8.1-8.5) Unit II: Ch 9 (9.1-9.5) Unit III: Ch 11 (11.1-11.4)

Unit IV: Ch 13 (13.1-13.4) Unit V: Ch 19(19.1& 19.2)

REFERENCE BOOKS

1. O.L. Mangesarian, Non Linear Programming, TMH, New Yark.
2. Mokther S.Bazaraa and C.M. Shetty, Non Linear Programming, Theory and Algorithms, Willy, New Yark.
3. Premkumar Gupta and D.S. Hira, Operations Research: An Introduction, S. Chand and Co., Ltd. New Delhi.
4. S.S.Rao, Optimization theory and Applications, Wiley Eastern Ltd, New Delhi.

Course Outcomes	On completion of the course, students should be able to CO1: understand the concept of integer programming and dynamic programming. CO2: analyse the problems based on decision theory and game theory. CO3: get optimize inventory models. CO4: evaluate non-linear programming problems.

(NMC - M.SC Mathematics Syllabus - For the candidates admitted for the academic year 2015 onwards)

Code	Course	Title	Hours/Week	Semester	Credits
15PM419a	**CEC4A**	**Classical Dynamics**	**6**	**4**	**4**
Cognitive Level	**K – 1** Acquire/Remember **K – 2** Understand **K – 3** Apply **K - 4** Evaluate **K - 5** Analyze				
Course Objectives	**The Course aims to** • gain a detailed knowledge of the mechanical system of particles. • learn the applications of Lagrange's and Hamilton's equations **.**				
Employability and Skill Development	**Global need**	Participative learning and Problem solving			

UNIT	Content	No. of Hours
I	Introductory concepts: Mechanical system – Generalized Coordinates Constraints – Virtual Work – Energy and Momentum.	15
II	Lagrange's equations: Derivations of Lagrange's Equations – Examples – Integrals of Motion.	15
III	Hamilton's equations: Hamilton's Principle – Hamilton's Equations.	15
IV	Hamilton – Jacobi theory: Hamilton's Principle function – Hamilton-Jacobi Equation.	15
V	Canonical transformations: Differential forms and Generating Functions – Lagrange and Poisson Brackets.	15
Reference	**Text Book:** Donald T. Greenwood, Cl*assical Dynamics, Dover Publication.* New York. UNIT- I **:** Ch1 (§1.1 – 1.5) UNIT- II : Ch2 (§2.1 – 2.3) UNIT- III: Ch4 (§4.1 - 4.2) UNIT- IV: Ch5 (§5.1-5.2) UNIT -V : Ch6 (§6.1-6.3). **Reference Books:** 1. Goldstein, H. ,*Classical Mechanics*. Addison Wesley Press, Inc.,1950 2. Synge, J.L. and Griffith, B.A., *Principles of Mechanics*. Third Edition., McGraw-Hill company,1959	

Course Outcomes	On completion of the course, students should be able to CO 1: understand the 3N-Coordinate system made up of N-Spatial coordinates, N-velocity coordinates and N-acceleration coordinates CO 2: analyse the motion of mechanical systems with constraints using Lagranian description CO 3: apply Hamilton's principle and gain proficiency in solving equations of motions CO 4: use the Hamilton-Jacobi theory in solving equations of motions

(NMC - M.SC Mathematics Syllabus - For the candidates admitted for the academic year 2015 onwards)

Code	Course	Title	Hours/Week	Semester	Credits
15PM419c	**CEC4C**	**Mathematical Probability and Statistics**	**6**	**4**	**4**
Cognitive Level	**K1** – Acquire/Remember **K2** – Understand **K3** – Apply **K4** – Evaluate **K5** – Analyze				
Course Objectives	**The Course aims to** • learn the concepts of Probability, Random Variables and Statistical Applications.				
Employability and Skill Development	**Global need**	Problem Solving & Participative Learning			

Unit I

Probability spaces: Definition of Probability- Some Simple Properties-Discrete Probability Space-General Probability Space-Induced Probability Space.

Unit II

Distribution Functions: Distribution Function of Random Variables-Decomposition of Distribution Functions. Expectation and Moments: Definition of Expectation-Properties of Expectation-Moments, Inequalities.

Unit III

Definition of density function of Chi-square distribution-Constants of the Distribution-Additive Property-Test of Goodness of fit –Test of Independence of attributes

Unit IV

Student's t- statistic-Definition of density function of student's t-distribution- Properties of the Distribution-Test for single mean and difference of means-Paired t-test for difference of means

Unit V

F-Statistic-Definition of density function of F Variate –Test of Population Variances-Relations between F, t, Chi-square distributions-Analysis of Variance- One way and Two way ClasSification.

Text Book:

B. Ramdas Bhat, Modern Probability Theory, II Edition, Wiley Eastern Ltd, 1988.
Unit 1: Ch 1(1.1-1.4)& Ch 2(2.1-2.4)Unit 2: Ch 3(3.1-3.6) Unit 3: Ch 4(4.1-4.4)
Unit 4: Ch5(5.1-5.3) Unit 5: Ch 7(7.1-7.5)

Reference Book:

1.Sheldon Ross, First course in probabilitdy, Maxwell Mac. Millar International Edition, New York, VI Edition, 2008.
2.Geoffery Grimmell and Domeonic Welsh, Probability-An Introduction, Oxford University press,1986,
3.M.Fisz, Probability Theory and Mathematical Statistics, John Wiley and Sons, New York, 1963.
4.K.L. Chung, A Course in Probability, Academic Press, NewYork, 1974.

Course Outcomes	On completion of the course, students should be able to CO1: understand the basic concepts of fundamental probability. CO2: apply the test of goodness of fit. CO3: analyze the concept of Chi- square distribution. CO4: acquire the knowledge of one way and two way classification.

(NMC - M.SC Mathematics Syllabus - For the candidates admitted for the academic year 2015 onwards)

Code	Course	Title	Hours/week	Semester	Credits
15PM419b	**CEC4B**	**Coding Theory**	**6**	**4**	**4**
Cognitive Level	**K – 1** Acquire/Remember **K – 2** Understand **K – 3** Apply **K - 4** Evaluate **K - 5** Analyze				
Course Objectives	**The Course aims to** • provide the concept of linear Block Codes, Cyclic Codes, Rings and Polynomials, Cyclic Codes, Rings and Polynomials, Bounds on codes.				
Employability	**National need**	Problem Solving & Participative Learning			

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UNIT I

Linear Block Codes**:** Basic Definitions, The Generator Matrix, Description of Linear Block codes, the parity check matrix and Dual Codes, Error Deletion and Correction over Hand-Input Channels, Weight, Distributions of Codes and their Duals.

UNIT II

Hamming Codes and their codes, Performance of linear codes, Modifications to Linear Codes, Best Known Linear Block Codes

UNIT III

Cyclic Codes, Rings and Polynomials**:** Introduction, Basic Definitions, Rings, Quotient Rings, Ideals in Rings, Algebraic Description of Cyclic Codes, Nonsystematic Encoding and Parity Check, Systematic Coding.

UNIT IV

Some Hardware Background, Cyclic Encoding, Syndrome Decoding.

UNIT V

Bounds on codes: The Gilbert – Varshamov Bound, The Poltkin Bound, The Griesmer Bound, The Linear Programming and Related Bound, the MCEliece-Rodemich-Rumsey-Welsch Bound.

TEXT BOOK

Toddk. Moon, Error Correction Coding Mathematical Methods and Algorithms, Wiley Interscience & John Wiley & Sons, INC., Publications.

UNIT I: Ch 3(3.1-3.4), UNIT II: Ch 3 (3.5-3.10), UNIT III: Ch 4 (4.1-4.8)

UNIT IV: Ch 4(4.9-4.11) UNIT V: Ch 9 (9.1-9.5).

REFERENCE BOOKS

1. S.J.Macwilliams and N.J.A. Slone, The theory of Error-Correcting Code, Amster Bam, North Holland, 1977.
2. Raymond Hill, A First Course in Coding Theory, Clarendon Press, Oxford, 1986.

Course Outcomes	On completion of the course, students should be able to CO1: apply linear block codes for error deduction and correction.. CO2: understand the importance in the design of codes. CO3: apply the tools of linear algebra to construct special type of codes. CO4: use algebraic techniques in designing coefficient and reliable data transmission methods.

OPEN ELECTIVE COURSE

Code	Course	Title	Hours/week	Semester	Credits
15PM210b	**OEC1 - Open to all(except Maths Major)**	**Mathematical Modeling And Simulation**	**6**	**2**	**4**

Cognitive Level	**K – 1** Acquire/Remember **K – 2** Understand **K – 3** Apply **K - 4** Evaluate **K - 5** Analyze
Course Objectives	**The Course aims to** • learn the concepts of mathematical modeling and simulation
Employability	**National need** / Problem Solving & Participative Learning

UNIT	Content	No. of Hours
I	Statistical Models in Simulation**:** Review of Terminology. And Concepts – Useful Statistical Model –Discrete Distributions – Continuous Distributions – Poisson Process – Empirical Distributions.	15
II	Queueing Models: Characteristics of Queueing Systems – Queueing Notations – Transient and Steady –State Behaviour of Infinite –.Long – Run Measures of Performance Of Queueing Systems.	15
III	Queueing Models: Steady –State Behaviour of Infinite – populations Markovian Models –Steady State Behaviour of Finite Population Models (M/M/C/K/K) - Networks of Queue.	15
IV	Random –Number Generation**:** Properties of Random Numbers – Generation of Pseudo - Random Numbers – Techniques for Generating random Numbers – Tests for random Numbers.	15
V	Random –Variate Generation: Inverse Transform Technique – Direct Transformation for the normal distribution – Convolution Method Acceptance Rejection – Rejection Technique	15

Reference	**Text Books:** Jerry Banks, John S.Carson, Barry l.Nelson, Discrete – Event system Simulation, Second edition, Prentice – Hall of India, 1998. UNIT-I : Ch 6 UNIT-II : Ch 7(§7.1-7.4) UNIT-III **:** Ch 7(§7.5-7.7) UNIT-IV : Ch 8 UNIT-V : Ch 9 **Reference Books:** • Geoffrey Gordon, System Simulation, Second edition, Prentice Hall of India, New Delhi, 1995.
Course Outcomes	On completion of the course, students should be able to do CO 1: acquire the role of discrete and continuous distributions in simulation CO 2:understand the steady state behavior of queuing models CO 3: evaluate the performance measures of queuing system CO 4: demonstrate on random number and variate generation

Code	Course	Title	Hours/week	Semester	Credits
15PM210c	**OEC2 - Open to all(except Maths Major)**	**Statistics**	**6**	**2**	**4**

Cognitive Level	**K – 1** Acquire/Remember **K – 2** Understand **K – 3** Apply **K - 4** Evaluate **K - 5** Analyze
Course Objectives	**The Course aims to** • gain the knowledge of data collection and classification , measures of dispersion, correlation and regression • test the data for goodness of fit • analyze data using chi square statics
Employability	**Local need** / Problem Solving & Participative Learning

Course Code & Title			
Class			
Cognitive Level			
Course Objectives	•		
Employability	**Local need**	Participative learning and Problem solving	

UNIT	Content	No. of Hours
I	Collection, Classification and Tabulation of data –Graphical and Diagrammatic Representation of Data-Bar Diagrams, Pie Diagram, Histogram, Frequency Polygon, Frequency curve and Gives- Measures of Central Tendency-Mean, Median and Mode in Series of Individual Observation, Discrete and Continuous Series, More than Frequency, Less than Frequency, Mid value and Open End Class.	15
II	Measures of Dispersion- Range, Quartile Deviation, Mean Deviation about an average, Standard Deviation and	15

	Coefficient of Variation for Individual, Discrete and Continuous type data.	
III	Correlation-Different types of Correlation- Positive, Negative, Simple, Multiple, Linear and Non Linear Correlation, Methods of Correlation- Karl Pearson's and Spearman's Correlation-Concurrent Deviation Method.	15
IV	Regression Types and Method of Analysis, Regression Line, Regression Equations, Derivation taken from Arithmetic Mean of X and Y, Derivation taken from Assumed Mean, Partial and Multiply Regression Coefficients- Applications.	15
V	Chi-Square tests for Variance, Goodness of fit (Expected frequencies are equal or in a specified proportion only) and independence of attributes F test for equality of two Variances, Analysis of Variance- One way, Two Way and Latin Square design.	15
Reference	**Text Books:** 1. S.C.Gupta and V.K.Kapoor, Fundamentals of Statistics, Sultan Chand and Sons New Delhi 1994. 2. S.C.Gupta, Fundamentals of Statistics, 6th Revised and Enlarged Edition, Himalaya Publishing House. UNIT-I : Ch4(§4.1-4.4),Ch 5(§5.1-5.8) of (1) UNIT-II : Ch6(§6.4-6.9,6.12)of(1) UNIT-III :Ch 8(§8.1-8.4,8.7,8.8) of (1) UNIT-IV : Ch 9(§9.1-9.4) of (1) UNIT-V : Ch18(§18.1,18.2,18.4-18.6) of (2) **Reference Books:** 1. J.E. Freund, Mathematical Statistics, Prentice Hall of India. 2. A.M. Goon, M.K. Gupta, B.Dos Gupta, Fundamentals of Statistical, Vol – I, World Press, Calcutta, 1991.	
Course Outcomes	On completion of the course, students should be able to CO 1: represent data diagrammatically CO 2: evaluate measures of dispersion CO 3: apply correlation and regression analysis CO 4: demonstrate on analysis of variance	