Master of Science

Mathematics

SRI VIDYA MANDIR ARTS & SCIENCE COLLEGE

(Autonomous)

[An Autonomous College Affiliated to Periyar University,Salem,Tamil Nadu]

[Accredited by NAAC with 'A' Grade with CGPA of 3.27]

[Recognized 2(f) & 12(B) Status under UGC Act of 1956]

Katteri – 636 902, Uthangarai (Tk), Krishnagiri (Dt)

Tamil Nadu, India

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DEGREE OF MASTER OF SCIENCE IN MATHEMATICS

CHOICE BASED CREDIT SYSTEM (CBCS)

REGULATIONS AND SYLLABUS FOR

M.Sc. MATHEMATICS PROGRAMME

(SEMESTER PATTERN)

(For Students Admitted in the College from the Academic Year 2020-2021 Onwards)

Programme Outcomes (POs)

PO1	Identify and enhance mathematical and computational strategies in order to solve mathematical problems.
PO2	Construct logical arguments for solving abstract or applied mathematical problems.
PO3	Obtain accurate solutions for the community oriented problems via various mathematical models.
PO4	Know various specialised areas of advanced mathematics and its applications.
PO5	Present papers in seminars and conferences in order to defend their mathematical skills on various topics in the curriculum.
PO6	Work as professional mathematicians either in academia or elsewhere.
PO7	Inculcate knowledge of formulation and apply mathematical concepts which are suitable for real life applications.
PO8	Crack lectureship and fellowship exams affirmed by UGC like CSIR-NET and SET.

Programme Specific Outcomes (PSOs)

PSO1	Develop the mathematical skills and knowledge for their intrinsic beauty, for proficiency in analytical reasoning, utility in modeling and solving the real world problems by using the concepts of Algebra, Analysis, Dynamics, Differential Equations, Geometry, Topology, Operations Research, Fuzzy Sets & Fuzzy Logic, Fluid Dynamics and Matlab.
PSO2	Develop computational and logical thinking and the habit of making conclusions based on quantitative information.
PSO3	Work efficiently and constructively as a part of a team and do project Individually.
PSO4	Do projects related to emerging Social and Environmental issues.
PSO5	Join in various Universities and Institutions like IMSC, IISc, etc., in order to do summer research projects on Algebra, Analysis, Topology, Mechanics,Fluid Dynamics, Differential Equations, Number Theory, Matlab, Differential Geometry and Fuzzy sets.

SRI VIDYA MANDIR ARTS & SCIENCE COLLEGE

(Autonomous)

Master of Science (M.Sc.) in Mathematics

Programme Pattern and Syllabus (CBCS)

(For Students Admitted in the College from the Academic Year 2020-2021 Onwards)

Sl. No.	Nature of the Course	Course Code	Name of the Course	Hours / Week	Credits	Marks		
						CIA	ESE	Total
SEMESTER - I								
1	Core – I	20PMA1C01	Linear Algebra	6	5	25	75	100
2	Core – II	20PMA1C02	Real Analysis – I	6	5	25	75	100
3	Core – III	20PMA1C03	Ordinary Differential Equations	6	4	25	75	100
4	Core – IV	20PMA1C04	Classical Mechanics	6	4	25	75	100
5	Elective – I	----	From Group – A	6	4	25	75	100
Total				**30**	**22**	**125**	**375**	**500**
SEMESTER - II								
6	Core – V	20PMA2C05	Abstract Algebra	6	5	25	75	100
7	Core – VI	20PMA2C06	Real Analysis – II	6	5	25	75	100
8	Core – VII	20PMA2C07	Partial Differential Equations	6	4	25	75	100
9	Core – VIII	20PMA2C08	Graph Theory	6	4	25	75	100
10	Elective – II	----	From Group – B	4	4	25	75	100
11	Common Course	20P2HR01	Human Rights	2	2	25	75	100
Total				**30**	**24**	**150**	**450**	**600**

SEMESTER - III								
12	Core – IX	20PMA3C09	Complex Analysis	6	5	25	75	100
13	Core – X	20PMA3C10	Topology	6	5	25	75	100
14	Core – XI	20PMA3C11	Measure Theory and Integration	6	4	25	75	100
15	Core – XII	20PMA3C12	Calculus of Variation & Integral Equations	6	4	25	75	100
16	Elective – III	----	From Group – C	6	4	25	75	100
Total				**30**	**22**	**125**	**375**	**500**
SEMESTER - IV								
17	Core – XIII	20PMA4C13	Functional Analysis	6	5	25	75	100
18	Core – XIV	20PMA4C14	Probability Theory	6	4	25	75	100
19	Core – XV	20PMA4C15	Optimization Techniques	6	4	25	75	100
20	Elective – IV	----	From Group – D	6	4	25	75	100
21	Core-XVI	20PMA4PR01	Project	6	5	-	100	100
Total				**303**	**22**	**100**	**400**	**500**
Cumulative Total				**120**	**90**	**500**	**1600**	**2100**

Elective Course

Semester	Course Code	Paper Title	Credits
Group – A			
Semester I	20PMA1E01	Numerical Analysis	4
	20PMA1E02	Difference Equations	4
	20PMA1E03	Stochastic Processes	
Group – B			
Semester II	20PMA2E04	Discrete Mathematics	4
	20PMA2E05	Fuzzy Sets and applications	4
	20PMA2E06	Fluid Dynamics	4
Group – C			
Semester III	20PMA3E07	Combinatorial Mathematics	4
	20PMA3E08	Mathematical Statistics – I	4
	20PMA3E09	Fractional Differential Equations	4
Group – D			
Semester IV	20PMA4E10	Number Theory	4
	20PMA4E11	Differential Geometry	4
	20PMA4E12	Mathematical Statistics – II	4

Note:

CBCS – Choice Based Credit system

CIA – Continuous Internal Assessment

ESE – End of Semester Examinations

SWAYAM –Study Webs of Active-Learning for Young Aspiring Minds

NPTEL –National Programme on Technology Enhanced Learning

PROGRAMME SYLLABUS

Program: M.Sc. Mathematics				
Core – I		Course Code: 20PMA1C01	Course Title: Linear Algebra	
Semester	Hours/Week	Total Hours	Credits	Total Marks
I	6	90	5	100

Course Objectives

The objective of this course is to develop a strong foundation in linear algebra that provide a basic for advanced studies not only in mathematics but also in other branches like engineering, physics and computers, etc. Particular attention is given to canonical forms of linear transformations, diagonalizations of linear transformations, matrices and determinants.

Unit I: Linear Transformations

Linear transformations – The Algebra of Linear Transformations-Isomorphism – Representations of linear transformations by matrices – Linear functional. (Chapter 3: Sections: 3.1–3.5, Pages 67–107).

Unit II: Algebra of Polynomials

Algebra-The algebra of polynomials –Polynomial ideals - The prime factorization of a polynomial - Determinant functions. (Chapter 4: Sections: 4.1, 4.2, 4.4 & 4.5, Pages: 117–123 & 127–139) and (Chapter 5: Sections: 5.1 & 5.2, Pages: 140–150).

Unit III: Determinants

Permutations and the uniqueness of determinants – Classical adjoint of a (square) matrix – Inverse of an invertible matrix using determinants – Characteristic values – Annihilating polynomials. (Chapter 5: Sections: 5.3 & 5.4, Pages: 150–162) and (Chapter 6: Sections: 6.1–6.3, Pages: 181–197).

Unit IV: Diagonalization

Invariant subspaces – Simultaneous triangulations – Simultaneous Diagonalization – Direct-sum decompositions – Invariant direct sums – Primary decomposition theorem. (Chapter 6: Sections: 6.4–6.8, Pages: 198–226).

Unit V: The Rational and Jordan Forms Cyclic subspaces – Cyclic decompositions theorem (Statement only) – Generalized Cayley – Hamilton theorem - Rational forms – Jordan forms. (Chapter 7: Sections: 7.1–7.3, Pages: 227–251).

Text Book

1. Kenneth M Hoffman and Ray Kunze, "Linear Algebra", 2nd Edition, Prentice hall of India Pvt. Ltd., New Delhi, 2015.

Reference Books

1. M. Artin, "Algebra", Prentice hall of India Pvt. Ltd., 2005.
2. S.H. Friedberg, A.J. Insel and L.E Spence, "Linear Algebra", 4th Edition, Prentice hall of India Pvt. Ltd., 2009.
3. I.N. Herstein, "Topics in Algebra", 2nd Edition, Wiley Eastern Ltd., New Delhi, 2013.
4. J.J. Rotman, "Advanced Modern Algebra", 2nd Edition, Graduate Studies in Mathematics, Vol. 114, AMS, Providence, Rhode Island, 2010.
5. G. Strang, "Introduction to Linear Algebra", 2nd Edition, Prentice hall of India Pvt. Ltd., 2013.

E –Learning Source

http://nptel.ac.in/courses/111106051/

Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand basic concepts of Linear transformations,characteristic roots and matrices of linear transformation and its applications.	K2
CO2	Explain about algebra of polynomials, polynomial ideals and prime factorization of a polynomial.	K4
CO3	Understand basic concepts of determinents and its additional properties.	K2
CO4	Understand concepts of Simultaneous triangulations and Diagonalization.	K3
CO5	Analyse canonical Form, Jordan Form and Rational Form.	K4 & K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of COs with POs

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	M	M	M	M	M	S	S	S
CO2	M	M	S	S	S	S	S	S
CO3	M	M	S	S	S	S	S	S
CO4	M	M	S	S	S	S	S	S
CO5	M	M	S	S	S	S	S	S

S – Strong **M – Medium** **L – Low**

Program: M.Sc. Mathematics				
Core – II	Course Code: 20PMA1C02	Course Title: Real Analysis – I		
Semester	Hours/Week	Total Hours	Credits	Total Marks
I	6	90	5	100

Course Objectives

The course will develop a deeper and more rigorous understanding of calculus including defining terms and proving theorems about functions, sequences, series, limits, continuity and derivatives. The course will develop specialized techniques in problem solving.

Unit I: Basic Topology

Finite, Countable and Uncountable Sets – Metric Spaces – Compact Sets – Connected Sets (Perfect sets - Omitted). (Chapter 2: Pages: 24–40 & 42–46).

Unit II: Numerical Sequences and Series

Convergent sequences – Subsequences – Cauchy sequences - Upper and lower limits - Some special sequences – Series – Series of nonnegative terms - The number *e* - The root and ratio tests. (Chapter 3: Pages: 47–68).

Unit III: Rearrangements of Series

Power series – Summation by parts – Absolute convergence – Addition and multiplication of series – Rearrangements. (Chapter 3: Pages: 69–82).

UNIT IV: Continuity

Limit of Functions – Continuous functions - Continuity and Compactness – Continuity and Connectedness – Discontinuities – Monotonic functions – Infinite limits and Limits at infinity. (Chapter 4: Pages: 83–102).

UNIT V: Differentiation

The derivative of a real function – Mean value theorems – The continuity of the Derivative – L' Hospital's Rule – Derivatives of Higher order – Taylor's theorem – Differentiation of Vector–valued functions. (Chapter 5: Pages: 103–119)

Text Book

1. Walter Rudin, "Principles of Mathematical Analysis", 3rd Edition, McGraw Hill Book Co., Kogaskusha (1976)

Reference Books

1. Tom M. Apostol, "Mathematical Analysis", Narosa Publishers, New Delhi, 2002.

2. R. G. Bartle and D.R. Sherbert, "Introduction to Real Analysis", John Wiley & Sons, New York, 1982.
3. W.J. Kaczor and M.T. Nowak, "Problems in Mathematical Analysis I – Real Numbers, Sequences and Series", American Mathematical Society, 2000.
4. W.J. Kaczor and M.T. Nowak, "Problems in Mathematical Analysis II – Continuity and Differentiation", American Mathematical Society, 2000.
5. Steven G. Krantz, Real Analysis and Foundations, 4^{th} Edition, CRC Press, 2017.
6. H.H.Sohrab, "Basic Real Analysis", Springer International Edition, India, 2006.

E-Learning Source

https://ocw.mit.edu/courses/mathematics/18-100a-introduction-to analysis-fall-2012.

Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Describe fundamental properties of the real numbers that lead to the formal development of real analysis.	K2
CO2	Demonstrate an understanding of limits and how they are used in sequences, series, differentiation and integration.	K2
CO3	Appreciate how abstract ideas and rigorous methods in mathematical analysis can be applied to important practical problems.	K3
CO4	Describe fundamental properties of the real numbers that lead to the formal development of real analysis.	K5
CO5	Comprehend regions arguments developing the theory underpinning real analysis.	K4

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of COs with POs

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	M	M	M	M	S	S	S	S
CO2	M	M	M	M	S	S	S	S
CO3	M	M	S	S	S	S	S	S
CO4	M	M	S	S	S	S	S	S
CO5	M	M	S	S	S	S	S	S

S – Strong **M – Medium** **L – Low**

Program: M.Sc. Mathematics				
Core – III	Course Code: 20PMA1C03		Course Title: Ordinary Differential Equations	
Semester I	Hours/Week 6	Total Hours 90	Credits 4	Total Marks 100

Course Objectives

The objective of this course is to equip the students with knowledge of some advanced concepts related to ordinary differential equations and to understand the concepts related to the solution of ordinary differential equations.

Unit I: Linear Equations with Constant Coefficients

The second order homogeneous equation – Initial value problems for second order equations - Linear dependence and independence – A formula for Wronskian. (Chapter 2: Sections: 1–5, Pages: 49–65).

Unit II: Linear Equations with Constant Coefficients

The non-homogeneous equation of order two – The homogeneous equation of order n – A special method for solving the non-homogeneous equation.

Linear Equations with Variable Coefficients

Reduction of the order of a homogeneous equation – The Legendre Equation. (Chapter 2: Sections: 6, 7 & 11, Pages: 66–75 & 90–93) and (Chapter 3: Sections: 5 & 8, Pages: 118–121 & 130–136).

Unit III: Linear Equations with Regular Singular Points

The Euler equation – Second order equations with regular singular points – The Bessel Equation – The Bessel Equation (continued). (Chapter 4: Sections: 1, 2, 3, 7 & 8, Pages: 143–154 & 168–178).

Unit IV: Existence and Uniqueness of Solutions to First Order Equations

Equations with variables separated – Exact equations – The method of successive approximations – The Lipschitz condition – Convergence of the successive approximations. (Chapter 5: Sections: 1–6, Pages: 185–214).

Unit V: Boundary Value Problems

Sturm-Liouville problem – Green's functions. (Chapter 7: Sections: 7.1–7.3).

Text Books

1. Earl A. Coddington, "An Introduction to Ordinary Differential Equations", Prentice Hall of India, New Delhi, 2011. (For Unit I to IV).
2. S.G. Deo, V. Lakshmikantham and V. Raghavendra, "Textbook of Ordinary Differential Equations", Tata McGraw-Hill, New Delhi, 1997. (For Unit V).

Reference Books

1. R.P. Agarwal and R. C. Gupta, "Essentials of Ordinary Differential Equation", McGraw Hill, New York, 1991.
2. A.K. Nandakumaran, P.S. Satti, Raju K. George, "Ordinary Differential Equations: Principles and Applications", Cambridge University Press, 2017.
3. D. Rai, D.P. Choudhury and H.I. Freedman, "A Course in Ordinary Differential Equations", Narosa Publ. House, Chennai, 2004.
4. Tyn Myint-U, "Ordinary Differential Equations", Elsevier Science, 1977.
5. Martin Braun**,** "Differential Equations and Their Applications: An Introduction to Applied Mathematics", Springer, 4th Edition, 1992.

E–Learning Source

http://nptel.ac.in/courses/111104031/ https://ocw.mit.edu/courses/mathematics/18-03-differential-equations-spring-2010

Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Acquire adequate knowledge about linear dependence and independence of the solutions of differential equations based on Wronskian value.	K2
CO2	Solve numerous initial value problems of homogenous and non-homogenous equations of n-th order.	K2
CO3	Gain understanding on the reduction of order of a homogenous equation, nature of the same with analytic coefficients and relate them on a Legendre equation.	K3
CO4	Examine the computations of Euler equations, equations with regular singular points along with the exception – The Bessel equation.	K5
CO5	Conclude the idea of Convergence of the successive approximations employing the Lipschitz condition.	K4

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of COs with POs

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	M	M	M	M	M	S	S	S
CO2	M	M	M	M	M	S	S	S
CO3	M	M	S	S	S	S	S	S
CO4	M	M	S	S	S	S	S	S
CO5	M	M	S	S	S	S	S	S

S – Strong **M – Medium** **L – Low**

Program: M.Sc. Mathematics				
Core – IV		**Course Code:** 20PMA1C04		**Course Title:** Classical Mechanics
Semester I	**Hours/Week** 6	**Total Hours** 90	**Credits** 4	**Total Marks** 100

Course Objectives

To study mechanical systems under generalized coordinate, virtual work, energy and momentum, also to study the mechanics developed by Newton, Lagrange, Hamilton and Jacobi. To develop flexibility and creativity of the students in applying mathematical ideas and techniques to unfamiliar problems arising in everyday life.

Unit I: Introductory Concepts

The mechanical system – Generalized coordinates – Constraints – Virtual work – Energy and momentum. (Chapter 1: Sections: 1.1–1.5).

Unit II: Lagrange's Equation

Derivation of Lagrange's equations – Examples – Integrals of the Motion. (Chapter 2: Sections: 2.1–2.3).

Unit III: Hamilton's Equations

Hamilton's principles – Hamilton's equations – Other variational principles. (Chapter 4: Sections: 4.1–4.3).

Unit IV: Hamilton-Jacobi Theory

Hamilton's Principal Function – The Hamilton-Jacobi equation – Separability. (Chapter 5: Sections: 5.1–5.3).

Unit V: Canonical Transformation

Differential forms and generating functions – Special transformations – Lagranginan and poisson brackets. (Chapter 6: Sections: 6.1–6.3).

Text Book

1. Classical Dynamics, Donald T. Greenwood, PHI Pvt. Ltd., New Delhi, 1985.

Reference Books

1. H. Goldstein, Classical Mechanics (2^{nd} Edition), Narosa Publishing House, New Delhi, Reprint, 2001
2. Narayan Chandra Rana & PromodSharad Chandra Joag, Classical Mechanics, Tata McGraw Hill, 1991

E-Learning Source

https://ocw.mit.edu/courses/physics/8-09-classical-mechanics-iii-fall-2014

Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the basic concepts of the mechanical system,generalized coordinates, work, energy and momentum	K1&K2
CO2	Solve and analyze the Lagrange's equations and integrals of motion with examples	K3&K4
CO3	Understand the Hamilton's Principle and other variational principles and gain ability to analyze those principles to the problems arising in practical situations	K3
CO4	Gain knowledge about the differential forms and generating functions in canonical transformations, the bilinear covariant and compare the Lagrange's and Poisson brackets	K4&K5
CO5	Understand and develop the Hamilton's Principal function and Hamilton Jacobi equation	K3&K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of COs with POs

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	M	M	S	S	S	S	S	S
CO2	M	M	S	S	S	S	S	S
CO3	M	M	S	S	S	S	S	S
CO4	M	M	S	S	S	S	S	S
CO5	M	M	S	S	S	S	S	S

S – Strong **M – Medium** **L – Low**

<table>
<tr><th colspan="5">Program: M.Sc. Mathematics</th></tr>
<tr><td colspan="2">Elective – I
(From Group – A)</td><td>Course Code: 20PMA1E01</td><td colspan="2">Course Title: Numerical Analysis</td></tr>
<tr><td>Semester
I</td><td>Hours/Week
6</td><td>Total Hours
90</td><td>Credits
4</td><td>Total Marks
100</td></tr>
</table>

Course Objectives

This course aims at providing the necessary basic concepts of numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.

Unit I: Numerical Solutions to Ordinary Differential Equation

Numerical solutions to ordinary differential equation – Power series solution – Pointwise method – Solution by Taylor's series – Taylor's series method for simultaneous first order differential equations – Taylor's series method for Higher order Differential equations – Predictor – Corrector methods – Milne's method – Adam – Bashforth method. (Chapter 11: Sections: 11.1–11.6 & Sections: 11.18–11.20, Pages: 11.3–11.12 & 11.49–11.59).

Unit II: Picard and Euler Methods

Picard's Method of successive approximations – Picard's method for simultaneous first order differential equations – Picard's method for simultaneous second order differential equations – Euler's Method – Improved Euler's method – Modified Euler's Method. (Chapter 11: Sections: 11.7–11.12, Pages: 11.13–11.32).

Unit III: Runge-Kutta Method

Runge's method – Runge-Kutta methods – Higher order Runge-Kutta methods-Runge-Kutta methods for simultaneous first order differential equations – Runge-Kutta methods for simultaneous second order differential equations. (Chapter 11: Sections: 11.13–11.17, Pages: 11.32–11.49).

Unit IV: Numerical Solutions to Partial Differential Equations

Introduction – Difference Quotients – Geometrical representation of partial differential quotients – Classifications of partial differential equations – Elliptic equation – Solution to Laplace's equation by Liebmann's iteration process. (Chapter 12: Sections: 12.1–12.6, Pages: 12.1–12.23).

Unit V: Numerical Solutions to Partial Differential Equations (Contd.)

Poisson equation – Its solution – Parabolic equations – Bender – Schmidt method – Crank – Nicholson method – Hyperbolic equation. (Chapter 12: Sections: 12.7–12.10, Pages: 12.23–12.42).

Text Book

1. V.N. Vedamurthy and Ch. S.N. Iyengar, Numerical Methods, Vikas Publishing House Pvt. Ltd., 1998.

Reference Books

1. S.S. Sastry, Introductory Methods of Numerical Analysis, Printice hall of India, 1995.
2. C.F. Gerald and P.O. Wheathy, Applied Numerical Analysis, Fifth Edition, Addison Wesley, 1998.
3. M.K. Venkatraman, Numerical Methods in Science and Technology, National Publishers Company, 1992.
4. P. Kandasamy, K. Thilagavathy, K. Gunavathy, Numerical Methods, S. Chand & Company, 2003.

E-Learning Sources

http://www.math.ust.hk/~machas/numerical-methods.pdf

Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand and apply Numerical Solution to ODE.	K2&K3
CO2	Analyze Picards and Eulers Method.	K4
CO3	Evaluate Runge-Kutta Method-First,Second order Differential Equations	K5
CO4	Understand and apply Numerical Solution to PDE	K2&K3
CO5	Analyze Numerical Solution to PDE	K4

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of COs with POs

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	M	M	S	S	S	S	S	S
CO2	M	M	S	S	S	S	S	S
CO3	M	M	S	S	S	S	S	S
CO4	M	M	S	S	S	S	S	S
CO5	M	M	S	S	S	S	S	S

S – Strong **M – Medium** **L – Low**

Program: M.Sc. Mathematics				
Elective – I (From Group – A)	**Course Code:** 20PMA1E02		**Course Title:** Difference Equations	
Semester I	**Hours/Week** 6	**Total Hours** 90	**Credits** 4	**Total Marks** 100

Course Objectives

To introduce the process of discretization, discrete version of Differential Equations, oscillation and the asymptotic behavior of solutions of certain class of difference equations. Solving difference equations using z-transforms is stressed.

Unit I: Difference Calculus

Difference operator – Summation – Generating function – Approximate summation. (Chapter 2, Sections: 2.1–2.3).

Unit II: Linear Difference Equations

First order equations – General results for linear equations. (Chapter 3, Sections: 3.1–3.2).

Unit III: Linear Difference Equations (Contd.)

Equations with constant coefficients – Equations with variable coefficients – z – transform. (Chapter 3, Sections: 3.3, 3.5 & 3.7).

Unit IV: Initial Value Problems for Linear Systems

Initial value problems for linear systems – Stability of linear systems. (Chapter 4, Sections: 4.1–4.3).

Unit V

Asymptotic analysis of sums – Linear equations. (Chapter 5, Sections: 5.1–5.3).

Text Book

1. W.G. Kelley and A.C. Peterson, Difference Equations, Academic press, New York, 1991.

Reference Books

1. S.N. Elaydi, An Introduction to Difference Equations, Springer – Verleg, NewYork, 1990
2. R. Mickens, Difference Equations, Van Nostrand Reinhold, New York, 1990.
3. R.P. Agarwal, Difference Equations and Inequalities Marcel Dekker, New York, 1992.

E–Learning Sources

http://people.math.aau.dk/~matarne/11-imat/notes2011a.pdf

http://pj.freefaculty.org/guides/stat/Math/DifferenceEquations/DifferenceEquationsguide.pdf.

Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Evoke basic concepts behind the theory of difference oprators	K2
CO2	Interpret notation of solving linear difference equations of first order.	K2
CO3	Perceive idea of converting nonlinear equations into linear and their applications on Z-transform	K3
CO4	Resolve various initial value problem for linear systems	K5
CO5	Appraise methods of Asymptotic and analysis and non linear equations	K4

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of COs with POs

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	M	M	S	S	S	S	S	S
CO2	M	M	S	M	S	S	S	S
CO3	M	M	S	S	S	S	S	S
CO4	M	M	S	S	S	S	S	S
CO5	M	M	S	S	S	S	S	S

S – Strong **M – Medium** **L – Low**

Program: M.Sc. Mathematics				
Elective – I (From Group – A)		**Course Code:** 20PMA1E03	**Course Title:** Stochastic Processes	
Semester I	**Hours/Week** 6	**Total Hours** 90	**Credits** 4	**Total Marks** 100

Course Objectives

To introduce to the students the basic ideas of Stochastic processes, Markov chains, Markov process and Renewal process and to motivate research in these areas.

Unit I: Stationary Process

Specification of Stochastic processes – Stationary processes – Markov chains – Definitions and Examples – Higher Transition Probabilities – Generalization of Independent Bernoulli trails – Sequence of chain dependent trials. (Chapter 2: Sections: 2.2 & 2.3 and Chapter 3: Sections: 3.1–3.3).

Unit II: Markov Chains

Stability of a Markov system – Graph theoretic approach – Markov chain with denumerable Number of states – Reducible chains – Statistical inference for Markov chains. (Chapter 3: Sections: 3.6–3.10).

Unit III: Markov Processes with Discrete State Space: Poisson Process and its Extensions

Poisson process – Poisson process and related distributions – Generalizations of Poisson process – Birth and death process – Markov process with discrete state space (Continuous time Markov chains). (Chapter 4: Sections: 4.1–4.5).

Unit IV: Markov Processes with Continuous State Space

Brownian motion – Wiener process – Differential equations for a Wiener process Kolmogorov Equations – First Passage time distribution for Wiener process. (Chapter 5: Sections: 5.1–5.5).

Unit V: Renewal Processes and Theory Renewal process – Renewal process in continuous time – Renewal equation – Stopping time: Wald's equation – Renewal theorems– Delayed and equilibrium renewal processes. (Chapter 6: Sections: 6.1–6.6).

Text Book

1. J. Medhi, Stochastic Processes, Second Edition, New Age International Publication, New Delhi, 2002.

Reference Books

1. Erhan Cinlar, Introduction to Stochastic Process, Prentice Hall Inc., 1975.
2.Samauel Karlin, A First Course in Stochastic Process, Second edition Academic Press 1968.
3. S.K. Srinivasan and A. Vijayakumar, Stochastic Process, Narosa Publishing House, New Delhi, 2003.
4. V. Narauyan Bhat, Elements of Applied Stochastic Processes, John Wiley and Sons, 1972.

Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand stochastic models for many real life probabilistic situations.	K2
CO2	Learn well known models like birth-death and queueing to reorient their knowledge of stochastic analysis.	K2
CO3	Learn transition probabilities and its classifications.	K3
CO4	Solve random walk associated with real life situation t.	K5
CO5	Evauate the real life queueing problems by comparing the conventional queueing models.	K4

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of COs with POs

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	M	M	S	S	S	S	S	S
CO2	M	M	S	S	S	S	S	S
CO3	M	M	S	S	S	S	S	S
CO4	M	M	S	S	S	S	S	S
CO5	M	M	S	S	S	S	S	S

S – Strong **M – Medium** **L – Low**

Program: M.Sc. Mathematics				
Core – V		**Course Code:** 20PMA2C05	**Course Title:** Abstract Algebra	
Semester II	**Hours/Week** 6	**Total Hours** 90	**Credits** 5	**Total Marks** 100

Course Objectives

The objective of this course is to introduce the basic ideas of counting principle, Sylow subgroups, finite abelian groups, field theory and Galois Theory and to see its application to the solvability of polynomial equations by radicals.

Unit I: Sylow's Theorem

Another Counting Principle – 1st, 2nd and 3rd parts of Sylow's Theorems – Double coset – The normalizer of a group. (Chapter 2: Sections: 2.11 & 2.12, Pages: 82–101).

Unit II: Finite Abelian Groups

External and Internal direct Products – Structure theorem for finite abelian groups – Non isomorphic abelian groups – Polynomial rings. (Chapter 2: Sections: 2.13 & 2.14, Pages: 103–115) and (Chapter 3: Section: 3.9, Pages: 153–158).

Unit III: Splitting Field

Polynomials over rational fields – The Eisenstein criterion – Extension fields – Roots of polynomials – Splitting fields. (Chapter 3: Section: 3.10, Pages: 159–161) and (Chapter 5: Sections: 5.1 & 5.3, Pages: 207–214 & 219–227).

Unit IV: Galois Theory

More about roots – Simple extension – Separable extension – Fixed fields – Symmetric rational functions – Normal extension – Galois group – Fundamental theorem of Galois theory. (Chapter 5: Section: 5.5 & 5.6, Pages: 232–249).

Unit V: Solvability by Radicals

Solvable group – The commutator subgroup – Solvability by radicals – Finite fields. (Chapter 5: Section: 5.7, Pages: 250–256) and (Chapter 7: Section: 7.1, Pages: 356–360).

Text Book

1. I.N. Herstein, Topics in Algebra, 2nd Edition, John Wiley and Sons, New York, 1975.

Reference Books

1. S. Lang, "Algebra", 3rd Edition, Addison-Wesley, Mass, 1993.

2. John B. Fraleigh, "A First Course in Abstract Algebra", Addison Wesley, Mass, 1982.
3. M. Artin, "Algebra", Prentice-Hall of India, New Delhi, 1991.
4. V. K. Khanna and S.K. Bhambri, "A Course in Abstract Algebra", Vikas Publishing House Pvt. Limited, 1993.

Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand Sylows theorem and its applications.	K2
CO2	Acquire knowledge on extension fields and roots of Polynomials.	K2
CO3	Analyze elements of Galois theory and Galois Groups over the Rationals.	K3
CO4	Explain Wedderburn's Theorem on Finite Division Rings and a theorem of Frobenius.	K5
CO5	Analysis finite field and solvability by radicals.	K4

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of COs with POs

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	M	M	S	S	S	S	S	S
CO2	M	S	S	S	S	S	S	S
CO3	M	M	S	S	S	S	S	S
CO4	M	S	S	S	S	S	S	S
CO5	M	M	S	S	S	S	S	S

S – Strong **M – Medium** **L – Low**

Program: M.Sc. Mathematics				
Core – VI	**Course Code:** 20PMA2C06		**Course Title:** Real Analysis – II	
Semester II	**Hours/Week** 6	**Total Hours** 90	**Credits** 5	**Total Marks** 100

Course Objectives

The course will develop a deeper and more rigorous understanding of calculus including defining terms and proving theorems about sequence and series of functions, integration, special functions and multivariable calculus. The course will develop specialized techniques in problem solving.

Unit I: Riemann – Stieltjes Integral

Definition and Existence of the Integral – Properties of the Integral – Integration and Differentiation – Integration of Vector-valued functions – Rectifiable curves. (Chapter 6: Pages: 120–137).

Unit II: Sequences and Series of Functions

Discussion of main problem – Uniform Convergence - Uniform Convergence and Continuity - Uniform Convergence and Integration – Uniform Convergence and Differentiation.(Chapter 7: Pages: 143–154).

Unit III: Sequences and Series of Functions (Contd…)

Equicontinuous families of functions – Stone-Weierstrass Theorems – Algebra of complex valued functions. (Chapter 7: Pages: 155–171).

Unit IV: Some Special Functions

Power series – The Exponential and Logarithmic functions – Trigonometric Functions – Fourier series - The Gamma functions (Algebraic completeness of the complex field - omitted). (Chapter 8: Pages: 172–203, Omit Theorem 8.8).

Unit V: Functions of Several Variables

Linear transformations – Differentiation – The contraction principle - The inverse function theorem – The implicit function theorem. (Chapter 9: Pages: 204–228).

Text Book

1. Walter Rudin, "Principles of Mathematical Analysis", 3rd Edition, McGraw Hill Book Co., Kogaskusha, 1976.

Reference Books

1. T.M. Apostol, “Mathematical Analysis”, Narosa Publishers, New Delhi, 1985.
2. W.J. Kaczor and M.T. Nowak, “Problems in Mathematical Analysis III – Integration”, American Mathematical Society, 2000.
3. A. Browder, “Mathematical Analysis, an Introduction”, Springer-Verlag, New York, 1996.
4. K.A. Ross, “Elementary Analysis: The Theory of Calculus”, 2nd Edition, Springer, New York, 2013.

Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand Riemann integrals and its properties.	K2
CO2	Acquire knowledge for any advanced learning in Pure Mathematics.	K2
CO3	Solve Convergence of a sequences and series of functions.	K3
CO4	Evaluate the basics of special functions.	K5
CO5	Analyse Multivariate analysis.	K4

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of COs with POs

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	M	M	M	M	S	S	S	S
CO2	M	M	M	M	S	S	S	S
CO3	M	M	M	M	S	S	S	S
CO4	M	M	S	S	S	S	S	S
CO5	M	M	S	S	S	S	S	S

S – Strong **M – Medium** **L – Low**

Program: M.Sc. Mathematics		
Core – VII	**Course Code:** 20PMA2C07	**Course Title:** Partial Differential Equations

Semester	Hours/Week	Total Hours	Credits	Total Marks
II	6	90	4	100

Course Objectives

The objective of this course is to enable the students to understand the concepts related to the solution of partial differential equations arising in various fields.

Unit I: Partial Differential Equations of First Order

Nonlinear partial differential equations of the first order – Cauchy's method of characteristics – Compatible systems of first order equations – Charpit's method – Special types of first order equations – Jacobi's method. (Chapter 2: Sections: 7– 11 & 13, Pages: 59– 73 & 78–80).

Unit II: Partial Differential Equations of Second Order

Linear partial differential equations with constant coefficients – Equations with variable coefficients – The solution of linear hyperbolic equations – Separation of variables – Nonlinear equations of the second order. (Chapter 3: Sections: 4, 5,8, 9 & 11, Pages: 96– 109, 119– 126 & 131–135).

Unit III: Laplace's Equation

Elementary solution of Laplace's equation – Families of equipotential surfaces – Boundary value problems – Separation of variables – The theory of Green's function for Laplace equation. (Chapter 4: Sections: 2– 5 & 8, Pages: 145– 161 & 167– 174).

Unit IV: The Wave Equation

Elementary solutions of the one-dimensional wave equation – Vibrating membranes: Applications of the calculus of variations – Three dimensional problems – Green's function for the wave equation. (Chapter 5: Sections: 2,4,5 & 7, Pages: 215– 221, 226– 239 & 244–248).

Unit V: The Diffusion Equation

Elementary solutions of the diffusion equation – Separation of variables – The use of Green's functions. (Chapter 6: Sections: 3,4 & 6, Pages: 282– 290 & 294–298).

Text Book

1. I.N. Sneddon, Elements of Partial Differential Equations, Dover, Singapore, 2006.

Reference Books

1. D. Colton, "Partial Differential Equations: An Introduction", Dover Publishers, New York, 1988.
2. H. Hattori, "Partial Differential Equations: Methods, Applications and Theories", World Scientific, Singapore, 2013.
3. M.D. Raisinghania, "Advanced Differential Equations", S. Chand & Company, New Delhi, 2013.
4. K. Sankara Rao, "Introduction to Partial Differential Equations", Second Edition, Prentice –Hall of India, New Delhi, 2006.

E–Learning Sources

https://ocw.mit.edu/courses/mathematics/18-156-differential-analysis-ii-partial-differential-equations-and-fourier-analysis spring2016/index.htm?utm_source=OCWDept&utm_medium=CarouselSm&utm_campaign=Featured Course

Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand fundamental concepts of classification of second order partial differential equations, canonical forms.	K2
CO2	Analyse hyperbolic equations.	K2
CO3	Determine the occurence of Laplace equations, boundary value problems and develop Green's function for Laplace Equation.	K3
CO4	Develop the knowledge of one dimensional wave equation.	K5
CO5	Determine the occurence of Diffusion equations,Seperation of Variables and develop Green's function for Laplace Equation.	K3&K4

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of COs with POs

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	M	M	M	S	S	S	S	S
CO2	M	M	M	S	S	S	S	S
CO3	M	M	M	S	S	S	S	S
CO4	M	M	S	S	S	S	S	S
CO5	M	M	M	S	S	S	S	S

S – Strong **M – Medium** **L – Low**

Program: M.Sc. Mathematics				
Core – VIII	**Course Code:** 20PMA2C08		**Course Title:** Graph Theory	
Semester II	**Hours/Week** 6	**Total Hours** 90	**Credits** 4	**Total Marks** 100

Course Objectives

To understand the concept of graphs, sub graphs, trees, connectivity, Euler tour, Hamilton cycle, matching, colouring of graphs, independent set, cliques, vertex colouring and planar graphs.

Unit I: Basic Results

Introduction – Basic concepts – Subgraphs – Degrees of vertices – Paths and connectedness – Automorphism of a simple graph. (Chapter 1: Sections: 1.1–1.6). Directed Graphs: Introduction – Basic concepts – Tournaments. (Chapter 2: Sections: 2.1–2.3).

Unit II: Connectivity and Trees

Connectivity: Introduction – Vertex cut and edge cut – Connectivity and Edge Connectivity. (Chapter 3: Sections: 3.1–3.3). **Trees:** Introduction – Definition, characterization and simple properties – Centers and centroids – Cutting the number of spanning trees. (Chapter 4: Sections: 4.1–4.4).

Unit III: Independent Sets and Matchings

Independent Sets and Matchings: Introduction – Vertex – Independent sets and vertex coverings – Edge – Independent sets – Matchings and factors – Matchings in bipartite graphs. (Chapter 5: Sections: 5.1–5.5).

Unit IV: Graph Colorings

Introduction – Vertex colorings – Critical graphs – Edge colorings of graphs – Kirkman's school girl – Problem – Chromatic Polynomials. (Chapter 7: Sections: 7.1, 7.2, (7.2.1 & 7.2.3 only), 7.6, 7.8 & 7.9).

Unit V: Planarity

Introduction – Planar and nonplanar graphs –Euler formula and its consequences – K_5 and $K_{3,3}$ are nonplanar graphs – Dual of a plane graph – The four-color theorem and the heawood five – Color theorem – Hamiltonian plane graphs. (Chapter 8: Sections: 8.1–8.6 & 8.8).

Text Book

1. R. Balakrishnan and K. Ranganathan, Text Book of Graph Theory (2nd Edition), Springer, New York, 2012.

Reference Books

1. J.A. Bondy and U.S.R. Murty, Graph Theory with Applications, North Holland, New York, 1982.
2. Narasing Deo, Graph Theory with Application to Engineering and Computer Science, Prentice Hall of India, New Delhi, 2003.
3. F. Harary, Graph Theory, Addison–Wesely Publication Company, the Mass, 1969.
4. L.R. Foulds, Graph Theory Application, Narosa Publication House, Chennai, 1933.

E–Learning Source

http://cs.bme.hu/fcs/graphtheory.pdf

Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Know basic definitions and concepts of graphs and subgraphs.	K2
CO2	Getting acquainted with the concepts of trees and connectivity study its applications.	K2
CO3	Recoganize concepts and properties of Euler Tours and Matchings and study its applications.	K3
CO4	Assimilate knowledge about many different coloring problems for graphs, formulate applied problems as coloring problems and understand the notations of independent sets.	K5
CO5	Evaluate applications of graph theory in other disciplines.	K4

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of COs with POs

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	M	M	M	S	S	S	S	S
CO2	M	M	M	S	S	S	S	S
CO3	M	M	M	S	S	S	S	S
CO4	M	M	M	S	S	S	S	S
CO5	M	M	M	S	S	S	S	S

S – Strong **M – Medium** **L – Low**

Program: M.Sc. Mathematics				
Elective – II (From Group – B)		**Course Code:** 20PMA2E04	**Course Title:** Discrete Mathematics	
Semester II	**Hours/Week** 4	**Total Hours** 60	**Credits** 4	**Total Marks** 100

Course Objectives

The objective of this course is to understand the basic ideas of logic, proof methods and strategy, the growth of functions, counting techniques, pigeonhole principle, recurrence relations, solving recurrences using generating functions, Boolean functions, apply Boolean algebra to circuits and gatting networks, use finite state-machines to model computer operations.

Unit I: The Foundation of logic logic – Propositional equivalence – Predicates and quantifiers – Proof methods and strategy – The growth of functions. (Chapter 1: Sections: 1.1–1.3 & 1.8 and Chapter 3: Section: 3.2).

Unit II: Counting – Basics of counting – The pigeonhole principle – Permutations and combinations – Generalized permutations and combinations – Generating permutations and combinations. (Chapter 5: Sections: 5.1–5.3, 5.5 & 5.6).

Unit III: Advanced counting techniques – Recurrence relation – Solving recurrence relations – Generating functions. (Chapter 6: Sections: 6.1, 6.2 & 6.4).

Unit IV: Boolean algebra – Boolean functions – Representing Boolean functions – Logic gates – Minimization of circuits. (Chapter 10: Sections: 10.1–10.4).

Unit V: Modeling computations finite – State machines with output, finite – State machines with no output – Turing machines. (Chapter 12: Sections: 12.2, 12.3 & 12.5).

Text Book

1. Kenneth H. Rosen, Discrete Mathematics and its Applications, 7th Edition, WCB/ McGraw Hill Publications, New Delhi, 2011.

Reference Books

1. Edward A. Bender and S. Gill Williamson, “A Short Course in Discrete Mathematics”, Dover Publications, 2006
2. M.O. Albertson and J.P. Hutchinson, “Discrete Mathematics with Algorithms”, John Wiley & Sons, 2008.

3. Rajendra Akerkar and Rupali Akarkar, “Discrete Mathematics”, Pearson Education Pvt. Ltd., Singapore, 2004.
4. J.P. Trembley and R. Manohar, “Discrete Mathematical Structures”, Tata McGraw Hill, New Delhi, 1997.

Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Express a logic sentence in terms of predicates, quantifiers and logical connectives.	K2
CO2	Apply rules of inference and methods of proof including direct and indirect proof forms, proof by contradiction and mathematical induction.	K2
CO3	Solve discrete mathematics problems that involve: computing permutations and combinations of a set, fundamental enumeration principles.	K3
CO4	Evaluate Boolean functions and simplify expressions using the properties of Booleanalgebra.	K5
CO5	Analyze State Machine with output,finite state machine	K4

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of COs with POs

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	M	M	M	M	M	S	S	S
CO2	M	M	M	M	S	S	S	S
CO3	M	M	S	M	S	S	S	S
CO4	M	M	S	M	S	S	S	S
CO5	M	M	S	M	S	S	S	S

S – Strong **M – Medium** **L – Low**

Program: M.Sc. Mathematics				
Elective – II (From Group – B)		**Course Code:** 20PMA2E05		**Course Title:** Fuzzy Sets and Applications
Semester II	**Hours/Week** 4	**Total Hours** 60	**Credits** 4	**Total Marks** 100

Course Objectives

This course aims to introduce fuzzy graphs, fuzzy relations, fuzzy logic and fuzzy composition and initiate the learners into the application of these ideas.

Unit I: Basics

Crispsets – Fuzzy sets: Basic types – Basic concepts – Additional properties of α-cuts – Representation of Fuzzy sets – Extension principle for Fuzzy sets. (Chapter 1: Sections: 1.2–1.4 and Chapter 2: Sections: 2.1–2.3).

Unit II: Operations on Fuzzy sets

Types of operations – Fuzzy complements – Fuzzy intersections: t-norms – Fuzzy unions: t-Conorms – Combinations of operations. (Chapter 3: Sections: 3.1–3.5).

Unit III: Fuzzy Arithmetic

Fuzzy numbers – Linguistic variables – Arithmetic operations on intervals – Arithmetic operations on Fuzzy numbers – Lattice of Fuzzy numbers – Fuzzy equations. (Chapter 4: Sections: 4.1–4.6).

Unit IV: Fuzzy Relations

Crisp versus Fuzzy relations – Binary Fuzzy relations – Binary relations on a single set – Fuzzy Equivalence relations – Fuzzy compatibility relations – Fuzzy ordering relations – Sup –*ω* icompositions of Fuzzy relations – Inf -*ω*icompositions of Fuzzy relations. (Chapter 5: Sections: 5.1, 5.3–5.7, 5.9 & 5.10).

Unit V: Constructing Fuzzy Sets

Methods of construction: An overview – Direct methods with one expert – Direct methods with multiple experts – Indirect methods with one expert - Indirect methods with multiple experts (Chapter 10: Sections: 10.2–10.7).

Text Book

1. George J. Klirand Yuan. B, Fuzzy Sets and Fuzzy Logic: Theory and Applications, Prentice Hall India Private Ltd., 2007.

Reference Books

1. H. J. Zimmerman, Fuzzy Set Theory and its Applications, Second edition Kluwer Academic Publishers, London, 1996.
2. Pundir and Pundir, Fuzzy sets and their Applications, A Pragati Edition, 2006.
3. Timothy J. Ross, Fuzzy logic with engineering Applications, McGraw Hill Inc., New Delhi, 2004.
4. V. Novak, Fuzzy Sets and their Applications, Adam Hilger, Bristol, 1969.

E–Learning Source

http://nptel.ac.in/courses/105108081/module9/lecture36/lecture.pdf

Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Gain knowledge about basic types of fuzzy sets and difference between crisp sets and fuzzy sets.	K1
CO2	Understand the concept of operations on fuzzy sets.	K2
CO3	Acquire knowledge about concepts of fuzzy arithmetic and gain knowledge to solve the related problems.	K3&K4
CO4	Discriminate relations and fuzzy relations.	K4
CO5	Create a fuzzy model and solve social, environmental and biological problems.	K6

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of COs with POs

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	M	M	M	M	M	S	S	S
CO2	M	M	S	S	S	S	S	S
CO3	M	M	S	S	S	S	S	S
CO4	M	M	S	S	S	S	S	S
CO5	M	M	S	S	S	S	S	S

S – Strong **M – Medium** **L – Low**

Program: M.Sc. Mathematics				
Elective – II (From Group – B)		**Course Code:** 20PMA2E06	**Course Title:** Fluid Dynamics	
Semester II	**Hours/Week** 4	**Total Hours** 60	**Credits** 4	**Total Marks** 100

Course Objectives

This course aims to provide basic knowledge in Kinematics of fluids in motion, equations of motion of a fluid, three dimensional flows and viscous flows.

Unit I: Kinematics of Fluids in Motion

Real fluids and ideal fluids – Velocity of a fluid at a point – Stream lines 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. (Chapter 2: Sections: 2.1– 2.8).

Unit II: Equations of Motion of a Fluid

Pressure at a point in a fluid at rest – Pressure at a point in a moving fluid – Conditions at a boundary of two inviscid immiscible fluids – Euler's equations of motion – Bernoulli's equation – Worked examples – Discussion of the case of steady motion under conservative body forces. (Chapters 3: Sections: 3.1–3.7).

Unit III: Some Three-Dimensional Flows

Introduction - Sources, Sinks and doublets – Images in rigid infinite plane – Images in solid spheres – Axis symmetric flows. (Chapter 4: Sections– 4.1–4.4).

Unit IV: Some Two-Dimensional Flows

Meaning of two-dimensional flow – Use of cylindrical polar coordinates – The stream function – The complex velocity potential for two dimensional irrotational – Incompressible flow – Complex velocity potentials for standard two-dimensional flows – Some worked examples – Two dimensional image systems – Thomson circle theorem. (Chapter 5: Sections: 5.1–5.8).

Unit V: Viscous Fluid

Stress components in a real fluid – Relation 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 coefficient of viscosity and laminar flow –

The Navier – Stokes equation of a viscous fluid – Some solvable problems in viscous flow – Steady motion between parallel planes only. (Chapter 8: Sections: 8.1 & 8.10.1).

Text Book

1. Frank Chorlton, Textbook of Fluid Dynamics, CBS Publishers & Distributors, 2004.

Reference Books

1. L.M. Milne-Thomson, Theoretical Hydrodynamics, Macmillan, London, 1955.
2. G.K. Batchelor, An Introduction to Fluid Dynamics Cambridge Mathematical Library, 2000.

E–Learning Source

http://web.mit.edu/1.63/www/lecnote.html

Course Outcomes (COs)

On successful completion of the course, the students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Gain knowledge about real fluids, equations of continuity and vorticity vector.	K2
CO2	Understand notions of fluid pressure and derive Euler's equations of motion.	K2
CO3	Know and apply the concepts of sources, sinks and doublets	K3
CO4	Examine force and moment of the given flow of incompressible fluid using theorem of Blasins.	K5
CO5	Evaluate pressure of a viscous fluid by using Navier-Stokes equations of motion of a viscous fluid and create a fluid dynamics model and solve the problems in Physics, Biology and Engineerin.	K4

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of COs with POs

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	M	M	M	M	M	S	S	S
CO2	M	M	M	S	S	S	S	S
CO3	M	M	M	S	S	S	S	S
CO4	M	M	M	S	S	S	S	S
CO5	M	M	M	S	S	S	S	S

S – Strong **M – Medium** **L – Low**