RU MEMORIAL COLLEGE

(AUTONOMOUS)

(Nationally Accredited with 'A' Grade)

PUTHANAMPATTI - 621007.

PG & RESEARCH DEPARTMENT OF MATHEMATICS

PROGRAMME

M.Sc. MATHEMATICS

Courses of Study

Scheme of Examinations

&

Syllabi

(For the students admitted from 2019 – 2020 onwards)

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 2019 onwards)

Semester	Courses	No. of Credits
I	5 Core courses (Extra Credit Course I)	23 (3)
II	4 Core courses 1 Open Elective course (Extra Credit Course II)	23 (3)
III	3 Core courses 2 Elective courses (Extra Credit Course III)	22 (3)
IV	2 Core courses 2 Elective courses 1 Project (Extra Credit Course IV)	22 (3)
TOTAL	**20 courses +(4 courses)**	**90 credits + (12 credits)**

NEHRU MEMORIAL COLLEGE (AUTONOMOUS)
Post Graduate Programme Course Structure CBCS
(For the candidates admitted from 2019-2020 onwards)

Sem	Subject Code	Course	TITLE	HOURS	CREDIT	Int	Ext	TOTAL
I	19PM101	CC-I	Linear Algebra	6	5	25	75	100
	19PM102	CC-II	Real Analysis – I	6	5	25	75	100
	19PM103	CC-III	Ordinary Differential Equations	6	4	25	75	100
	19PM104	CC-IV	Integral Equations, Calculus of Variations and Fourier Transforms	6	4	25	75	100
	19PM105	CC-V	Classical Dynamics	6	5	25	75	100
	Total			**30**	**23**	**125**	**375**	500
II	19PM206	CC-VI	Algebra	6	5	25	75	100
	19PM207	CC-VII	Real Analysis – II	6	5	25	75	100
	19PM208	CC-VIII	Topology	6	5	25	75	100
	19PM209	CC-IX	Partial Differential Equations	6	4	25	75	100
		OEC	Open Elective Course	6	4	25	75	100
	Total			**30**	**23**	**125**	**375**	500
III	19PM311	CC-X	Complex Analysis	6	5	25	75	100
	19PM312	CC-XI	Differential Geometry	6	4	25	75	100
	19PM313	CC-XII	Measure and Integration	6	5	25	75	100
	19PM314	CEC-I	Elective Course I	6	4	25	75	100
	19PM315	CEC-II	Elective Course II	6	4	25	75	100
	Total			**30**	**22**	**125**	**375**	**500**
IV	19PM416	CC-XIII	Functional Analysis	5	5	25	75	100
	19PM417	CC-XIV	Stochastic Processes	5	4	25	75	100
	19PM418	CEC-III	Elective Course III	6	4	25	75	100
	19PM419	CEC-IV	Elective Course IV	6	4	25	75	100
		CC-XV	PROJECT	8	5	25	75	100
	Total			**30**	**22**	**125**	**375**	**500**
GRAND TOTAL				**120**	**90**	**500**	**1500**	**2000**

EXTRA CREDIT COURSES OFFERED BY THE DEPARTMENT(OPTIONAL)

SEMESTER	TITLE	Hours/Week	CREDIT	Ext
I	R Programming Lab	3	3	100
II	Mini Project	-	3	100
III	Any online certified course (Approved by BOS Chairman/HOD)	-	3	100
IV	Comprehensive Mathematics	-	3	100

CORE COURSES (CC)

Course	Title of the Courses	Lecture Hours	Tutorial Hours	Credit	Prerequisite (Exposure)
CC-I	Linear Algebra	4	2	5	NIL
CC-II	Real Analysis – I	4	2	5	NIL
CC-III	Ordinary Differential Equations	4	2	4	NIL
CC-IV	Integral Equations, Calculus of Variations and Fourier Transforms	4	2	4	NIL
CC-V	Classical Dynamics	4	2	5	NIL
CC-VI	Algebra	4	2	5	CC-I
CC-VII	Real Analysis – II	4	2	5	CC-II
CC-VIII	Topology	4	2	5	CC-II
CC-IX	Partial Differential Equations	4	2	4	CC-IV
CC-X	Complex Analysis	4	2	5	CC-II & CC-VII
CC-XI	Differential Geometry	4	2	4	CC-II & CC-VII
CC-XII	Measure and Integration	4	2	5	CC-II & CC-VII
CC-XIII	Functional Analysis	3	2	5	CC-II, CC-VIII & CC-XII
CC-XIV	Stochastic Processes	3	2	4	Probability & Statistics UG level
CC-XV	Project Work	-	-	5	CCI-CCXIV

CORE ELEECTIVE COURSES (CEC)

Course	Title of the Courses	Lecture Hours	Tutorial Hours	Credit	Prerequisite (Exposure)
CEC-I	Fuzzy Mathematics	4	2	4	Set Theory
CEC-I	Number Theory	4	2	4	NIL
CEC-II	Graph Theory	4	2	4	NIL
CEC-II	Numerical Analysis	4	2	4	NIL
CEC-III	Optimization Techniques	4	2	4	NIL
CEC-III	Probability Theory	4	2	4	NIL
CEC-IV	Coding theory	4	2	4	NIL
CEC-IV	Fluid dynamics	4	2	4	Dynamics (UG level)

OPEN ELEECTIVE COURSES (OEC)

(Courses offered to other Departments)

Course	Title of the Courses	Lecture Hours	Tutorial Hours	Credit	Prerequisite (Exposure)
OEC-1	Mathematical Modeling and Simulation	4	2	4	+2 Level Mathematics
OEC-2	Statistics	4	2	4	+2 Level Mathematics

NEHRU MEMORIAL COLLEGE (AUTONOMOUS)

(Nationally Accredited with 'A' Grade)

PUTHANAMPATTI - 621007.

UG Programme (Mathematics)

(For the candidates admitted from 2019 – 2020 onwards)

Bloom's Taxonomy Based Assessment Pattern

Knowledge Level

K1 – Acquire/Remember;**K2** – Understanding; **K3** – Apply; **K4** – Evaluate; **K5** – Analyze

1. Part I, II and III

Theory (External + Internal = 75 + 25 = 100 marks)

External/Internal					
Knowledge Level	**Section**	**Marks**	**Hrs**	**Total**	**Passing Mark**
K1-K4	A (Answer all)	10× 2= 20	3	75	38
K3-K5	B (Either or pattern)	5 × 5 = 25			
K1, K3-K5	C (Answer 3 out of 5)	3 × 10 = 30			
Internal					
Components	**Maximum Marks**	**Conversion**	**Hrs**	**Total**	**Passing Mark**
CIA 1	75	10	3	25	12
CIA 2	75	10	3		
Seminar	20	5	-		
			Total	**100**	**50**

NEHRU MEMORIAL COLLEGE
(AUTONOMOUS)
Puthanampatti, Trichy Dist.

SYLLABUS REVISION 2019-2020

Department : Mathematics

Academic Programme offered : PG Programme

Year of Implementation : 2019-2020

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.

Course Code & Title	19PM101 : Linear Algebra	Percentage of Revision : 100%	
Class	**M.Sc Mathematics**	**Semester**	**II**
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	**Global need**	Participative learning and Problem solving	

UNIT	Content	No. of Hours
I	Vector spaces - subspaces - linear combinations and systems of linear equations - linear dependence and linear independence - bases and dimension - maximal linearly independent subsets.	15
II	Linear transformations, null Spaces, and ranges - the matrix representation of a linear transformation - combination of linear transformations and matrix multiplication - invertibility and isomorphisms - the change of coordinate matrix.	15
III	Elementary matrix operations and elementary matrices - the rank of a matrix and matrix inverses - system of linear equations - theoretical aspects and computational aspects - determinants of order 2 - determinants of order n - properties of determinants -summary - important facts about determinants.	15
IV	Eigen values and eigen vectors - diagonalizability - Cayley Hamilton Theorem.	15
V	The Jordan Canonical Form 1 - the Jordan Canonical Form 2 - the minimal polynomial.	15

Reference	**Text Books:** Stephen H. Friedberg, Arnold J. Insel and Lawrence Edition, PHI Learning Private Limited, New Delhi, 2014. UNIT – I : Ch 1 UNIT – II :Ch 2: (§2.1 to 2.5) UNIT – III : Ch 3 and Ch 4: (§ 4.1 to 4.4) UNIT – IV : Ch 5: (§ 5.1 to 5.4) UNIT – V : Ch 7(§ 7.1 to 7.3)

	Reference Books: 1. S. Kumaresan, Linear Algebra, Prentice-Hall of India Ltd, 2000. 2. K. Hoffman and R. Kunze, Linear Algebra, Second Edition, PHI, New Delhi 1975. 3. M.Artin, Algebra, Prentice Hall of India, New Delhi, 1994. 4. Jin Ho Kwak, Linear Algebra, Second Edition, Birkhäuser, 2004. 5. I.N. Herstein, Topics in Algebra, Wiley Eastern Limited, New Delhi, 1975. 6. Gilbert Strang, Linear Algebra and its applications, Cengage Learning 8th Indian edition, 2011 7. A.R. Rao, P. Bhimashankaram, Linear Algebra, Tata McGraw Hill, 1996. 8. V. Krishnamurthy et al, Introduction to Linear Algebra, East West Press Ltd, 1985
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.

Mapping of COs with PSOs & POs:

CO/PO	PO							PSO				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	S	S	S	S	M	M	S
CO2	S	S	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	S	S	M	M	S

Strongly Correlating(S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

<table>
<tr><td>Course Code & Title</td><td colspan="2">19PM102 : Real Analysis-I</td><td colspan="2">Percentage of Revision : 40%</td></tr>
<tr><td>Class</td><td colspan="2">M.Sc Mathematics</td><td>Semester</td><td>I</td></tr>
<tr><td>Cognitive Level</td><td colspan="4">K – 1 Acquire/Remember
K – 2 Understand
K – 3 Apply
K - 4 Evaluate
K - 5 Analyze</td></tr>
<tr><td>Course Objectives</td><td colspan="4">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.</td></tr>
<tr><td>Employability and Skill Development</td><td colspan="2">Global need</td><td colspan="2">Participative learning and Problem solving</td></tr>
<tr><td>UNIT</td><td colspan="3">Content</td><td>No. of Hours</td></tr>
<tr><td>I</td><td colspan="3">Sets and Functions, Mathematical Induction, Finite and Infinite sets. Real Number system: Algebraic and Order properties: Infimum, Supremum, Countable and uncountable sets.</td><td>15</td></tr>
<tr><td>II</td><td colspan="3">Metric spaces – Definition and examples - open balls and open sets</td><td>15</td></tr>
<tr><td>III</td><td colspan="3">Sequences and Series of real numbers – limit theorems – monotone sequences – Cauchy criterion – limsup, liminf - Convergent sequences in metric spaces – limit and cluster points – Cauchy sequences – Bounded sets – Dense sets.</td><td>15</td></tr>
<tr><td>IV</td><td colspan="3">Continuous functions – Equivalent Definitions of Continuity – Uniform Continuity -Limit of a function – Discontinuities of a Real Valued function - Compact spaces and their properties – Continuous functions on Compact spaces- Characterization of Compact Metric spaces.</td><td>15</td></tr>
<tr><td>V</td><td colspan="3">Connectedness : Connected spaces – Complete metric spaces – Examples- Baire Category Theorem – Banach Contraction Principle.</td><td>15</td></tr>
<tr><td>Reference</td><td colspan="4">Text Books:
R.G. Bartle and D.R. Sherbert, Introduction to Real Analysis 3rd Edn, John Wiley & Sons, 2000.
S. Kumaresan, Topology of Metric Spaces, Narosa Publishing House, New Delhi, 2005.
UNIT – I :Ch 1 and 2 from (1)
UNIT – II :Ch 1 from (2)</td></tr>
</table>

	UNIT – III :Ch 3 from (1) and Ch 2 (§ 2.1 to 2.5 from (2)) UNIT – IV :Ch 3, Ch 4 from (2) (§ 3.3 and 3.6 omitted) and Ch 5 from (1) UNIT – V :Ch 5 (§ 5.1) and Ch 6 (§ 6.1, 6.3 and 6.4 (section 6.2, 6.3.16 and 6.3.17 omitted) from (2) **Reference Books:** 1. Edward D. Gaughan, Introduction to Analysis, AMS, Indian edition, 2010. 2. Kenneth A. Ross, Elementary Analysis: The Theory of Calculus, Springer Verlag, 2004. 3. M.H. Protter, C.B. Morrey, A First Course in Real Analysis, 2nd Edition, Springer Verlag, 1991. 4. S.K. Berberian, A First course in Real Analysis, Springer Verlag, 1994. 5. Charles Chapman Pugh, Real Mathematical Analysis, Springer Verlag, 2002. 6. R.P. Boas, A primer of real functions, Mathematical Association of America, 1966. 7. Tom M. Apostol, Mathematical Analysis 2 edn, Narosa, New Delhi, 1985. 8. Walter Rudin, Principles of Mathematical Analysis,Third Edition, Mcgraw Hill, 1976 9. N.L. Carothers, Real Analysis, Cambridge University Press, South Asian Edition, 2000.
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.

Mapping of COs with PSOs & POs:

CO/PO	PO							PSO				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	S	M	S	S	S	M	M	S
CO2	S	S	S	S	S	M	S	S	S	M	M	S

CO3	S	M	S	S	M	S	S	S	S	S	M	S
CO4	S	S	S	S	S	M	S	S	S	M	M	S

Strongly Correlating(S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Code & Title	19PM103 : Ordinary Differential Equations		
Class	**M.Sc Mathematics**	**Semester**	**I**
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**	Participative learning and Problem solving	

UNIT	Content	No. of Hours
I	Second order linear equations and power series method: The general solution of the homogeneous equation - Method of variation of parameters – A review of power series – Series solution of first order equations – Ordinary points.	15
II	Power series solutions and special functions singular points – Regular singular points	15
III	Some special functions of Mathematical Physics: Legendre polynomials – Properties of Legendre polynomials – Bessel functions – The Gamma functions – Properties of Bessel functions.	15
IV	System of first order equations: Linear systems – Homogeneous linear system with constant coefficient – The method of successive approximation – Picard's theorem	15
V	Non - linear equations: Autonomous system: The phase plane and its phenomena – Types of critical points – Stability – Critical points and stability for linear system – Stability by Liapunov's direct method – Simple critical points of non – Linear systems.	15
	Text Books: 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)	

Reference	UNIT – III : Ch 6(§32 – 35) UNIT – IV : Ch 7(§37 & 38) Ch 11(§55 & 56) UNIT – V : Ch 8(§40 – 44) **Reference Books:** 1. M.E. Taylor, Introduction to Differential Equations, AMS Indian Edition, 2011. 2. M. Braun, Differential Equations and Their Applications, Springer, 1992. 3. Boyce and DiPrima, Elementary Differential Equations and Boundary Value Problems, 7th Edn, John Wiley, 2001. 4. S. Deo et al, A textbook of Differential Equations, McGraw Hill, 2002. 5. Lawrence Perko, Differential Equations and Dynamical Systems, Springer, 2006. 6. E.A. Coddington and N. Levinson, Theory of Ordinary Differential Equations, McGraw Hill, 1955. 7. Tyn Myint-U, Ordinary Differential Equations, North-Holland, New York, 1978. 8. 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.

Mapping of COs with PSOs & POs:

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	M	S	S	S	S	S	M	S	S
CO2	S	S	S	M	S	S	S	S	S	M	S	S
CO3	S	S	S	M	S	S	S	S	M	M	S	S

CO4	S	S	S	M	S	S	S	S	M	M	S	S

Strongly Correlating(S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Code & Title	19PM104: Integral Equation, Calculus of Variations and Fourier Transforms		
Class	**M.Sc Mathematics**	**Semester**	**I**
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**	Participative learning and Problem solving	

UNIT	Content	No. of Hours
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.	15
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).	15
III	Variational Problems with Fixed Boundaries: The concept of variation and its properties - Euler's equations – variational problems for functionals – functionals dependent on higher order derivatives – functions dependent on functions of several independent variables – variational problems in parametric form.	15
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	15

	function – Legendre condition.	
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.	15
Reference	**Text Books:** 1. Ram.P.Kanwal, Linear integral equations theory and technique, Academic press 1971. 2. A.S. Gupta, Calculus of Variations with Applications, 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: Ch1 and 2 of (1) UNIT-II:Ch3 and 4 of (1) UNIT-III:Ch1[1.1-1.6] of (2) UNIT-IV:Ch2[2.1-2.3] & ch3[3.1-3.4] of (2) UNIT-V:Ch7 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, Springer, 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.	

Mapping of COs with PSOs & POs:

CO/PO	PO							PSO				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	M	S	S	S	S	S	M	M	S
CO2	S	S	S	M	S	S	S	S	S	M	M	S
CO3	S	S	S	M	S	S	S	S	S	M	S	S
CO4	S	S	S	M	S	S	S	S	S	M	S	S

Strongly Correlating(S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Code & Title	19PM105 : Classical Dynamics		
Class	**M.Sc Mathematics**	**Semester**	**I**
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

Mapping of COs with PSOs & POs:

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	M	S	M	S	S	S	M	M	S
CO2	S	S	S	M	S	M	S	S	S	M	M	S
CO3	S	M	S	M	S	M	S	S	S	M	M	S
CO4	S	M	S	M	S	M	S	S	S	M	S	S

Strongly Correlating(S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Code & Title	19PM206 : Algebra		
Class	**M.Sc Mathematics**	**Semester**	**II**
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 and Skill Development	**Global need**	Participative learning and Problem solving	

UNIT	Content	No. of Hours
I	Group theory: Another counting principle, Sylow's theorem, Direct Products, Finite Abelian groups.	15
II	Ring theory: Euclidean Rings, A particular Euclidean Ring, Polynomial Rings, Polynomials over the Rational Field, Polynomial Rings over commutative Rings.	15
III	Vector spaces and modules: Dual spaces, Inner product spaces, Modules.	15
IV	Fields: Extension Fields, Roots of polynomials, More about Roots, The Elements of Galois's theory.	15
V	Linear transformations: Characteristic Roots, Matrices, and Canonical Forms: Triangular Form, Nilpotent Transformations, Hermitian, Unitary and Normal Transformations.	15

Reference	**Text Book:** I. 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

Mapping of COs with PSOs & POs:

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	W	S	W	S	M	M	M	M	S
CO2	S	S	S	W	S	W	S	M	M	M	M	S
CO3	S	M	S	W	S	W	S	M	M	M	M	S
CO4	S	M	S	W	S	W	S	M	S	M	S	S

Strongly Correlating(S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Code & Title	19PM207: Real Analysis-II	Percentage of revision : 80%	
Class	M.sc-Mathematics	Semester	II
Cognitive Level	**K1** – Acquire/Remember **K2** – Understand **K3** – Apply **K4** – Evaluate **K5** – Analyze		
Course Objectives	**The Course aims to** • provide the knowledge of differentiation of single variable, sequences and series of functions of several variables.		
Employability and Skill Development	**Global need**	Participative learning and Problem solving	

UNIT	Content	No. of Hours
I	Differentiation of single variable: Derivatives – The chain rule – Local extrema – Rolle's theorem – Mean Value Theorem – Taylor's formula – Derivatives of vector valued functions – Functions of Bounded variation and rectifiable curves – Total variation –Functions of bounded variation – Equivalence of paths – Change of parameter	15
II	Riemann-Stieltjes integral: Definition – linear properties of the integral – Necessary conditions for the existence - First fundamental theorem of Integral calculus - Mean Value Theorems for integrals – Second fundamental theorem of Integral calculus - Change of variable in a Riemann integral – Second Mean value Theorem for Riemann Integrals	15
III	Sequence and series of functions – Point wise convergence – Uniform convergence – Uniform convergence and integration – Uniform convergence and Differentiation - Sufficient conditions for uniform convergence of a series	15
IV	Functions of Severable variables – Directional derivative –Total derivative – Jacobian – Chain rule –Mean Value Theorem – Taylor's formula.	15
V	Inverse function theorem – Implicit function theorem – Extremum problems with side conditions	15
Reference	**Text Book:** Tom M. Apostol, Mathematical Analysis Second Edition, Narosa Publishing House, New Delhi, 1985. UNIT –I :Ch 5 and 6 UNIT –II : Ch 7 (§7.1 -7.22)	

	UNIT–III : Ch 9(§ 9.1 - 9.11) and (§9.14 -9.18) UNIT–IV : Ch 12 UNIT – V :Ch 13 **Reference Books:** 1. M.H. Protter, C.B. Morrey, A First Course in Real Analysis, 2nd Edition, Springer Verlag International Edition, 1991. 2. Torrence Tao, Mathematical Analysis, Vol I & II, Hindustan Book Agency, 2006. 3. J.E. Marsden, A.J. Tromba, A.Weinstein, Basic multivariable calculus, Springer Verlag, 1993. 4. Robert T. Seeley, Calculas of Several Variables, Scott, Foresman and Co, 1970. 5. T.W. Korner, A Companion to Analysis, AMS Indian edition, 2011. 6. N.L. Carothers, Real Analysis, Cambridge University Press, South Asian Edition, 2000 7. S. Kumaresan, A Course in Differential Geometry and Lie groups, Hindustan Book Agency, 2002 8. Walter Rudin, Principles of Mathematical Analysis,Third Edition, Mcgraw Hill, 1976. 9. Tom Apostol, Calculas II, Mcgraw Hill, 1983
Course Outcomes	On completion of the course, students should be able to CO1:know differentiation of single variables. CO2: acquire the knowledge of Riemann-Stieltjes integrals.and inverse function theorem CO3: demonstrate on the convergence and uniform convergence of sequence and series of functions CO4:evaluate directional derivative, total derivative, Jacobian of functions of several variables.

Mapping of COs with PSOs & POs:

CO/PO	PO							PSO				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	S	M	S	S	S	M	S	M	M	M	M	S
CO2	S	M	S	S	S	M	S	M	M	M	M	S
CO3	S	M	S	S	S	M	S	M	M	M	M	S
CO4	S	S	S	S	S	S	S	M	M	M	M	S

Strongly Correlating(S) - 3 marks

Moderately Correlating (M)	-	2 marks
Weakly Correlating (W)	-	1 mark
No Correlation (N)	-	0 mark

Course Code & Title	19PM208 : Topology		
Class	**M.Sc Mathematics**	**Semester**	**II**
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 and Skill Development	**Global need**	Participative learning and Problem solving	

UNIT	Content	No. of Hours
I	Topological spaces - Basis for a topology - The order topology - The product topology on X×Y - The subspace topology - closed sets and limit points.	15
II	Continuous functions - the product topology - The metric topology.	15
III	Connectedness: connected subspaces of the Real line - components and local connectedness	15
IV	Compactness: compact subspaces of the Real line - Limit Point Compactness - Local Compactness.	15
V	The Countability Axioms - The Separation Axioms – Normal Spaces – The Urysohn Lemma – The Urysohn metrization theorem – The Tietz extension theorem.	15
Reference	**Text Book:** James R. Munkres, Topology (2nd edition), Pearson Education Pvt. Ltd., New Delhi – 2002 (3rd 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 – 28) UNIT–V :Ch 4 (§30 – 35) **Reference Books:** 1. G.F. Simmons, Introduction to topology and 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 UryZohn's Lemma and understand the dynamics of the proof techniques.

Mapping of COs with PSOs & POs:

CO/PO	PO							PSO				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	M	M	S	S	S	M	S	S
CO2	S	S	S	S	M	M	S	S	S	M	S	S
CO3	S	S	S	S	M	M	S	S	S	M	S	S
CO4	S	S	S	S	M	M	S	S	S	M	S	S

Strongly Correlating(S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Code & Title	19PM209 : Partial Differential Equations		
Class	**M.Sc Mathematics**	**Semester**	**II**
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	**Global need**	Participative learning and Problem solving	

UNIT	Content	No. of Hours
I	First Order PDE – Curves and Surfaces – Genesis of First Order PDE – Classification of Integrals – Linear Equations of the First order – Paffian Differential Equations – Compatible Systems – Charpit's Method – Jacobi's Method.	15
II	Integral Surfaces Through a Given Curve – Quasi-linear Equations – Non-linear First order PDE.	15
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).	15
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.	15
V	Heat Conduction Problem – Heat Conduction Infinite Rod Case – Heat conduction Finite Rod case – Duhamel's principle – Wave Equation – Heat Conduction Equation.	15

Reference	**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 Book:** I.C.Evens, 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.

Mapping of COs with PSOs & POs:

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	S	M	S	S	M	S	S	S	M	S	M	S
CO2	S	M	S	S	M	S	S	S	M	S	M	S
CO3	S	M	S	S	M	S	S	S	M	S	M	S
CO4	S	M	S	S	M	S	S	S	M	S	M	S

Strongly Correlating(S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Code & Title	19PM311: Complex Analysis	**Percentage of Revision :90%**	
Class	**M.Sc Mathematics**	**Semester**	**III**
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 and Skill Development	**Global need**	Participative learning and Problem solving	

UNIT	**Content**	**No. of Hours**
I	The real numbers - The field of complex numbers - The complex plane – Polar representation and roots of complex numbers - Lines and half planes in the complex plane -The extended plane and its spherical representation	15
II	Power series- Analytic functions - Analytic functions as mapping – Mobius Transformation	15
III	Riemann-Stieltjes integrals - Power series representation of analytic functions - Zeros of an analytic function - The index of a closed curve - Cauchy's Theorem and Integral Formula - The homotopic version of Cauchy's Theorem and simple connectivity – Counting zeros - The Open Mapping Theorem- Goursat's Theorem	15
IV	Classification of singularities - Residues - The Argument Principle	15
V	The Maximum Principle - Schwarz's Lemma - Convex functions and Hadamard's Three Circles Theorem- Phragmen-Lindelof Theorem	15
Reference	**Text Book:** J.B. Conway, Functions of One Complex Variable, Narosa, 2 edn., 1991 UNIT–I :Ch 1 UNIT–II :Ch 3 UNIT–III :Ch 4 UNIT–IV :Ch 5 UNIT–V :Ch 6 **Reference Books**:	

	1. Bak, J., Newman, D.J., Complex Analysis, Springer-Verlag, New York, 1997. 2. L.S. Hahn and B. Epstein, Classical Complex analysis, Jones and Barlett Student Edition, 2011. 3. R. Priestely, Introduction to Complex Analysis, Oxford India, 2008. 4. Lars V. Ahlfors, Complex Analysis, Third Ed. McGraw-Hill Book Company, Tokyo, 1979. 5. Theodore W. Gamelin, Complex Analysis, Springer Verlag, 2001. 6. Donald Sarason, Notes on Complex Function theory, Hindustan Book Agency, 1994. 7. V. Karunakaran, Complex Analysis 2 edn, Narosa, New Delhi, 2005. 8. S. Ponnusamy and H. Silverman, Complex Variables with applications, Birkhauser, 2006. 9. R.V. Churchill & J.W. Brown, Complex Variables and applications, McGraw-Hill, 1990
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

Mapping of COs with PSOs & POs:

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	S	M	S	M	M	S	S	S	M	S	M	S
CO2	S	M	S	M	M	S	S	S	M	S	M	S
CO3	S	M	S	M	M	S	S	S	M	S	M	S
CO4	S	M	S	M	M	S	S	S	M	S	M	S

Strongly Correlating(S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Code & Title	19PM312: Differential Geometry	Percentage of Revision : 90%	
Class	M.Sc Mathematics	**Semester**	**III**
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	Participative learning and Problem solving	

UNIT	**Content**	**No. of Hours**
I	Graphs and Level sets - Vector fields - Tangent space.	15
II	Surfaces –vector fields on surfaces.	15
III	Gauss map – geodesics	15
IV	Parallel Transport - Weingarten map	15
V	Curvature of plane curves - arc length and Line integrals - Curvature of surface.	15

Reference

Text Book

Elementary topics in Differential Geometry, J.A.Thorpe ,Undergraduate texts in Mathematics, Springer- Verlag, 1979.

UNIT-I : Ch 1 to 3.
UNIT-II : Ch 4 and 5.
UNIT-III : Ch 6 and 7.
UNIT-IV : Ch 8 and 9.
UNIT-V : Ch 10 to 12.

Reference Books:

1. S. Kumaresan, A Course in Differential Geometry and Lie groups, Texts and Readings in Mathematics 22 - Hindustan Book Agency, 2002.
2. Struik, D.T. Lectures on Classical Differential Geometry, Addison - Wesley, Mass. 1950.
3. Kobayashi S. and Nomizu. K. Foundations of Differential Geometry Interscience Publishers, 1963.
4. Wihelm Klingenberg: A course in Differential Geometry, Graduate

	Texts in Mathematics, Springer Verlag, 1978. 5. T.J. Willmore, An Introduction to Differential Geometry, Oxford University Press,(17th Impression) New Delhi 2002. (Indian Print).
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.

Mapping of Cos with PSOs & Pos:

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	M	M	M	M	S	S	M	M	S	S
CO2	S	S	M	M	S	M	S	S	S	M	S	S
CO3	S	S	M	M	M	S	S	S	M	M	M	S
CO4	S	S	M	M	M	S	S	S	M	M	M	S

Strongly Correlating(S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Code & Title	19PM313: Measure Theory and Integration		
Class	**M.Sc Mathematics**	**Semester**	**III**
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 and Skill Development	Global need	Participative learning and Problem solving	

UNIT	Content	No. of Hours
I	Measure on real line – Lebesgue outer measure – Measurable sets – Regularity measurable Function – Borel and Lebesgue measurability.	15
II	Integration of non-negative functions The general integral, integration of series, Riemann and Lebesgue integrals.	15
III	Abstract measure spaces – measures and outer measure, completion of a measure, measure spaces, integration with respect to a measure.	15
IV	L^P spaces – Convex functions, Jenson's inequality, inequalities of Holder and Minkowski completeness of $L^P(\mu)$	15
V	Signed measure – Hahn decomposition measurability in a product spaces, Fubini'sTheorem.	15

Reference

Text Book:

De Barra, Measure Theory and Integration, New Age International PVT Limited

UNIT-I: Ch 2 (§2.1-2.5)
UNIT-II: Ch 3 (§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) & Ch 10(§10.1 7 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 and D.R. Sherbert, Introduction to Real Analysis 3rd Edn,

	John Wiley & Sons, 2000.
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.

Mapping of COs with PSOs & POs:

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	M	M	S	M	M	M	S	S
CO2	S	S	S	S	M	M	S	M	M	M	S	S
CO3	S	S	S	S	M	M	S	M	M	M	S	S
CO4	S	S	S	S	M	M	S	M	M	M	M	S

Strongly Correlating(S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Code & Title	19PM416 : Functional Analysis	Percentage of Revision : 80%	
Class	M.sc-Mathematics	Semester	IV
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 and Skill Development	Global need	Participative learning and Problem solving	

UNIT	Content	No. of Hours
I	Normed Spaces: Examples of Normed Spaces- Finite-dimensional Normed Spaces- Banach Spaces	13
II	Inner Product Spaces, Hilbert Spaces: Inner Product-Orthogonality- Orthogonal Complements- Ortho normal Bases in Infinite Dimensions	13
III	Linear Operator: Continuous linear transformations- The normal of a Bounded Linear Operator – The Space B(X, Y) and Dual Spaces- Inverses of Operators	12
IV	Linear Operator on Hilbert Spaces: The adjoint of an operator- Normal, Self-adjoint and Unitary Operators- The Spectrum of an Operator- Positive operators and Projections	13
V	Compact Operators: Compact Operators- Spectral theory of Compact Operators- Self-adjoint Compact Operators.	12

Reference

Text Book:

Bryan P.Rynne and Martin A. Youngson, " Linear Functional Analysis", Springer-Verlag, 2000.
Unit I: Ch 2 (2.1-2.3)
Unit II: Ch 3 (3.1-3.4)
Unit III: Ch 4 (4.1-4.4)
Unit IV: Ch5 (5.1-5.4)
Unit V: Ch 6 (6.1-6.3)

Reference Books:

1. Bela Bollobas, "Linear Analysis an introductory course", Cambridge Mathematical textbooks, Cambridge University Press, 1990.
2. G. F. Simmons, "Introduction toTopology and Modern Analysis", McGraw-Hill, 1963.
3. B.V.Limaye, "Functional Analysis", Wiley Easter Limited, Bombay,

	2nd edition, 1985. 4. M. Thamban Nair, " Functional Analysis: A first course", Prentice hall of India, 2002. 5. K. Yosida, "Functional Analysis", Springers-Verlag, 1974. 6. E. Kreyszig, "introductory Functional Analysis with applications", John Wiley, 1978. 7. V.K. Krishan, "Textbook of Functional analysis: A Problem-oriented Approach", Prentice Hall of india, 2004.
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

Mapping of Cos with PSOs & Pos:

CO/PO	PO							PSO				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	M	S	S	M	S	M	M	S
CO2	S	S	S	S	M	S	S	M	S	M	M	S
CO3	S	S	S	S	M	S	S	M	S	M	M	S
CO4	S	S	S	S	M	S	S	M	S	M	M	S

Strongly Correlating(S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Code & Title	19PM417: Stochastic Processes		
Class	**M.sc-Mathematics**	**Semester**	**IV**
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**	Participative learning and Problem solving	

UNIT	**Content**	**No. of Hours**
I	Stochastic Processes: Some notions – Specification of Stochastic processes – Stationary processes – Markov Chains – Definitions and examples – Higher Transition probabilities – Generalization of Independent Bernoulli trails – Sequence of chain – Dependent trains.	13
II	Markov chains: Classification of states and chains – Determination of Higher transition probabilities – stability of a Markov system – Reducible chains – Markov chains with continuous state space.	12
III	Markov processes with Discrete state space : Poisson processes and their extensions – Poisson process and related distribution – Generalization of Poisson process- Birth and Death process – Markov processes with discrete state space (continuous time Markov Chains).	13
IV	Renewal processes and theory : Renewal process – Renewal processes in continuous time – Renewal equation – stopping time – Wald's equation – Renewal theorems.	12
V	Stochastic processes in Queuing – Queuing system – General concepts – the queuing model M/M/1 – Steady state behaviour – transient behaviour of M/M/1 Model – Non- Markovian models - the model GI/M/1.	12
Reference	**Text Book:** J. Medhi, Stochastic Processes, Wiley Eastern, 1982. 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: Ch4 (§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 §(10.22, 10.23, 10.7.2.1,	

	10.7.3.2, 10.7.3.4, 10.8.2)) **Reference Books:** 1. Samuel Karlin, Howard M. Taylor, A first course in stochastic processes, 2nd edition, Academic Press, 1975. 2. Narayan Bhat , Elements of Applied Stochastic Processes, 2nd edn, John Wiley,1984. 3. S.K. Srinivasan and K.Mehata, Stochastic Processes, Tata McGraw Hill, 1976. 4. N.U. Prabhu, Stochastic Processes. Macmillan, 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 .

Mapping of COs with PSOs & POs:

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	S	M	S	S	S	M	S	M	S
CO2	S	S	S	S	M	S	S	S	S	S	S	S
CO3	S	S	S	S	M	S	S	S	S	S	S	S
CO4	S	S	S	S	M	S	S	S	S	S	S	S

Strongly Correlating(S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

CORE ELECTIVE COURSE (CEC)

Course Code & Title	19PM314a: Fuzzy Mathematics		
Class	**M.Sc Mathematics**	**Semester**	**III**
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**	Participative learning and Problem solving	

UNIT	Content	No. of Hours
I	Fuzzy set theory: Fuzzy set, Type of Fuzzy sets, General definitions and properties of Fuzzy sets, General theorems, Solved examples.	15
II	Operations on fuzzy sets: Introduction, Some important theorems, Extension Principle for Fuzzy sets, Fuzzy Complements-Some important theorems.	15
III	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.	15
IV	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.	15
V	Fuzzy logic: An overview of classical logic, Connectives, Types of sentences, Truth values and Truth table, Tautology, Algebra of Statements, Validity of Arguments, Logical	15

	identities of Crisp logic ,Well formed formulas Predicates and Quantifiers ,Quantifiers and logical operators ,Normal form, Fuzzy logic ,Fuzzy Connectives ,Fuzzy inference.	
Reference	**Text Book:** Sudhir K.Pundir,Rimple Pandir, Fuzzy Sets and their Application, Pragati Prakashan,2008 UNIT- I: Ch 1 (§1.16-1.19) UNIT-II: Ch 2 (§2.1-2.5) UNIT- III: Ch 3 (§3.2-3.4,3.6-3.9) UNIT-IV: Ch 4 (§4.1-4.6,4.8,4.9) UNIT-V: Ch 7 (§7.1-7.15) **Reference Book:** 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	

Mapping of COs with PSOs & POs:

CO/PO	PO							PSO				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	S	M	S	M	M	S	M	S	M	M	M	M
CO2	S	M	S	M	M	S	M	S	M	M	M	M
CO3	S	M	S	M	M	S	M	S	M	M	M	M
CO4	S	M	S	M	M	S	M	S	S	S	S	M

Strongly Correlating(S)	-	3 marks
Moderately Correlating (M)	-	2 marks
Weakly Correlating (W)	-	1 mark
No Correlation (N)	-	0 mark

Course Code & Title	19PM314b : Number Theory		
Class	**M.Sc Mathematics**	**Semester**	**III**
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**	Participative learning and Problem solving	

UNIT	**Content**	**No. of Hours**
I	Divisibility:Introduction-Divisibility-Primes-The Bionomical Theorem.	15
II	Congruence-Solutions of Congruence-The Chinese Remainder Theorem-Techniques of Numerical Calculation-Prime Power Module-Primitive roots and Power Residue.	15
III	Quadratic Reciprocity and Quadratic Forms: Quadratic Residues- Quadratic Reciprocity-The Jacobi Symbol-Binary Quadratic Forms.	15
IV	Some Function of Number Theory: Greatest integer Function-Arithmetic Functions –The Mobius Inversion Formula-Recurrence Functions.	15
V	Some Diophantine Equations: The Equation ax+ by=c – Simultaneous Linear Equations-Pythagorean Triangles-Assorted Examples.	15

Reference	**Text Books:** 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. . 2. 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.

Mapping of COs with PSOs & POs:

CO/PO	PO							PSO				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	M	M	M	M	S	M	M	M	S
CO2	S	S	S	M	M	S	M	S	M	M	M	S
CO3	S	S	S	M	M	S	M	S	M	M	M	S
CO4	S	S	S	M	M	S	M	S	S	M	S	S

Strongly Correlating(S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Code & Title	19PM315a: Graph Theory		
Class	**M.sc-Mathematics**	**Semester**	**III**
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.		
Skill Development	**Global need**	Participative learning and Problem solving	

UNIT	Content	No. of Hours
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	15
II	Connectivity – Blocks - Euler tours – Hamilton Cycles.	15
III	Matchings: Matchings and Coverings in Bipartite Graphs – Edge Chromatic Number – Vizing's Theorem.	15
IV	Independent sets – Ramsey's Theorem – Chromatic Number – Brook's Theorem – Chromatic Polynomials.	15
V	Plane and planar Graphs – Dual graphs –Euler's Formula – The Five –colour Theorem and the Four-Colour Conjecture.	15

Reference

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. 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: idetify Eulerian graphs and Hamiltonian graphs. CO4: understand the concepts planarity including Euler identity, matchings and colorings.

Mapping of COs with PSOs & POs:

CO/PO	PO							PSO				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	S	M	S	M	M	S	M	S	S	S	S	M
CO2	S	M	S	M	M	S	M	S	S	S	S	M
CO3	S	S	S	M	M	S	M	S	S	S	S	M
CO4	S	S	S	M	M	S	M	S	S	S	S	M

Strongly Correlating(S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Code & Title	19PM315b: Numerical Analysis		
Class	**M.Sc-Mathematics**	**Semester**	**III**
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	**Global need**	Participative learning and Problem solving	

UNIT	Content	No. of Hours
I	Transcendental and Polynomial Equations: Rate of convergence – Iterative Methods – Polynomial Equations: Bridge – Vista method, Barstow's method, Graffe's root squaring method.	15
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.	15
III	Interpolation and Approximation**:** Hermit Interpolations – Piecewise and Splice Interpolation – Vicariate Interpolation – Approximation – least square approximation.	15
IV	Differentiation and Integration: Numerical Differentiation – optimum choice of step – length Extrapolation methods – Partial Differentiation – Methods based on undetermined coefficients – Gauss Methods.	15
V	Ordinary Differential Equations: Local truncation error – Euler, Backward Euler, Midpoint, Taylor's Method and second orders Runge – kutta method – stability analysis.	15
Reference	**Text Book:** M. K. Jain, S. R. K. Iyengar and R. K. Jain, " Numerical Methods for Scientific and Engineering Computation" 3rd Edition, Wiley Easten Ltd, 1993. UNIT-I: Ch2(§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 **Reference Book :** 1. Kendall E. Atkinson, " An Introduction to Numerical Analysis", 2nd Edition, John Wiley & sons, 1998 2. M. K. Jain, " Numerical Solution of Differential Equations", 2nd Edition, NewAge Interanational 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.	

Mapping of COs with PSOs & POs:

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	S	M	S	M	S	M	S	S	M	M	S	M
CO2	S	M	S	M	S	M	S	S	M	M	S	M
CO3	S	M	S	M	S	M	S	S	M	M	S	M
CO4	S	S	S	M	S	S	S	S	S	M	S	M

Strongly Correlating(S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Code &Title	19PM418a: Optimization Techniques		
Class	**M.Sc Mathematics**	**Semester**	**IV**
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**	Participative learning and Problem solving	

UNIT	**Content**	**No. of Hours**
I	Integer Programming	15
II	Dynamics (Multistage) Programming	15
III	Decision Theory and Games.	15
IV	Inventory Models	15
V	Non-Linear Programming algorithms	15

Reference

Text Book:

Hamdy 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.

Mapping of COs with PSOs & POs:

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	S	M	S	M	M	S	S	S	M	S	S	M
CO2	S	M	S	M	M	S	S	S	M	S	S	M
CO3	S	M	S	M	M	S	S	S	M	S	S	M
CO4	S	M	S	M	M	S	S	S	S	S	S	M

Strongly Correlating(S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Code & Title	19PM418b: Probability Theory	**Percentage of revision : 100%**	
Class	**M.Sc Mathematics**	**Semester**	**IV**
Cognitive Level	**K1** – Acquire/Remember **K2** – Understand **K3** – Apply **K4** – Evaluate **K5** – Analyze		
Course Objectives	**The Course aims to** • provide the knowledge of the Probability, Random Variables, estimation, MGF, characteristics function, distributions and limit theorems.		
Employability and Skill Development	**Global need**	Participative learning and Problem solving	

UNIT	**Content**	**No. of Hours**
I	Random Events and Random Variables - Random events – Probability axioms-Combinatorial formulae – conditional probability – Bayes Theorem – Independent events-Random Variables – Distribution Function – Joint Distribution – Marginal Distribution –Conditional Distribution – Independent random variables – Functions of random variables.	15
II	Parameters of the Distribution - Expectation- Moments – The Chebyshev Inequality - Absolute moments – Order parameters – Moments of random vectors – Regression of the first and second types.	15
III	Characteristic functions - Properties of characteristic functions – Characteristic functions and moments – semi-invariants – characteristic function of the sum of the independent random variables – Determination of distribution function by the Characteristic function – Characteristic function of multidimensional random vectors – Probability generating functions.	15
IV	Some Probability distributions - One point , two point , Binomial – Polya – Hypergeometric – Poisson (discrete) distributions – Uniform – normal gamma – Beta – Cauchy and Laplace (continuous) distributions.	15
V	Limit Theorems - Stochastic convergence – Bernaulli law of large numbers Convergence of sequence of distribution functions – Levy-Cramer Theorems – de Moivre-Laplace Theorem – Poisson, Chebyshev, Khintchine Weak law of large numbers – Lindberg Theorem – Lapunov Theroem – Borel-Cantelli Lemma - Kolmogorov Inequality and Kolmogorov Strong Law of large numbers.	15

Reference	**Text Book:** M. Fisz, *Probability Theory and Mathematical Statistics*, John Wiley and Sons, New York, 1963. UNIT-I: Ch 1 (§1.1 to 1.7), Ch 2 (§2.1 to 2.9) UNIT-II: Ch 3 (§3.1 to 3.8) UNIT-III: Ch 4 (§4.1 to 4.7) UNIT-IV: Ch 5 (§5.1 to 5.10) UNIT-V :Ch 6 (§6.1 to 6.4, 6.6 to 6.9 , 6.11 & 6.12) **Reference Books:** 1. R.B. Ash, *Real Analysis and Probability*, Academic Press, New York, 1972 2. K.L.Chung, *A course in Probability*, Academic Press, New York, 1974. 3. K.R. Parthasarathy, Introduction to Probability and measure, Texts and Readings in Mathematics 22,Hindustan Book Agency, 2002. 4. R.Durrett, *Probability : Theory and Examples*, (2nd Edition) Duxbury Press, New York, 1996. 5. V.K.Rohatgi *An Introduction to Probability Theory and Mathematical Statistics*, Wiley 6. Eastern Ltd., New Delhi, 1988(3rd Print). P. Billingsley, Probability and Measure, John Wiley, 1985. 7. B.R.Bhat , *Modern Probability Theory* (3rd Edition), New Age International (P)Ltd, New Delhi, 1999 8. J.P. Romano and A.F. Siegel, *Counter Examples in Probability and Statistics***,** Wadsworth and Brooks / Cole Advanced Books and Software, California, 1968.
Course Outcomes	On completion of the course, students should be able to CO1: acquire the knowledge of random variables, distribution. CO2: understand the concept of expectation, characteristics function. CO3: demonstrate on Chebyshev inequality and various distributions CO4: apply limit theorems to analyze stochastic convergence.

Mapping of COs with PSOs & POs:

CO/PO	PO							PSO				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	S	M	M	M	S	S	M	M	M	M
CO2	S	S	S	M	M	M	S	S	S	M	M	M
CO3	S	S	S	M	M	S	S	S	M	S	S	M
CO4	S	S	S	M	S	S	S	S	S	M	M	M

Strongly Correlating(S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Code & Title	19PM419a - Coding Theory		
Class	M.Sc Mathematics	**Semester**	**IV**
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	**Global need**	Participative learning and Problem solving	

UNIT	**Content**	**No. of Hours**
I	Linear Block Codes**:** Basic Definitions, The Generator Matrix, Description of Linear Block codes, theparitycheck matrix and Dual Codes, Error Deletion and Correction over Hand-Input Channels, Weight, Distributions of Codes and their Duals.	15
II	Hamming Codes and their codes, Performance of linear codes, Modifications to Linear Codes, Best Known Linear Block Codes	15
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.	15
IV	Some Hardware Background, Cyclic Encoding, Syndrome Decoding.	15
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.	15

Reference	**Text Books:** Toddk.Moon, Error Correction Coding Mathematical Methods and Algorithms, Wiley Interscience & John Wiley & Sons, INC., publications,2005 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.

Mapping of COs with PSOs & POs:

CO/PO	PO							PSO				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	S	M	S	M	S	S	W	S	M	W	M	M
CO2	S	M	S	M	S	S	W	S	M	W	M	M
CO3	S	M	S	M	S	S	W	S	S	M	S	M
CO4	S	S	S	M	S	S	W	S	M	M	S	M

Strongly Correlating(S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Code & Title	19PM419b: Fluid Dynamics		
Class	**M.Sc Mathematics**	**Semester**	**IV**
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 the students an introduction to the behavior of fluid in motion • give the students a feel of the applications of complex analysis in the analysis of flow of fluids.		
Employability	**Global need**	Participative learning and Problem solving	

UNIT	Content	No. of Hours
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.	15
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.	15
III	Some Three-dimensional Flows: Sources, sinks and doublets – Images in rigid infinite plane – mages in solid spheres - Axisymmetric flour; Stoke's stream function.	15
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.	15
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	15

	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.	
Reference	**Text Books:** 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.	

Mapping of COs with PSOs & POs:

CO/PO	PO							PSO				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	S	M	S	M	S	M	M	S	M	M	S	M
CO2	S	M	S	M	S	M	M	S	M	M	S	M
CO3	S	S	S	M	S	S	M	S	M	M	S	M
CO4	S	M	S	M	S	S	M	S	M	M	S	M

Strongly Correlating(S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

OPEN ELECTIVE COURSE

Course Code & Title	19PM210a:OEC-1Mathematical Modeling And Simulation		
Class	**Open to all(except Maths Major)**	**Semester**	**II**
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**	Participative learning and Problem solving	

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
	Text Books: Jerry Banks, John S.Carson, Barry l.Nelson, Discrete – Event system Simulation,	

Reference	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

Mapping of Cos with PSOs & Pos:

CO/PO	**PO**							**PSO**				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**	**4**	**5**
CO1	S	S	W	W	S	W	S	M	M	M	M	S
CO2	S	S	W	W	S	W	S	M	M	M	M	S
CO3	S	M	W	W	S	W	S	M	M	M	M	S
CO4	S	M	W	W	S	W	S	M	S	M	S	S

Strongly Correlating(S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Code & Title	19PM210b:OEC-2 Statistics		
Class	**Open to all(except Maths Major)**	**Semester**	**II**
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**	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 Coefficient of Variation for Individual, Discrete and Continuous type data.	15
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	

Mapping of COs with PSOs & POs:

CO/PO	PO							PSO				
	1	2	3	4	5	6	7	1	2	3	4	5
CO1	S	S	S	M	S	M	S	M	M	M	M	S
CO2	S	S	S	M	S	M	S	M	M	M	M	S
CO3	S	M	S	M	S	M	S	M	M	M	M	S
CO4	S	M	S	M	S	M	S	M	S	M	S	S

Strongly Correlating(S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark