CAUVERY COLLEGE FOR WOMEN (AUTONOMOUS)

Nationally Accredited with 'A' Grade by NAAC

ISO 9001:2015 Certified

TIRUCHIRAPPALLI

PG AND RESEARCH DEPARTMENT OF MATHEMATICS

M. Sc. MATHEMATICS

AUTONOMOUS SYLLABUS

2022 – 2023 and onwards

CAUVERY COLLEGE FOR WOMEN (AUTONOMOUS)

PG AND RESEARCH DEPARTMENT OF MATHEMATICS

VISION

To strive for excellence in the mathematical sciences in addition to encourage people to undertake opportunities in transdisciplinary domains.

MISSION

- To enhance analytical and logical problem-solving capabilities.
- To provide excellent mathematical science knowledge for a suitable career and to groom students for national prominence.
- To teach students how to use data analytics.
- To prepare students for transdisciplinary research and applications.
- Value-based education and service-oriented training programmes are used to acquire life skills.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEOs	Statements
PEO1	**LEARNING ENVIRONMENT** To facilitate value-based holistic and comprehensive learning by integrating innovative learning practices to match the highest quality standards and train the students to be effective leaders in their chosen fields.
PEO2	**ACADEMIC EXCELLENCE** To provide a conducive environment to unleash their hidden talents and to nurture the spirit of critical thinking and encourage them to achieve their goal.
PEO3	**EMPLOYABILITY** To equip students with the required skills in order to adapt to the changing global scenario and gain access to versatile career opportunities in multidisciplinary domains.
PEO4	**PROFESSIONAL ETHICS AND SOCIAL RESPONSIBILITY** To develop a sense of social responsibility by formulating ethics and equity to transform students into committed professionals with a strong attitude towards the development of the nation.
PEO5	**GREEN SUSTAINABILITY** To understand the impact of professional solutions in societal and environmental contexts and demonstrate the knowledge for an overall sustainable development.

PROGRAMME OUTCOMES FOR M.Sc MATHEMATICS

PO NO.	On completion of M.Sc Mathematics, the students will be able to
PO 1	**Problem Analysis** Provide opportunities to develop innovative design skills, including the ability to formulate problems, to think creatively, to synthesize information, and to communicate effectively.
PO 2	**Scientific Skills** Create and apply advanced techniques and tools to solve the societal environmental issues.
PO 3	**Environment and Sustainability** Ascertain eco-friendly approach for sustainable development and inculcate scientific temper in the society.
PO 4	**Ethics** Imbibe ethical and social values aiming towards holistic development of learners.
PO 5	**Life long learning** Instill critical thinking, communicative knowledge which potentially leads to higher rate of employment and also for higher educational studies.

PROGRAMME SPECIFIC OUTCOMES FOR M.Sc MATHEMATICS

PSO NO.	The Students of M.Sc Mathematics will be able to	POs Addressed
PSO1	Make a significant contribution to society's development through mathematical study	PO1 PO2 PO3
PSO2	Provide an in-depth and extensive functional understanding of mathematical basics.	PO1
PSO3	Develop the experimental abilities in order to solve scientific and technical problems.	PO1 PO5
PSO4	Promote the learners and explore the potential in emerging fields.	PO4 PO5
PSO5	Enhance problem-solving, thinking, and creative skills through assignments and project work.	PO4 PO5

Cauvery College for Women (Autonomous), Trichy

M. Sc Mathematics

(For the candidates admitted from the Academic year 2022-2023 and Onwards)

Semester	Course	Course Title	Course Code	Ins.Hrs/Week	Credits	Exam			Total
						Hrs	Mark		
							Int.	Ext.	
I	Core Course – I (CC)	Algebra –I	22PMA1CC1	6	5	3	25	75	100
	Core Course – II (CC)	Ordinary Differential Equations	22PMA1CC2	6	5	3	25	75	100
	Core Course – III (CC)	Integral Equations, Calculus of Variations and Transforms	22PMA1CC3	6	5	3	25	75	100
	Core Course – IV (CC)	Algebraic Number Theory	22PMA1CC4	6	5	3	25	75	100
	Elective Course - I (EC)	Advanced Numerical Analysis	22PMA1EC1A	6	3	3	25	75	100
		Mathematical Modelling	22PMA1EC1B						
		Boundary Value Problems	22PMA1EC1C						
	TOTAL			**30**	**23**	**-**	**-**	**-**	**500**

Semester I	Internal Marks: 25		External Marks: 75	
COURSECODE	**COURSETITLE**	**CATEGORY**	**Hrs / WEEK**	**CREDITS**
22PMA1CC1	**ALGEBRA- I**	**CORE**	**6**	**5**

Course Objective

- **Gain** expertise and confidence in proving theorems to progress in mathematical studies.
- **Acknowledge** the students with experience in axiomatic mathematics while keeping in close touch with the computational aspects of the subject.
- **Enhance** students to understand principles, concepts necessary to formulate, solve and analyze Algebra.

Prerequisite:

- Basic knowledge of sets, relations and functions.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	State, Explain and Apply the basic Concepts of groups, series of groups, rings and Euclidean domains	K1, K2, K3
CO2	Examine in detail about permutation groups and normal groups, quotient rings and ideals, Gaussian integers and norms	K3
CO3	Analyze the field of Quotients of an integral domain and Euclidean domains	K4
CO4	Classify groups of finite order using Sylow theorems and factorization of polynomials over a field	K4
CO5	Explain unique Factorization domain and Gaussian integers	K5

Mapping of CO with POs and PSOs

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3	3	3	2	2	2
CO2	3	2	3	3	3	3	3	3	2	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	2	3	3	2	2	3
CO5	3	2	3	3	2	3	3	3	3	2

"1" – Slight (Low) Correlation ¬ "2" – Moderate (Medium) Correlation ¬

"3" – Substantial (High) Correlation ¬ "-" indicates there is no correlation.

Syllabus

Unit I **(17 Hours)**

Binary Operations – Groups – Subgroups - Permutations I - Permutations II.

Unit II **(18 Hours)**

Isomorphism - Direct products - Finitely Generated Abelian Groups - Groups of Cosets- Normal Subgroups and Factor Groups.

Unit III **(17 Hours)**

Series of Groups - Isomorphism Theorems; Proof of the Jordan - Holder Theorem- Sylow Theorems**.**

Unit IV **(20 Hours)**

Rings - Integral domains - The Field of Quotients of an Integral Domain - Quotient Rings and Ideals.

Unit V **(18 Hours)**

Factorization of Polynomials over a Field - Unique Factorization Domains -Euclidean Domains -Gaussian Integers and Norms**.**

Unit VI- Self-Study for Enrichment (Not included for End Semester Examinations)

Cyclic Groups – Homomorphisms - Applications of the Sylow Theorem - Some Noncommutative examples - Homomorphism of Rings

Text Book

1. John B. Fraleigh,(2018(Reprint)), *A First Course in Abstract Algebra*, Narosa Publishing House, Third edition.

Chapters and Sections

UNIT-I	Chapters 1 to 5[1]
UNIT-II	Chapters 7,8,9,11 and 12[1]
UNIT-III	Chapter 14,15 and 18[1]
UNIT-IV	Chapter 23,24,26 and 28[1]
UNIT-V	Chapter 31 to 34[1]

Reference Books

1. David S. Dummit and Richard M. Foote, (2004), *Abstract Algebra*, Wileyand Sons, Third Edition.
2. Joseph A. Gallian, (1999), *Contemporary Abstract Algebra*, Narosa Publishing House, Fourth Edition.
3. Herstein. I.N, (1975), *Topics in Algebra*, John Wiley, Second Edition.

Web References

1. **https://www.youtube.com/watch?v=g7L_r6zw4-c**
2. **https://www.youtube.com/watch?v=VSB8jisn9xI**
3. **https://www.youtube.com/watch?v=WwndchnEDS4**
4. **https://www.youtube.com/watch?v=xTCxmr4ISU4**
5. **https://www.youtube.com/watch?v=iobTKR4-19o**
6. **https://www.youtube.com/watch?v=NfmJQ1ah4vM**
7. **https://www.youtube.com/watch?v=vrFd-5uEv4k**

Pedagogy

Power Point Presentations, Group Discussions, Seminar, Quiz, Assignment.

Course Designer

1. Dr. K. Kalaiarasi.

Semester I	Internal Marks: 25		External Marks: 75	
COURSECODE	**COURSETITLE**	**CATEGORY**	**Hrs / Week**	**CREDITS**
22PMA1CC2	**ORDINARY DIFFERENTIAL EQUATIONS**	**CORE**	**6**	**5**

Course Objective

- **Recognize** certain basic types of first order ODEs for which exact solutions may be obtained and to apply the corresponding methods of solution
- **Qualitative Analysis** of Solutions of First Order Autonomous Equations.
- **Analyze** the concepts of existence and uniqueness of solutions.

Prerequisite

- Fundamental knowledge of ordinary differential equations in UG.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On successful completion of this work, students will be able to	Cognitive Level
CO1	**Interpret** linear, non-linear, homogeneous, non-homogeneous and autonomous system of ordinary differential equations.	**K2**
CO2	**Develop** the Qualitative properties of general solutions of ordinary differential equations, Initial value problems and **Identify** the regular singular points, Eigen values, Eigen functions of the equations.	**K3**
CO3	**Diagnose** the power series solution for ordinary differential equations, system of homogeneous equations and **Identify** the critical points of the system of equations.	**K3**
CO4	**Analyze** the general solutions of ordinary differential equations, system of equations and Orthogonality of some special functions.	**K4**
CO5	**Discriminate** the Qualitative properties of Boundary value problems by using Sturm theorems and **Analyze** the Stability nature of Linear and Non-Linear system by various methods.	**K4**

Mapping of CO with POs and PSOs

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3	3	3	3	2	3
CO2	3	3	3	3	3	3	3	3	2	3
CO3	3	3	3	3	3	3	3	3	2	3
CO4	3	3	2	3	3	3	3	3	2	3
CO5	3	3	3	3	3	3	3	3	2	3

"1" – Slight (Low) Correlation ¬ "2" – Moderate (Medium) Correlation ¬

"3" – Substantial (High) Correlation ¬ "-" indicates there is no correlation.

Syllabus

UNIT I **(18 Hours)**

The General Solution of the Homogeneous Equation – The Use of a Known Solution to Find Another – The Method of Variation of Parameters – Power Series Solutions and Special Functions: Introduction: A Review of Power Series – Series Solutions of First Order Equations – Second Order Linear Equations. Ordinary Points.

UNIT II **(18 Hours)**

Regular Singular Points – Gauss's Hypergeometric Equation – The Point at Infinity. Legendre Polynomials – Properties of Legendre Polynomials - Bessel Functions. The Gamma Function, Properties of Bessel Functions.

UNIT III **(18 Hours)**

Linear Systems – Homogeneous Linear Systems with Constant Coefficients – The Existence and Uniqueness of Solutions: The Method of Successive Approximations - Picard's Theorem.

UNIT IV **(18 Hours)**

Qualitative Properties of Solutions: Oscillations and the Strum Separation Theorem – The Sturm Comparison Theorem – Eigen Values , Eigen Functions and the Vibrating String.

UNIT V **(18 Hours)**

Nonlinear Equations: Autonomous Systems. The Phase Plane and Its Phenomena – Types of Critical Points.Stability – Critical Points and Stability for Linear Systems – Stability by Liapunov's Direct Method - Simple Critical Points of Nonlinear Systems.

UNIT VI - Self- Study for Enrichment(Not included for End Semester Examinations)

The Homogeneous Equation with Constant Coefficients - Regular Singular Points (Continued) – Systems. The Second Order Linear Equation - Sturm Liouville Problems - Nonlinear Mechanics, Conservative systems.

Text Book

1. George F. Simmons (2003). Differential Equations with Applications and Historical Notes, Second Edition. Tata McGraw- Hill Editions.

Chapters and Sections

UNIT – I	Chapter 3	Sections 15, 16, 19
	Chapter 5	Sections 26 to 28
UNIT – II	Chapter 5	Sections 29, 31, 32
	Chapter 8	Sections 44 to 47
UNIT – III	Chapter 10	Sections 55, 56
	Chapter 13	Sections 68, 69
UNIT – IV	Chapter 4	Sections 24, 25
	Chapter 7	Sections 40
UNIT –V	Chapter 11	Sections 58 to 62

Reference Books

1. Raisinghania M.D. (2006), Ordinary and Partial Differential Equations,1st Edition, S.Chand & Co.
2. Coddington E.A. and Levinson N. (2002), Theory of Ordinary Differential Equations, Mc-Graw Hill Publishing Company, NewYork.
3. Chicone, Carmen. (2006), A Ordinary Differential Equations With Applications,2nd Edition, Spring Verlag, NewYork.

Web References

1. https://www.youtube.com/watch?v=gd1FYn86P0c
2. https://www.youtube.com/watch?v=6o7b9yyhH7k
3. https://www.youtube.com/watch?v=HAb9JbBD2ig
4. https://www.youtube.com/watch?v=kj-qTWhH5N4
5. https://www.youtube.com/watch?v=CV81OjuHUS8
6. https://www.youtube.com/watch?v=oTN7hGoSPMw
7. https://www.youtube.com/watch?v=IWm6Coa3_bQ
8. https://www.youtube.com/watch?v=1HUnrokDN0U
9. https://www.youtube.com/watch?v=1HUnrokDN0U

Pedagogy

Chalk and Talk method, Power point presentations, Group Discussions, Seminar, Quiz, Assignment.

Course Designer

1. Dr. G. JANAKI

Semester I	Internal Marks: 25		External Marks: 75	
COURSECODE	**COURSETITLE**	**CATEGORY**	**Hrs / Week**	**CREDITS**
22PMA1CC3	**INTEGRAL EQUATIONS, CALCULUS OF VARIATIONS AND TRANSFORMS**	**CORE**	**6**	**5**

Course Objective

- To introduce the concept of calculus of variations and integral equations and their applications.
- To learn the different types of transforms and their properties.
- To give an experience in the implementation of Mathematical concepts like integral transforms, integral equations and calculus of variations in various field of Engineering.

Prerequisite

- Basic Knowledge of Integral Calculus and Fourier Series

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On successful completion of this work, students will be able to	Cognitive Level
CO1	Define the concepts in calculus of variations, transforms and different types of integral equations.	K1
CO2	Understand the various kinds of Fourier transforms with their properties, calculus of variations, Hankel transform , Fredholm and Volterra integral equations.	K2
CO3	Apply the concepts of calculus of variations to find the maxima and minima of quantities defined as integrals containing unknown functions and explain the concept of transform,	K3
CO4	Recognize and solve particular cases of Fredholm and Volterra integral equations, transforms and variational problems.	K4
CO5	Evaluate the integral equations by various methods in their respective streams.	K5

Mapping of CO with POs and PSOs

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	3	3	3	2	2	2	3
CO2	2	3	3	2	2	2	3	2	2	3
CO3	2	2	3	3	3	3	3	2	2	3
CO4	3	3	2	2	3	3	3	2	2	2
CO5	2	2	3	3	2	3	2	2	2	3

"1" – Slight (Low) Correlation ¬ "2" – Moderate (Medium) Correlation ¬

"3" – Substantial (High) Correlation ¬ "-" indicates there is no correlation.

Syllabus

UNIT I **(18 Hours)**

Calculus of variations and applications: Maxima and Minima – The simplest case – Illustrative examples - Natural boundary conditions and transition conditions – The Variational notation – The More general case – constraints and Lagrange multipliers – variable end points – Sturm-Liouville problems.

UNIT – II **(18 Hours)**

Fourier transforms: Dirichlet's conditions – Fourier series – Fourier's Integral formula – Fourier transform or complex Fourier transform – Inversion theorem for complex Fourier transform – Fourier sine transform - Inversion formula for Fourier sine transform - Fourier cosine transform - Inversion formula for Fourier cosine transform – Linearity property of Fourier transform – Change of scale property – Shifting Property – Modulation Theorem – Multiple Fourier transforms - Convolution - The convolution or Falting theorem for Fourier transforms - Parseval's identity for transforms – Relationship between Fourier and Laplace transforms – Fourier transform of the derivatives of a function – Problems related to integral equations.

UNIT III **(18 Hours)**

Hankel Transforms :Definition – Inverse formula for the Hankel transform – Some important results for Bessel function – Linearity property – Hankel Transform of the derivatives of the function – Hankel Transform of differential operators.

UNIT IV **(18 Hours)**

Definition, Regularity Conditions – Special Kind of Kernels – Eigen values and Eigen functions – Convolution Integral – The Inner or Scalar Product of Two Functions – Notation – Integral Equations with Separable Kernals: Reduction to a System of Algebraic Equations – Examples– Fredholm Alternative – Examples.

UNIT V **(18 Hours)**

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 – Examples – Fredholm's Second Theorem.

UNIT VI - Self-Study for Enrichment (Not included for End Semester Examinations)

Hamilton's Principle - Finite Fourier transforms- Parseval's Theorem- An Approximate Method – Fredholm Integral Equation of the First Kind - Fredholm's Third Theorem.

Text books

1. Francis.B. Hildebrand,(1972), Methods of Applied Mathematics, Prentice – Hall of India Pvt Ltd, New Delhi.
2. Vasishtha.A.R. and Gupta.R.K,(2002), Integral Transforms, Krishna Prakashan Media Pvt Ltd
3. Ram.P.Kanwal,(1971), Linear Integral Equations, Academic Press.

Chapters and Sections

Unit I	Chapter 2	Sections 2.1 to 2.8 [1]
Unit II	Chapter 6	Sections 6.1 to 6.20[2]
Unit III	Chapter 9	Sections 9.1 to 9.6[2]
Unit IV	Chapter 1	Sections 1.1 to 1.7[3]
	Chapter 2	Sections 2.1 to 2.4[3]
Unit V	Chapter 3	Sections 3.1 to 3.5[3]
	Chapter 4	Sections 4.1 to 4.4[3]

Reference Books

1. Gupta,A.S.(2006), Calculus of Variations with Applications, Prentice Hall of India Private Limited, New Delhi.
2. Raisinghania,M.D. (2007), Integral Equations and Boundary Value Problems, S.Chand & Company Ltd, New Delhi.
3. Gupta.P.P and Sunjay Gupta,(2003), Integral Transforms, Kedarnath Ram Nath , Meerut.

Web References

1. https://youtu.be/70lYJs2xL6Q
2. https://youtu.be/HlwYQqUdrQs
3. https://youtu.be/6HeQc7CSkZs
4. https://youtu.be/UKHBWzoOKsY
5. https://youtu.be/3OCYjT5h23w
6. https://youtu.be/pAwvErIGIV8
7. https://youtu.be/HH9QH692AZE

Pedagogy

Chalk and talk, Power point presentation, Discussion , Assignment, Quiz, Seminar.

Course Designers

1.Dr. S.Sasikala.

2.Dr.R.Radha.

Semester I	Internal Marks: 25		External Marks: 75	
COURSECODE	**COURSETITLE**	**CATEGORY**	**Hrs / Week**	**CREDITS**
22PMA1CC4	**ALGEBRAIC NUMBER THEORY**	**CORE**	**6**	**5**

Course Objective

- **Explore** fundamental concepts of divisibility, Congruences and primes.
- **Analyze** the quadratic Residues, The Mobius Inversion formula, Diophantine equations and their problems.
- **Apply** the ideas of Pythagorean triangle and The Chinese remainder theorem to solve problems.

Prerequisites

Theory of Numbers, Abstract Algebra

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Explain the concepts of divisibility, congruences, prime modulus, prime power moduli, quadratic reciprocity, quadratic forms, some functions of Number Theory, Mobius inversion formula and various topics in Diophantine equations.	K2
CO2	Apply the various concepts of divisibility, congruences, prime modulus, prime power moduli, quadratic reciprocity, quadratic forms, functions of Number Theory, Mobius inversion formula and some topics in Diophantine equations.	K3
CO3	Examine of ideas of divisibility, congruences, prime modulus, prime power moduli, quadratic reciprocity, quadratic forms, functions of Number Theory, Mobius inversion formula, Diophantine equations, Simultaneous linear equations, and Pythagorean triangles.	K4
CO4	Evaluate the concepts of divisibility, congruences, prime modulus, prime power moduli, quadratic reciprocity, quadratic forms, functions of Number Theory, Mobius inversion formula, Diophantine equations, Simultaneous linear equations, and Pythagorean triangles.	K5
CO5	Develop the ideas of divisibility, congruences, prime modulus, prime power moduli, quadratic reciprocity, quadratic forms, functions of Number Theory, Mobius inversion formula, Diophantine equations, Simultaneous linear equations, and Pythagorean triangles.	K6

Mapping of CO with POs and PSOs

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3	3	3	2	2	3
CO2	2	3	2	3	2	2	2	2	2	3
CO3	3	3	2	3	3	3	2	2	2	3
CO4	3	3	3	3	3	3	3	2	2	3
CO5	3	3	3	3	3	3	3	2	2	3

"1" – Slight (Low) Correlation ¬ "2" – Moderate (Medium) Correlation ¬

"3" – Substantial (High) Correlation ¬ "-" indicates there is no correlation.

Syllabus

UNIT I **(18 Hours)**

Divisibility and Congruences

Introduction – Divisibility – The Binomial Theorem – Congruences – Solutions of Congruences – The Chinese Remainder Theorem.

UNIT II **(18 Hours)**

Congruences

Techniques of Numerical Calculation — Prime Power Moduli – Prime Modulus – Congruences of Degree Two, Prime Modulus – Public Key Cryptography.

UNIT III **(18 Hours)**

Quadratic Reciprocity and Quadratic Forms

Quadratic Residues – Quadratic Reciprocity – The Jacobi Symbol – Binary Quadratic Forms – Equivalence and Reduction of Binary Quadratic Forms – Sums of Two Squares.

UNIT IV **(18 Hours)**

Some Functions of Number Theory

Greatest Integer Function – Arithmetic Functions – The Mobius Inversion Formula.

UNIT V **(18 Hours)**

Some Diophantine Equations

The Equation $ax + by = c$ – Simultaneous Linear Equations – Pythagorean Triangles.

UNIT VI - Self-Study for Enrichment (Not included for End Semester Examinations)

Primes - Primitive Roots and Power Residues - Positive Definite Binary Quadratic Forms - Recurrence Functions - Assorted Examples**.**

Text Books

1. Ivan Niven, Herbert S. Zuckerman & Hugh L. Montgomery (2016) Reprint, *An Introduction to the Theory of Numbers*, (*Fifth Edition, Reprint 2016*). Wiley Publishers.

UNIT – I	Chapter 1	Sections 1.1, 1,2 & 1.4
	Chapter 2	Sections 2.1 to 2.3
UNIT – II	Chapter 2	Sections 2.4 to 2.7 & 2.9
UNIT – III	Chapter 3	Sections 3.1 to 3.6
UNIT – IV	Chapter 4	Sections 4.1 to 4.3
UNIT – V	Chapter 5	Sections 5.1 to 5.3

Reference Books

1. David M. Burton (2012), *Elementary Number Theory (Sixth Edition)***,** Tata McGraw Hill Education Private Limited, New Delhi.
2. Telang S. G. (2005), *Number Theory* (Reprint 2001),Tata McGraw Hill Education Private Limited, New Delhi.
3. Melvyn B. Nathanson (2005), *Methods in Number Theory*(Reprint 2006), Springer-Verlag, New York, Inc.

Web References

1. **https://www.youtube.com/watch?v=ChG_7jeNRHo**
2. **https://www.youtube.com/watch?v=e8DtzQkjOMQ**
3. **https://www.youtube.com/watch?v=3W91U-aNclQ**
4. **https://www.youtube.com/watch?v=bg6CksAkZ-k**
5. **https://www.youtube.com/watch?v=4dVTlX4bwP0**
6. **https://www.youtube.com/watch?v=khfIH1H6iUg**
7. **https://www.youtube.com/watch?v=BC2BdenKsYs**

Pedagogy

Power point Presentations, Group Discussions, Seminar, Quiz, Assignment.

Course Designer

1. Dr. S. Vidhya.

Semester I	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSETITLE**	**CATEGORY**	**HRS /WEEK**	**CREDITS**
22PMA1EC1A	**ADVANCED NUMERICAL ANALYSIS**	**ELECTIVE**	**6**	**3**

Course Objective

- To **know** the theory behind various numerical methods.
- To **apply** these methods to solve mathematical problems.
- To **train** the students to develop analytical thinking and the study of stability analysis.

Prerequisite

A reasonable background in linear algebra, numerical analysis, partial differential equations, and finite difference methods.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	State and explain the methods to solve transcendental and polynomial equations	K1,K2
CO2	Classify the various techniques of interpolation and approximation	K3
CO3	Analyze and determine the error for Mathematical Problems arising in various fields	K4
CO4	Examine the numerical problems and its Convergence.	K4
CO5	Evaluate various methods to solve numerical differentiation and integration problems	K5

Mapping of CO with POs and PSOs

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	2	3	2	3	2	3	3
CO2	3	3	3	3	3	3	3	3	3	3
CO3	2	2	3	2	3	3	3	2	2	3
CO4	2	2	2	2	3	2	2	2	2	3
CO5	3	3	3	3	3	3	3	3	2	3

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Syllabus

UNIT I **(18 Hours)**

Transcendental and polynomial equations

Rate of convergence – Polynomial equations: Descartes' Rule of Signs - Iterative Methods: Birge-Vieta method - Bairstow's method.

UNIT II **(17 Hours)**

System of Linear Algebraic equations and Eigen Value Problems

Error Analysis for Direct methods – Iteration methods - Eigen values and Eigen vectors – Jacobi method for symmetric matrices - Power method.

UNIT III **(18 Hours)**

Interpolation and Approximation

Hermite Interpolation - Piecewise and Spline Interpolation.

UNIT IV **(17 Hours)**

Differentiation

Numerical Differentiation – Optimum choice of Step length – Extrapolation methods.

UNIT V **(20 Hours)**

Integration

Numerical Integration - Methods based on undetermined coefficients: Newton- Cotes methods: Trapezoidal Method - Simpson's Method - Gauss Legendre Integration Methods - Lobatto Integration Methods.

UNIT VI - Self -Study for Enrichment (Not included for End Semester Examinations)

Direct Method - Graeffe's root squaring method- Gauss Seidel Iteration method - Bivariate Interpolation: Lagrange Bivariate interpolation - Partial Differentiation - Gauss-Chebyshev Integration Methods.

Text Book

Jain. M. K, Iyengar. S. R. K. and Jain. R. K. (Sixth Edition), *Numerical Methods for Scientific and Engineering Computation,* New Age International (P) Limited Publishers, New Delhi.

Chapters and Sections

UNIT-I	Chapter 2	Sections 2.5 and 2.9(Page No. 83 - 93)
UNIT-II	Chapter 3	Sections 3.3 – 3.5, 3.7, 3.11
UNIT-III	Chapter 4	Sections 4.5 and 4.6
UNIT- IV	Chapter 5	Sections 5.2 - 5.4
UNIT- V	Chapter 5	Sections 5.6 (Page No. 348) and 5.8(Page No. 356-365, 380-382)

Reference Books

1. Jain. M. K, (1983), *Numerical Solution of Differential Equations*(2nd Edition), New Age International Pvt Ltd.,
2. Samuel. D. Conte and Carl. DeBoor, (1988), *Elementary Numerical Analysis*(3rd Edition), McGraw-Hill International.
3. Kendall E. Atkinson, (1989), *An Introduction to Numerical Analysis*(2nd Edition), John Wiley & Sons.

Web References

1. https://www.youtube.com/watch?v=hTVjuH6J_C8
2. https://www.youtube.com/watch?v=EMPyjetvaDg
3. https://www.youtube.com/watch?v=YkrSgTBznek
4. https://www.youtube.com/watch?v=-fE3I-usIKk
5. https://www.youtube.com/watch?v=gyyKvonahXk.

Pedagogy

Power point presentations, Group Discussions, Seminar, Quiz, Assignment.

Course Designers

2. Ms. R. Soundaria
3. Dr. P.Sudha

Semester I	Internal Marks: 25		External Marks: 75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS /WEEK**	**CREDITS**
22PMA1EC1B	**MATHEMATICAL MODELLING**	**ELECTIVE**	**6**	**3**

Course Objective

- **Analyze** the different mathematical models through Ordinary differential equation and Differential Equations.
- **Understand** the implementation of graph theoretical models.
- **Summarize** and implementation the kinds of Difference equations.

Prerequisite

Classification of ordinary differential equations.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Recall and Classify the models through Ordinary Differential equations.	K1, K2
CO2	Interpret the systems of Ordinary Differential equations for various models.	K2
CO3	Solve the Planetary motions through Ordinary Differential equations of second order.	K3
CO4	Analyze the basic concepts of Difference equation.	K4
CO5	Determine various types of models through Difference equation.	K5

Mapping of CO with POs and PSOs

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	3	3	3	2	2	2	3
CO2	2	3	3	2	2	2	3	2	2	3
CO3	2	2	3	3	3	3	3	2	3	3
CO4	3	3	2	2	3	3	3	3	2	2
CO5	2	2	3	3	2	3	2	2	2	3

"1" – Slight (Low) Correlation ¬ "2" – Moderate (Medium) Correlation ¬

"3" – Substantial (High) Correlation ¬ "-" indicates there is no correlation.

Syllabus

UNIT I **(18 Hours)**

Mathematical Modelling through Ordinary Differential Equations of First order

Mathematical Modelling Through Differential Equations- Linear Growth and Decay Models – Non-Linear Growth and Decay Models – Compartment Models – Mathematical Modelling in Dynamics Through Ordinary Differential Equations of First Order.

UNIT II **(18 Hours)**

Mathematical Modelling through Systems of Ordinary Differential Equations of First Order

Mathematical Modelling in Population Dynamics – Mathematical Modelling of Epidemics Through Systems of Ordinary Differential Equations of First Order – Compartment Models Through Systems of Ordinary Differential Equations – Mathematical Modelling in Medicine, Arms Race, Battles and International Trade in Terms of Systems of Ordinary Differential Equations – Mathematical Modelling in Dynamics Through Systems of Ordinary Differential Equations of First Order.

UNIT III **(20 Hours)**

Mathematical Modelling Through Ordinary Differential Equations of Second Order

Mathematical Modelling in Planetary Motions – Mathematical Modelling in Circular Motion and Motion of Satellites – Mathematical Modelling Through Linear Differential Equations of Second Order.

UNIT IV **(17 Hours)**

Mathematical Modelling Through Difference Equations

The Need for Mathematical Modelling Through Differential Equations: Some Simple Models – Basic Theory of Linear Difference Equations with Constant Coefficients – Mathematical Modelling Through Differential Equations in Economics and Finance– Mathematical Modelling Through Differential Equations in Probability Theory.

UNIT V **(17 Hours)**

Mathematical Modelling through Graphs

Situations that can be Modelled Through Graphs – Mathematical Models in Terms of Directed Graphs–Mathematical Models in Terms of Signed Graphs–Mathematical Models in Terms of Weighted Digraphs.

UNIT VI - Self-Study for Enrichment (Not included for End Semester Examinations)

Mathematical Modellingof Geometrical problems Through Ordinary Differential Equations of First Order - Mathematical Modelling in Economics Through Systems of Ordinary Differential Equations of First Order - Miscellaneous Mathematical Models Through Systems of Ordinary Differential Equations of Second Order - Mathematical Modelling Through Differential Equations in Population Dynamics and Genetics - Mathematical Modelling in Terms of Unoriented Graphs.

Text Books

1. J N Kapur, (Reprint 2001). *Mathematical Modelling.* New Age International (P) Limited, Publishers, New Delhi.

UNIT-I Chapter 2: Sections 2.1 to 2.5

UNIT-II	Chapter 3	Sections 3.1 to 3.3 & 3.6
UNIT-III	Chapter 4	Sections 4.1 to 4.3
UNIT- IV	Chapter 5	Sections 5.1 to 5.3&5.5
	Chapter 7	Sections 7.1 to 7.4
UNIT- V	Chapter 15	Sections 15.1 to 15.3.6 [2]
	Chapter 16	Sections 16.2 to16.2.5, 16.5, 16.5.1 to 16.5.3 [2].

Reference Books

1. Bimal K.Mishra & Dipak K.Satpathi (First Edition, Reprint 2009). *Mathematical Modeling Applications, Issues and Analysis(1st Edition).* Ane Books Pvt. Ltd.

2. Edward A. Bender. *An Introduction to Mathematical Modelling*(Reprint 2000).Dover Publications.

3. Rutherford A. *Mathematical Modelling Techniques*(Revised Edition 2012).Dover Publications.

Web References

1. **https://www.youtube.com/watch?v=3Yfsh1SnGIw**
2. **https://www.youtube.com/watch?v=EdtwK8KSwOo**
3. **https://www.youtube.com/watch?v=zczt5GhkylY**
4. **https://www.youtube.com/watch?v=-wVCKOvceok**
5. **https://www.youtube.com/watch?v=BZwp8gAxvUc**

Pedagogy

Power point Presentations, Group Discussions, Seminar, Quiz, Assignment and Smart Classroom.

Course Designer

1. Dr R. Buvaneswari.

Semester I	Internal Marks: 25		ExternalMarks:75	
COURSE CODE	**COURSE TITLE**	**CATEGORY**	**HRS /WEEK**	**CREDITS**
22PMA1EC1C	**BOUNDARY VALUE PROBLEMS**	**ELECTIVE**	**6**	**3**

Course Objective

- **Gain** expertise and confidence in proving theorems to progress in mathematical studies.
- **Analyze** the implementation of boundary value problem through various models.
- **Summarize** the various aspects of boundary value problem.

Prerequisite:

- Exposure on Fourier series and Differential Equations.

Course Outcome and Cognitive Level Mapping

CO Number	CO Statement On the successful completion of the course, students will be able to	Cognitive Level
CO1	Recall and Understand the concept of Fourier Series	K1, K2
CO2	Apply real world scenarios in order to solve the problems using multiple approaches.	K3
CO3	Examine the applications of Fourier Bessel Series, Laplace and Poisson Equations	K4
CO4	Associate the results of Fourier Bessel Series, Laplace and Poisson Equations	K4
CO5	Evaluate Dirichlet Problems and its solutions in various Regions.	K5

Mapping of CO with PO and PSO

COs	PSO1	PSO2	PSO3	PSO4	PSO5	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	3	3	3	2	2	2	3
CO2	2	3	3	2	2	2	3	2	2	3
CO3	2	2	3	3	3	3	3	2	3	3
CO4	3	3	2	2	3	3	3	3	2	2
CO5	2	2	3	3	2	3	2	2	2	3

"1" – Slight (Low) Correlation ¬ "2" – Moderate (Medium) Correlation ¬

"3" – Substantial (High) Correlation ¬ "-" indicates there is no correlation.

Syllabus

UNIT I **(18 Hours)**

One-sided Derivatives- An Integration Formula – Preliminary Theory – A Fourier Theorem- Discussion of the Theorem.

UNIT II **(17 Hours)**

Formal and Rigorous Solutions – The Vibrating String, Initially Displaced – Discussion of the Solution – Prescribed Initial Velocity – Non homogeneous Differential Equations – Elastic Bar- Temperatures in a Bar.

UNIT III **(18 Hours)**

A Dirichlet Problem – Fourier Series in Two Variable – An Application of Fourier Integrals – Temperatures $u(x,t)$ in an Unlimited Medium

Fourier-Bessel Series-Temperatures in a Long Cylinder-Heat Transfer at the Surface of the Cylinder.

UNIT IV **(17 Hours)**

Dirichlet Problems in Spherical Regions – Steady Temperature in a Hemisphere.

UNIT V **(20 Hours)**

Cauchy Criterion for Uniform Convergence –Abel's Test for Uniform Convergence – Uniqueness of Solutions of the Heat Equation – Example – Solutions of Laplaces's or Poisson's Equation.

UNIT VI - Self-Study for Enrichment (Not included for End Semester Examinations)

Other Forms of Fourier Series –The Orthonormal Trigonometric Functions - Other Boundary Conditions - Observations and Further Examples - Vibration of a circular Membrane - Other Orthogonal Sets - An Application.

Text Books

1. Ruel V Churchill. (1963). Fourier Series and Boundary Value Problems (Second Edition). McGraw-Hill Book Company.

UNIT-I	Chapter 4	Sections 38 to 42
UNIT-II	Chapter 7	Sections 55 to 61
UNIT-III	Chapter 7	Sections 63 to 66
	Chapter 8	Sections 78 to 80
UNIT-IV	Chapter 9	Sections 89 to 90
UNIT-V	Chapter10	Sections 92 to 96

Reference Books

1. Raisinghania, M.D(2014). Ordinary and Partial Differential Equations (1st Edition). S.Chand & Company Pvt.Ltd.
2. George F Simmons, (2003). Differential Equations with Applications and Historical Notes (2nd Edition). Tata McGraw-Hill Publishing Company.
3. Sankara Rao, K. (2019). Introduction to Partial Differential Equations (3rd Edition). Prentice-Hall of India.

Web References

1. **https://www.youtube.com/watch?v=m8aIO-GQkXE**
2. **https://www.youtube.com/watch?v=AgyeJEO2a-k**
3. **https://www.youtube.com/watch?v=O_HgMWx4a5w**
4. **https://www.youtube.com/watch?v=1tDkXMDbvDg&t=119s**
5. **https://www.youtube.com/watch?v=USOmOW-IN3I**

Pedagogy

Power point presentations, Group Discussions, Seminar, Quiz, Assignment.

Course Designer

1. Ms. P. Geethanjali.