M.Sc. MATHEMATICS

LOCF SYLLABUS 2023

Department of Mathematics
School of Computing Sciences
St. Joseph's College (Autonomous)
Tiruchirappalli - 620 002, Tamil Nadu, India

Vision

Forming globally competent, committed, compassionate and holistic persons, to be men and women for others, promoting a just society.

Mission

- Fostering learning environment to students of diverse background, developing their inherent skills and competencies through reflection, creation of knowledge and service.
- Nurturing comprehensive learning and best practices through innovative and value-driven pedagogy.
- Contributing significantly to Higher Education through Teaching, Learning, Research and Extension.

Programme Educational Objectives (PEOs)

- Graduates will be able to accomplish professional standards in the global environment.
- Graduates will be able to uphold integrity and human values.
- Graduates will be able to appreciate and promote pluralism and multiculturalism in working environment.

Programme Outcomes (POs)

1. Graduates will be able to apply assimilated knowledge to evolve tangible solution to emerging problems.
2. Graduates will be able to analyze and interpret data to create and design new knowledge.
3. Graduates will be able to engage in innovative and socially relevant research and effectively communicate the findings.
4. Graduates will become ethically committed professional and entrepreneurs upholding human values.
5. Graduates imbibed with ethical values and social concern will be able to understand and appreciate cultural diversity, social harmony and ensure sustainable environment.

Programme Specific Objectives (PSOs)

Graduate will be able to

1. Appreciate the emphasis given on teaching the fundamentals, the basic concepts, definitions with a variety of examples.
2. Realise the importance given to applications by applying the concepts studied for designing models to solve real life problems.
3. Develop the skill to solve problems which appear in the various examinations based on the concepts learned which in turn will hone the problem solving skills of students and help them to pass competitive examinations including CSIR-NET, SET, IAS, etc
4. Learn application oriented subjects which will impress upon them their responsibility to the society.
5. Get proper orientation that a research degree is not end of learning. They are encouraged to publish papers on a continual basis in the standard journals during and after Ph.D.

CONTINUOUS INTERNAL ASSESSMENT
Categorizing Outcome Assessment Levels Using Bloom's Taxonomy

Level	Cognitive Domain	Description
K1	Remember	It is the ability to remember the previously learned concepts or ideas.
K2	Understand	The learner explains concepts or ideas.
K3	Apply	The learner uses existing knowledge in new contexts.
K4	Analyse	The learner is expected to draw relations among ideas and to compare and contrast.
K5	Evaluate	The learner makes judgements based on sound analysis.
K6	Create	The learner creates something unique or original.

Question Paper Blueprint for Mid and End Semester Tests

<table>
<tr><td colspan="3">Duration: 2 Hours</td><td colspan="6">Maximum Marks: 60</td></tr>
<tr><td colspan="2" rowspan="2">Section</td><td colspan="6">K level*</td><td rowspan="2">Marks</td></tr>
<tr><td>K1</td><td>K2</td><td>K3</td><td>K4</td><td>K5</td><td>K6</td></tr>
<tr><td colspan="2">A (no choice)</td><td>7</td><td></td><td></td><td></td><td></td><td></td><td>7 × 1 = 7</td></tr>
<tr><td colspan="2">B (no choice)</td><td></td><td>5</td><td></td><td></td><td></td><td></td><td>5 × 3 = 15</td></tr>
<tr><td colspan="2">C (either… or type)</td><td></td><td></td><td>3</td><td></td><td></td><td></td><td>3 × 6 = 18</td></tr>
<tr><td rowspan="4">D (2 out of 3)</td><td>Courses with K4 as the highest cognitive level</td><td></td><td></td><td></td><td>2</td><td></td><td></td><td rowspan="4">2 × 10 = 20</td></tr>
<tr><td>Courses with K5 as the highest cognitive level wherein one question each on K4 and K5 is compulsory.
(Note:K4 has two questions whereas, K5 has no choice.)</td><td></td><td></td><td></td><td>1</td><td>1</td><td></td></tr>
<tr><td rowspan="2">Courses with K6 as the highest cognitive level wherein one question each on K5 and K6 is compulsory.
(Note: Mid Sem: K4 has two questions whereas, K5 has no choice; End sem: K5 has two questions whereas, K6 has no choice)</td><td></td><td></td><td></td><td colspan="2">Mid Sem</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td colspan="2">End Sem</td></tr>
<tr><td colspan="6">Total</td><td>60</td></tr>
</table>

** K4 and K5 levels will be assessed in the Mid semester test whereas K5 and K6 levels will be assessed in the End semester test.*

Question Paper Blueprint for Mid and End Semester Tests *(For quantitative courses only)*

Duration: 2 Hours							**Maximum Marks: 60**
Section	**K level**						**Marks**
	K1	**K2**	**K3**	**K4**	**K5**	**K6**	
A *(no choice)*	5	4					9 × 1 = 9
B *(either… or type)*			2	1			3 × 5 = 15
C *(2 out of 3)*					1	1*	2 × 18 = 36
						Total	**60**

NOTE: *K4 and K5 will be assessed in the Mid semester test whereas K5 and K6 will be assessed in the End semester test.*
** K6 compulsory*

SEMESTER EXAMINATION
Question Paper Blueprint for Semester Examination

Duration: 3 Hours								**Maximum Marks: 100**
Section		**K level**						**Marks**
		K1	**K2**	**K3**	**K4**	**K5**	**K6**	
A *(no choice, two questions from each unit)*		10						10 × 1 = 10
B *(no choice, two questions from each unit)*			10					10 × 3 = 30
C *(either… or type, one question from each unit)*				5				5 × 6 = 30
D *(3 out of 5, one question from each unit)*	*Courses with K4 as the highest cognitive level*				3			3 × 10 = 30
	Courses with K5 as the highest cognitive level wherein two K4 questions and one K5 question are compulsory. (Note: Three questions on K4 and two questions on K5)				2	1		
	Courses with K6 as the highest cognitive level wherein one question each on K4, K5, and K6 is compulsory. (Note: Two questions each on K4 and K5 and one question on K6)				1	1	1	
							Total	**100**

Question Paper Blueprint for Semester Examination *(For quantitative courses only)*

Section	Marks	K level
A	10 × 1 = 10	K1
B	5 × 6 = 30 *(either…or)*	K2 *(Q. No. 11 & 12)* K3 *(Q. No. 13, 14 & 15)*
C	4 × 15 = 60 *(4 out of 5)*	K4 *(Q. No. 16 & 17)* K5 *(Q. No. 18 & 19)* K6 *(Q. No. 20 compulsory)*
Total Marks: 100		

Evaluation Pattern for Part IV One/Two Credit Courses

Title of the Course	CIA	Semester Examination	Total Marks
Internship	100		**100**
UG Skill Enhancement Course (Non Major Elective) Foundation Course **PG** Ability Enhancement Course	20 + 10 + 20 = 50	50 *(External member from the Department)*	**100**
Value Education	50	50 *(CoE)*	**100**

M.Sc. MATHEMATICS							
PROGRAMME PATTERN							
Course Details					Scheme of Exams		
Sem	**Course Code**	**Title of the Course**	**Hours**	**Credits**	**CIA**	**SE**	**Final**
1	23PMA1CC01	**Core Course - 1**: Algebraic Structures	6	6	100	100	100
	23PMA1CC02	**Core Course - 2**: Real Analysis - 1	6	6	100	100	100
	23PMA1CC03	**Core Course - 3**: Ordinary Differential Equations	6	4	100	100	100
	23PMA1ES01	**Elective - 1:** Graph Theory and its Applications	5	3	100	100	100
	23PMA1ES02	**Elective - 2:** Fuzzy Sets and Their Applications	5	3	100	100	100
	23PMA1AE01	**Ability Enhancement Course:** Problem Solving in Advanced Mathematics	2	1	100	-	100
		Total	**30**	**23**			
2	23PMA2CC04	**Core Course - 4**: Advanced Algebra	6	6	100	100	100
	23PMA2CC05	**Core Course - 5**: Real Analysis - 2	5	4	100	100	100
	23PMA2CC06	**Core Course - 6**: Complex Analysis	6	5	100	100	100
	23PMA2SP01	**Self- paced Learning:** History of Mathematics*	-	2	50	50	50
	23PMA2ES03A	**Elective - 3:** Algebraic Number Theory	5	4	100	100	100
	23PMA2ES03B	**Elective - 3:** Optimization Techniques					
	23PSS2SE01	**Skill Enhancement Course:** Soft Skills	4	3	100	-	100
	23PMA2EG01A	**Generic Elective - 1 (WS):** Mathematical Foundations for Computer Applications	4	3	100	100	100
	23PMA2EG01B	**Generic Elective - 1 (WS):** Mathematical Foundations for Computer Science					
	-	Extra Credit Courses (MOOC/Certificate Courses) - 1	-	(3)			
		Total	**30**	**27(3)**			
3	23PMA3CC07	**Core Course - 7**: Measure and Integration	6	6	100	100	100
	23PMA3CC08	**Core Course - 8**: Topology	6	6	100	100	100
	23PMA3CC09	**Core Course - 9**: Classical Dynamics	5	5	100	100	100
	23PMA3CC10	**Core Course - 10**: Stochastic Processes	4	4	100	100	100
	23SCS3CC01	**Common Core:** Design and Analysis of Algorithms	5	4	100	100	100
	23PMA3EG02	**Generic Elective - 2 (BS):** Operations Research	4	3	100	100	100
	-	Extra Credit Courses (MOOC/Certificate Courses) - 2	-	(3)			
		Total	**30**	**28(3)**			
4	23PMA4CC11	**Core Course - 11**: Functional Analysis	6	6	100	100	100
	23PMA4CC12	**Core Course - 12**: Calculus of Variations and Integral Equations	6	6	100	100	100
	23PMA4CC13	**Core Course - 13**: Partial Differential Equations	5	5	100	100	100
	23PMA4ES04A	**Elective - 4:** Automata Theory	5	4	100	100	100
	23PMA4ES04B	**Elective - 4:** Differential Geometry					
	23PMA4PW01	Project Work and Viva Voce	8	5	100	100	100
	23PMA4CE01	Comprehensive Examination*	-	2	50	50	50
	-	Extra Credit Courses (MOOC/Certificate Courses) - 3	-	(3)			
		Total	**30**	**28(3)**			
2 - 4	23PCW4OR01	Outreach Programme (SHEPHERD)	-	4			
1 - 4		**Total (2years)**	**120**	**110**			

*- for grade calculation 50 marks are converted into 100 in the mark statements

Semester	Course code	Title of the Course	Hours/Week	Credits
1	23PMA1CC01	**Core Course - 1:** Algebraic Structures	6	5

Course Objectives
To gain a deep understanding of important concepts of class equations and Sylow's theorem in group theory and develop proficiency in their applications
To investigate the structure and behavior of algebraic systems and classify them based on certain properties, and apply the concepts to solve various mathematical problems in diverse area of studies
To understand the concepts of linear transformations and their properties, simplifying their representation, and analyzing their behaviors in various mathematical contexts
To simplify matrix representations while the rational canonical form aims to classify matrices, study minimal polynomials, and compute matrix powers efficiently
To provide insights into Eigen values and quadratic forms

UNIT I **(18 Hours)**

Counting Principle - Class equation for finite groups and its applications - Sylow's theorems (For theorem 2.12.1, First proof only).

UNIT II **(18 Hours)**

Solvable groups - Direct products - Finite abelian groups- Modules.

UNIT III **(18 Hours)**

Linear Transformations: Canonical forms –Triangular form - Nilpotent transformations.

UNIT IV **(18 Hours)**

Jordan form - rational canonical form.

UNIT V **(18 Hours)**

Trace and transpose - Hermitian, unitary, normal transformations, real quadratic form.

Teaching Methodology	Chalk and talk, Lectures, Demonstrations, PPT.

Books for Study

1. Herstein, I. N. (1975). *Topics in Algebra* (2nd ed.). Wiley Eastern Limited.

Unit I: Chapter 2: Sections 2.11 and 2.12 (Omit Lemma 2.12.5)

Unit II: Chapter 5: Section 5.7 (Lemma 5.7.1, Lemma 5.7.2, Theorem 5.7.1)
Chapter 2: Section 2.13 and 2.14 (Theorem 2.14.1 only)
Chapter 4: Section 4.5

Unit III: Chapter 6: Sections 6.4, 6.5

Unit IV: Chapter 6: Sections 6.6 and 6.7

Unit V: Chapter 6: Sections 6.8, 6.10 and 6.11 (Omit 6.9)

Books for Reference

1. Artin, M. (1991). *Algebra.* Prentice Hall.
2. Bhattacharya, P. B., Jain, S. K. & Nagpaul, S. R. (1997). *Basic abstract algebra* (2nd ed.). Cambridge University Press (Indian Edition).
3. Luther, I. S. & Passi, I. B. S. (1999). *Algebra, vol. I –Groups (1996); Vol. II Rings*. Narosa Publishing House.
4. Malik, D. S., Mordeson, J. N. & Sen, M. K. (1997). *Fundamental of abstract algebra* (International Edition). McGraw Hill.
5. Jacobson, N. & Freeman, W. H. (1980). *Basic algebra, Vol. I & II.* Hindustan Publishing Company.

Web Sources

1. http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,
2. http://www.opensource.org, www.algebra.com

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K - Level)**
CO1	recall basic counting principle, define class equations to solve problems, explain Sylow's theorems and apply the theorem to find number of Sylow subgroups.	**K1**
CO2	define Solvable groups, define direct products, examine the properties of finite abelian groups, define modules	**K2**
CO3	define similar Transformations, define invariant subspace, explore the properties of triangular matrix, to find the index of nilpotence to decompose a space into invariant subspaces, to find invariants of linear transformation, to explore the properties of nilpotent transformation relating nilpotence with invariants.	**K3**
CO4	define Jordan, canonical form, Jordan blocks, define rational canonical form, define companion matrix of polynomial, find the elementary devices of transformation, apply the concepts to find characteristic polynomial of linear transformation.	**K4**
CO5	define trace, define transpose of a matrix, explain the properties of trace and transpose, to find trace, to find transpose of matrix, to prove Jacobson lemma using the triangular form, define symmetric matrix, skew symmetric matrix, adjoint, to define Hermitian, unitary, normal transformations and to verify whether the transformation in Hermitian, unitary and normal	**K5**
CO6	interpret and evaluate ideas of theory of Eigen values and quadratic forms.	**K6**

Relationship Matrix											
Semester	**Course code**	**Title of the Course**								**Hours**	**Credits**
1	**23PMA1CC01**	**Core Course - 1:** Algebraic Structures								**6**	**5**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO 1**	**PSO 2**	**PSO3**	**PSO 4**	**PSO5**	
CO1	**3**	**3**	**3**	**2**	**1**	**3**	**2**	**3**	**2**	**3**	**2.5**
CO2	**2**	**3**	**3**	**2**	**2**	**2**	**3**	**2**	**1**	**3**	**2.3**
CO3	**3**	**2**	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2.3**
CO4	**3**	**3**	**2**	**2**	**2**	**3**	**3**	**3**	**2**	**3**	**2.6**
CO5	**2**	**3**	**3**	**2**	**1**	**3**	**3**	**2**	**2**	**3**	**2.4**
CO6	**2**	**3**	**3**	**2**	**1**	**3**	**3**	**2**	**2**	**3**	**2.4**
Mean overall Score											**2.42 (High)**

Semester	Course Code	Title of the Course	Hours/ Week	Credits
1	23PMA1CC02	**Core Course - 2:** Real Analysis -1	6	5

Course Objectives
To enable the students to learn the basic concepts of real analysis
To understand proof techniques in analysis and be well prepared for the advanced courses like functional analysis and advanced analysis
To work comfortably with functions of bounded variation, Riemann – Stieltjes Integration
To work with Convergence of infinite series and infinite product
To know uniform convergence and its interplay between various limiting operations

UNIT I **(18 Hours)**

Introduction – Properties of monotonic functions – Functions of bounded variation – Total variation – Additive property of total variation – Total variation on $[a, x]$ as a function of x – Functions of bounded variation expressed as the difference of two increasing functions – Continuous functions of bounded variation – Absolute and conditional convergence – Dirichlet's test and Abel's test – Rearrangement of series – Riemann's theorem on conditionally convergent series.

UNIT II **(18 Hours)**

Introduction – Notation – The definition of the Riemann – Stieltjes integral – Linear Properties – Integration by parts– Change of variable in a Riemann – Stieltjes integral – Reduction to a Riemann Integral – Euler's summation formula – Monotonically increasing integrators, Upper and lower integrals – Additive and linearity properties of upper, lower integrals – Riemann's condition – Comparison theorems.

UNIT III **(18 Hours)**

Integrators of bounded variation–Sufficient conditions for the existence of Riemann–Stieltjes integrals–Necessary conditions for the existence of RS integrals– Mean value theorems –integrals as a function of the interval – Second fundamental theorem of integral calculus–Change of variable –Second Mean Value Theorem for Riemann integral– Riemann–Stieltjes integrals depending on a parameter– Differentiation under integral sign–Lebesgue criteriaon for existence of Riemann integrals.

UNIT IV **(18 Hours)**

Double sequences – Double series – Rearrangement theorem for double series – A sufficient condition for equality of iterated series – Multiplication of series – Cesaro summability – Infinite products – Multiplication of power series – The Taylor's series generated by a function – Bernstein's theorem – Abel's limit theorem – Tauber's theorem

UNIT V **(18 Hours)**

Pointwise convergence of sequences of functions – Examples of sequences of real – valued functions – Uniform convergence and continuity – Cauchy condition for uniform convergence – Uniform convergence of infinite series of functions – Riemann – Stieltjes integration – Non–uniform Convergence and Term–by–term Integration – Uniform convergence and differentiation – Sufficient condition for uniform convergence of a series – Mean convergence.

Books for Study:

1. Apostol, T. M. (1974). *Mathematical analysis* (2nd ed.). Addison-Wesley Publishing Company Inc.

   Unit – I *Chapter 6(Sec 6.1 – 6.8) and Chapter 8 (8.8, 8.15, 8.17, 8.18)*

   Unit – II *Chapter 7 (Sec 7.1 – 7.14)*

   Unit – III *Chapter 7(Sec 7.15 – 7.26)*

   Unit – IV *Chapter 8(Sec 8.20 – 8.26) and Chapter 9 (9.14 9.15, 9.19, 9.20, 9.22, 9.23)*

   Unit – V *Chapter -9 (Sec 9.1 to 9.6, 9.8,9.9,9.10,9.11, 9.13)*

Books for Reference:

1. Bartle, R. G. (1976). *Real analysis*. John Wiley & Sons Inc.
2. Rudin, W. (1976). *Principles of mathematical analysis* (3rd ed.). McGraw Hill Company.
3. Malik, S. C. & Arora, S. (1991). *Mathematical analysis*. Wiley Eastern Limited.
4. Arora, S. & Lal, B. (1991). *Introduction to real analysis*. Satya Prakashan.
5. Gelbaum, B. R. & Olmsted, J. (1964). *Counter examples in analysis*. Holden day.
6. Gupta, A. L. & Gupta, N. R. (2003). *Principles of real analysis*. Pearson Education (Indian print).

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to :	**Cognitive Levels (K - Level)**
CO1	acquire knowledge of functions of bounded variation, Riemann-Stieltjes, and uniform convergence	**K1**
CO2	understand the concepts of Riemann- Stieltjes integral, uniform convergence and its properties.	**K2**
CO3	apply the properties of bounded variation, Riemann integral in convergence of sequence of functions.	**K3**
CO4	evaluate the properties of convergence of series and Riemann integrablity of functions	**K4**
CO5	analyze the functions of bounded variation, Riemann integral and double series.	**K5**
CO6	construct proofs and examples of Riemann- Stieltjes integration, convergence of sequence of functions and double series	**K6**

Relationship Matrix											
Semester	**Course code**	**Title of the Course**								**Hours**	**Credits**
1	**23PMA1CC02**	**Core Course - 2:** Real Analysis -1								**6**	**5**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO 2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**2**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**2**	**2.7**
CO2	**3**	**2**	**3**	**3**	**2**	**2**	**3**	**2**	**3**	**3**	**2.6**
CO3	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**2**	**3**	**3**	**2.8**
CO4	**3**	**2**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2.7**
CO5	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**2.9**
CO6	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**2**	**3**	**2.6**
Mean overall Score											**2.7 (High)**

Semester	Course code	Title of the Course	Hours	Credits
1	23PMA1CC 03	**Core Course - 3:** Ordinary Differential Equations	6	4

Course Objectives
Develop strong background on finding solutions to linear differential equations with constant and variable coefficients and also with singular points
Understanding the concepts of Linear dependence and independence, Wronskian, Singular points, Bessel function, Lipschitz condition, etc.,
Develop strong background on finding solutions to Legendre equation, Euler equation, Exact equation and its applications
Give a depth knowledge of solving initial value problems in ordinary differential equations
Skill to study the existence and uniqueness of solution in first and higher order differential equations

UNIT I: Linear Equations with Constant Coefficients (18 Hours)

Second order homogeneous equations-Initial value problems-Linear dependence and independence-Wronskian and a formula for Wronskian-Non-homogeneous equation of order two. **Chapter 2: Sections 1 to 6**

UNIT II: Linear Equations with Constant Coefficients (18 Hours)

Homogeneous and non-homogeneous equation of order n –Initial value problems-Annihilator method to solve non-homogeneous equation - Algebra of constant coefficient operators. **Chapter 2: Sections 7 to 12**

UNIT III: Linear Equation with Variable Coefficients (18 Hours)

Initial value problems -Existence and uniqueness theorems – Solutions to solve a non-homogeneous equation – Wronskian and linear dependence – reduction of the order of a homogeneous equation – homogeneous equation with analytic coefficients-The Legendre equation. **Chapter: 3 Sections 1 to 8 (Omit section 9)**

UNIT IV: Linear Equation with Regular Singular Points (18 Hours)

Euler equation – Second order equations with regular singular points –Exceptional cases – Bessel Function. **Chapter 4: Sections 1 to 4 and 6 to 8 (Omit sections 5 and 9)**

UNIT V (18 Hours)

Existence and uniqueness of solutions to first order equations: Equation with variable separated – Exact equation – method of successive approximations – the Lipschitz condition – convergence of the successive approximations and the existence theorem.

Chapter 5: Sections 1 to 6 (Omit Sections 7 to 9)

Teaching Methodology	Chalk and talk, Lectures, Demonstrations, PPT.

Books for Study

1. Coddington, E. A. (1987). *An introduction to ordinary differential equations* (3rd ed.). Prentice-Hall of India.

Books for Reference

2. Boyce, W. E. & Prima, R. C. D (1967). *Elementary differential equations and boundary value problems*. John Wiley & Sons, New York.
3. Simmons, G. F. (1974). *Differential equations with applications and historical notes.* Tata McGraw Hill, New Delhi.
4. Lebedev, N. N. (1965). *Special functions and their applications*. Prentice Hall of India, New Delhi.
5. Reid, W.T. (1971). *Ordinary differential equations*. John Wiley & Sons, New York.
6. Raisinghania, M. D. (2001). *Advanced differential equations*. S. Chand & Company Ltd, New Delhi.
7. Rai, B., Choudary, D. P. & Freedman, H. I. (2002). *A course in ordinary differential equations.* Narosa Publishing House, New Delhi.

Web Source

1. http://mathforum.org, http://ocw.mit.edu/ocwweb/Mathematics,
2. http://www.opensource.org, www.mathpages.com

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K - Level)**
CO1	establish the qualitative behaviour of solutions of systems of differential equations	**K1**
CO2	recognize the physical phenomena modelled by differential equations and dynamical systems.	**K2**
CO3	analyse solutions using appropriate methods and give examples	**K3**
CO4	formulate Wronskian for initial value problems	**K4**
CO5	understand and use various theoretical ideas and results that underlie the mathematics in this course.	**K5**
CO6	formulate and solve the different kinds of ordinary differential equations.	**K6**

Relationship Matrix											
Semester	**Course code**	**Title of the Course**								**Hours**	**Credits**
1	**23PMA1CC03**	**Core Course - 3:** Ordinary Differential Equations								**6**	**4**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**2.8**
CO2	**2**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**2.6**
CO3	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2.8**
CO4	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**2.8**
CO5	**2**	**2**	**3**	**2**	**3**	**2**	**3**	**3**	**2**	**3**	**2.5**
CO6	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2.8**
Mean overall Score											**2.7 (High)**

Semester	Course code	Title of the Course	Hours\Week	Credits
1	23PMA1ES01	**Elective - 1:** Graph Theory and its Applications	5	3

Course Objectives
To introduce the basic concepts of graphs and digraphs
To introduce the notion of connectivity in graphs and the concept of trees
To familiarize on the ideas of independent sets, coverings, matchings and factors
To acquaint on Eulerian, Hamiltonian and planar graphs and the concept of graph colorings, and the notion of duality in graphs
To develop the skill of formulating real life problems to graphical models and finding solutions

UNIT I **(15 Hours)**

Basic concepts – Subgraphs – Degrees of vertices – Paths and connectedness – Operations on graphs - Directed graphs: Basic concepts.

UNIT II **(15 Hours)**

Vertex cuts and Edge cuts – Connectivity and Edge – Connectivity – Trees: Definition, Characterization and Simple Properties – Applications: Prim's Algorithm.

UNIT III **(15 Hours)**

Vertex Independent sets and Vertex Coverings – Edge Independent sets – Matching's and Factors – Eulerian graphs – Hamiltonian graphs.

UNIT IV **(15 Hours)**

Vertex colorings - Applications of Graph Coloring – Critical graphs – Edge colorings of graphs.

UNIT V **(15 Hours)**

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.

Note: Theorems, propositions and results which are starred in the book are to be omitted.

Teaching Methodology	Chalk and Talk and PPT

Books for Study

1. Balakrishnan, R. & Ranganathan, K. (2000). *A Textbook of graph theory.* Springer (India) Private Limited.
   Unit I: *Chapter I: 1.1 - 1.4, 1.7, Chapter II: 2.1,*
   Unit II: *Chapter III: 3.1, 3.2, Chapter IV: 4.1, Chapter X: 10.3*
   Unit III: *Chapter V: 5.1 to 5.3, Chapter VI: 6.1, 6.2*
   Unit IV: *Chapter VII: 7.1, 7.2 and 7.4*
   Unit V: *Chapter VIII: 8.1 to 8.5*

Books for Reference

1. Bondy, J. A. & Murty, U. S. R. (1976). *Graph theory with applications.* Macmillan Press Ltd.
2. Harary, F. (1969). *Graph theory*. Addison – Wesley Publishing Company Inc.
3. Chartrand, G., Lesniak, L. & Zhang, P. (2010). *Graphs and digraphs.* CRC press.

Web Sources

1. https://onlinecourses.nptel.ac.in/noc20_ma05/preview
2. https://onlinecourses.swayam2.ac.in/cec20_ma03/preview

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K - Level)**
CO1	acquire in-depth knowledge on vital concepts in graph theory.	**K1**
CO2	understand the graphs, its types and on the theory of connectivity, colorings and planarity.	**K2**
CO3	apply the imbibed knowledge on the concepts to categorize graphs.	**K3**
CO4	analyze and infer properties of graphs and its associated concepts.	**K4**
CO5	evaluate various parameters of a graph.	**K5**
CO6	construct graphs with specific properties.	**K6**

Relationship Matrix											
Semester	**Course code**	**Title of the Course**								**Hours**	**Credits**
1	**23PMA1ES01**	**Elective - 1:** Graph Theory and its Applications								**5**	**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**2**	**3**	**3**	**2**	**3**	**3**	**2**	**2**	**2**	**3**	**2.5**
CO2	**3**	**2**	**2**	**3**	**2**	**2**	**3**	**2**	**2**	**3**	**2.4**
CO3	**2**	**3**	**2**	**2**	**2**	**3**	**3**	**3**	**2**	**2**	**2.4**
CO4	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**3**	**2**	**2.3**
CO5	**3**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**3**	**2.4**
CO6	**3**	**2**	**3**	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**2.4**
Mean overall Score											**2.4 (High)**

Semester	Course code	Title of the Course	Hours	Credits
1	23PMA1ES02	**Elective - 2:** Fuzzy Sets and Their Applications	5	3

Course Objectives
To enable the students to understand the concept of fuzzy logic, fuzzy sets, properties of α-cuts, extension principles
To enable the students to understand the generalized concepts of fuzzy complements, t-norm and t-conorm
To provide the idea of fuzzy numbers, fuzzy relations, fuzzy equivalence relations
To distinguish possibility theory and probability theory
To understand the decision-making process and apply them to real life problems

UNIT I: Basics of Fuzzy Sets: (15 Hours)

Fuzzy sets – introduction, Basic types and Basic concepts, Additional properties of α-cuts, Representation of fuzzy sets, Extension principles

UNIT II: Operations on Fuzzy Sets (15 Hours)

Type of operators on fuzzy sets and fuzzy complements, Fuzzy intersection and fuzzy unions, Combination of operations

UNIT III: Fuzzy Arithmetic and Fuzzy Relations (15 Hours)

Fuzzy numbers, arithmetic operations on intervals, Arithmetic operations on fuzzy numbers, Fuzzy equations, fuzzy relations: Binary fuzzy relations and binary relation on a single set, Fuzzy equivalence relations

UNIT IV: Possibility Theory (15 Hours)

Fuzzy measures - Evidence theory - Possibility theory - Fuzzy sets and Possibility theory - Possibility theory versus Probability theory

UNIT V: Fuzzy Decision making (15 Hours)

Introduction, Individual Decision Making, Multiperson decision Making, Multicriteria decision Making, Fuzzy ranking methods

Teaching Methodology	Chalk and Talk, PPT

Books for Study:

1. Klir, G. J. & Yuan, B. (1997). *Fuzzy sets and Fuzzy logic – Theory and applications*. Prentice Hall India.
   Unit I: *Chapter 1 and Chapter 2: Sections 1.3, 1.4, 2.1 to 2.3*

Unit II: *Chapter 3: Sections 3.1 to 3.5*
Unit III: *Chapter 4 and Chapter 5: Sections 4.1, 4.3, 4.4, 5.1 to 5.5*
Unit IV: *Chapter 7: Sections 7.1 to 7.5*
Unit V: *Chapter 15: Sections 15.1 to 15.6*

Books for Reference

1. Zimmermann, H. J. (1987). *Fuzzy sets, decision making and expert systems*. Kluwer.
2. Chen, S. J. & Hwang, C. L. (1992). *Fuzzy multiple attributes decision making*. Springer Verlag.

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K - Level)**
CO1	acquire the knowledge of various types of fuzzy sets, α-cuts and its properties and extension of functions.	**K1**
CO2	understand various operations (fuzzy complements, fuzzy intersections and fuzzy unions) on fuzzy sets and symbolic computations.	**K2**
CO3	apply the concepts of fuzzy decision-making methods in engineering and management problems.	**K3**
CO4	distinguish possibility theory and probability theory	**K4**
CO5	Explain various fuzzy related concepts	**K5**
CO6	Create the fuzzy relations and identify the different types of fuzzy relations and their applications numbers, divisors, modulo arithmetic, primitive roots and quadratic residues.	**K6**

Relationship Matrix

Semester	**Course code**	**Title of the Course**					**Hours**	**Credits**	
1	**23PMA1ES02**	**Elective - 2:** Fuzzy Sets and Their Applications					**5**	**3**	
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**2**	**2**	**1**	**2**	**2**	**3**	**2**	**2**	**3**	**3**	**2.2**
CO2	**2**	**1**	**2**	**1**	**2**	**2**	**3**	**3**	**3**	**2**	**2.1**
CO3	**1**	**2**	**2**	**3**	**1**	**2**	**3**	**3**	**3**	**2**	**2.2**
CO4	**3**	**2**	**1**	**2**	**3**	**2**	**3**	**3**	**2**	**1**	**2.2**
CO5	**2**	**3**	**2**	**3**	**1**	**3**	**3**	**2**	**3**	**3**	**2.5**
CO6	**1**	**2**	**2**	**3**	**1**	**2**	**3**	**3**	**3**	**2**	**2.2**
Mean overall Score											**2.2 (High)**

Semester	Course code	Title of the Course	Hours	Credits
1	23PMA1AE01	**Ability Enhancement Course:** Problem Solving in Advanced Mathematics	2	1

Course Objectives
To understand the concepts in Real Analysis, Algebra and Ordinary differential equations
To recall the fundamental ideas in various interpretations of the problems
To create many examples to justify the answers
To analyze and apply the results and techniques to get solutions
To train the students in problem-solving as a preparatory to NET/SET

UNIT I **(6 Hours)**

Sets – open – closed – compact – connected - Sequences and series.

UNIT II **(6 Hours)**

Continuity – uniform continuity – differentiability – mean value theorems – Riemann integral – Uniform convergence.

UNIT III **(6 Hours)**

Groups – subgroups – normal subgroups – cyclic groups – quotient groups – homomorphisms – permutation groups.

UNIT IV **(6 Hours)**

Cayley's theorem – class equations – Sylow theorems – Rings – ideals – quotient rings – prime and maximal ideals.

UNIT V **(6 Hours)**

Wronskian – Existence and uniqueness of solutions of initial value problems for first order ordinary differential equations.

Teaching Methodology	Chalk and talk, Lectures, Demonstrations, PPT.

Books for Study

1. Singh, A.P. (2017). *Info study's real analysis.* Info study Publications
   Unit I: *Chapter 1*: 1.1, 1.24 – 1.40, *Chapter 2*: 2.1 – 2.2
   Unit II: *Chapter 3*: 3.1 – 3.3, 3.5.3,
   Chapter 2: 2.3, *Chapter 5*: 5.1
2. Singh, A.P. (2017). *Info study's modern algebra.* Info study Publications
   Unit III: *Chapter 1*: 1.1 – 1.2, 1.5 – 1.7, 1.10

Chapter 2: 2.1 – 2.4

Unit IV: *Chapter 2*: 2.5 – 2.7, 3.5.3,
Chapter 3: 3.1 – 3.8, 3.10, 3.11, 3.15.6, 3.15.7

3. Singh, A.P. (2017). *Info study's differential equation*. Info study Publications

Unit V: *Chapter 2*: 2.10, *Chapter 3*: 3.1

Books for Reference

1. Rudin, W. (1976). *Principles of mathematical analysis* (3rd ed.). McGraw-Hill International Book Company.
2. Gallian, J. A. (2012). *Contemporary abstract algebra* (7th ed.). Katherine Tegan Books.
3. Coddington, E. A. (1992). *An introduction to ordinary differential equations*. Prentice-Hall of India.

Course Outcomes		
CO No.	**CO-Statements**	**Cognitive Levels (K - Level)**
	On successful completion of this course, students will be able to	
CO1	analyze the efficiency of a specific technique when solving a problem.	**K4**
CO2	evaluate various interpretations of the problems	**K5**
CO3	develop new problem-solving methodology to tackle problems in Advanced Mathematics	**K6**

Relationship Matrix											
Semester	**Course code**	**Title of the Course**								**Hours**	**Credits**
1	**23PMA1AE01**	**Ability Enhancement Course:** Problem Solving in Advanced Mathematics								**2**	**1**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**2**	**2**	**2**	**2**	**1**	**3**	**3**	**3**	**2**	**3**	**2.3**
CO2	**1**	**3**	**2**	**1**	**1**	**2**	**3**	**3**	**1**	**2**	**1.9**
CO3	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**3**	**2**	**2**	**2.3**
										Mean overall Score	**2.2 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	23PMA2CC04	**Core Course - 4:** Advanced Algebra	6	6

Course Objectives
To gain deep understanding of important concepts of extension fields and roots of Polynomials, field theory and develop proficiency in their applications.
To investigate the structure and behavior of algebraic systems and classify them based on certain properties, and apply the concepts to solve various mathematical problems in diverse areas of studies.
To understand the concepts of Hermitian, unitary and normal linear transformations and their properties, simplifying their representation, and analyzing their behaviors in various mathematical contexts.
Tosimplifyrealquadraticformsandtoclassifyvariouslineartransformationsefficiently.
To provide insights into finite fields and finite division rings.

UNIT I **(18 Hours)**

Extension fields - The Transcendence of e.

UNIT II **(18 Hours)**

Roots of Polynomials - More about roots

UNIT III **(18 Hours)**

Elements of Galois theory.

UNIT IV **(18 Hours)**

Finite fields - Wedderburn's theorem on finite division rings.

UNIT V **(18 Hours)**

Solvability by radicals - A theorem of Frobenius - Integral Quaternions and the Four - Square theorem.

Teaching Methodology	Chalk and talk, Lectures, Demonstrations, PPT.

Books for Study

1. Herstein, I. N. (1975), *Topics in Algebra* (2nd Ed.) Wiley Eastern Limited.
   Unit I Chapter 5: Section 5.1and5.2
   Unit II Chapter5: Sections 5.3 and 5.5
   Unit III Chapter 5: Section 5.6
   Unit IV Chapter7: Sections7.1 and 7.2(Theorem 7.2.1 only)
   Unit V Chapter5: Section5.7 (omit Lemma5.7.1, Lemma5.7.2andTheorem 5.7.1), Chapter 7: Sections 7.3 and7.4

Books for Reference

1. Artin, M. (1991). *Algebra.* Prentice Hall of India.
2. Bhattacharya, P. B., Jain, S. K., & Nagpaul, S.R. (1997). *Basic Abstract Algebra* (2nd Ed.). Cambridge University Press.
3. Luther, I. S. & Passi, I. B. S. (1996). *Algebra, Vol. I -Groups; Vol. II Rings*, Narosa Publishing House.
4. Malik, D. S., Mordeson, J. N., & Sen, M. K. (1997). *Fundamental of Abstract Algebra*, McGraw-Hill.
5. Jacobson, N. (1980). *Basic Algebra, Vol. I & II W.H. Freeman.* Hindustan Publishing Company.

Website and eLearning Sources

1. http://mathforum.org
2. http://ocw.mit.edu/ocwweb/Mathematics,
3. http://www.opensource.org
4. www.algebra.com

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K- Level)**
CO1	recall basic concepts on Vector spaces, define finite extension, define the number, define Hermitian, unitary and normal transformations, define Galois groups and finite fields	**K1**
CO2	classify the roots of a polynomial, summarize remainder theorem, understand the characteristics of a field, summarize Wedderburn's theorem and Frobenius theorem.	**K2**
CO3	relate solve ability for Galois groups, prove e is transcendental, relate unitary linear transformation to orthonormal basis	**K3**
CO4	illustrate Hermitian, unitary and normal linear transformations with examples.	**K4**
CO5	demonstrate knowledge and understanding of fundamental concepts including extension fields, Algebraic extensions, Finite fields, Class equations and Sylow's theorem.	**K5**
CO6	develop new results based on Wedderburn's theorem, Frobenius theorem and the Four-square theorem.	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
2	**23PMA2CC04**			**Core Course - 4:** Advanced Algebra					**6**		**6**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	2	1	3	2	3	2	3	**2.5**
CO2	2	3	3	2	2	2	3	2	1	3	**2.3**
CO3	3	2	3	2	2	3	2	2	2	2	**2.3**
CO4	3	3	2	2	2	3	3	3	2	3	**2.6**
CO5	2	3	3	2	1	3	3	2	2	3	**2.4**
CO6	2	3	3	2	1	3	3	2	2	3	**2.4**
										Mean Overall Score	**2.42 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	23PMA2CC05	**Core Course - 5:** Real Analysis - 2	5	4

Course Objectives
To give the students a thorough knowledge of the various aspects of real line and metric spaces.
To train the students for advanced learning in pure mathematics
To give the students the knowledge of analyzing and approaching life
To train the students to apply pure mathematics to applied problems
To train the students in problem-solving as a preparatory to NET/SET

UNIT I **(15 Hours)**

Finite, Countable and Uncountable Sets - Metric Spaces - Compact Sets - Perfect Sets - Connected Sets.

UNIT II **(15 Hours)**

The Root and Ratio Tests- Power Series-Summation by Parts - Absolute Convergence - Continuous functions - Continuity and Compactness - Continuity and Connectedness-Mean Value Theorems-L 'Hospital's Rule-Taylor's Theorem

UNIT III **(15 Hours)**

Power Series - The Exponential and Logarithmic Functions -The Trigonometric Functions-The Algebraic Completeness of the Complex Field.

UNIT IV **(15 Hours)**

Fourier Series - Parseval's Theorem-The Gamma Function.

UNIT V **(15 Hours)**

Linear Transformations - Differentiation - The Contraction Principle - The Inverse Function Theorem.

Teaching Methodology	Chalk and Talk, PPT

Book for study

1. Rudin, W. (1976). *Principles of Mathematical Analysis,* (3rd Ed.). McGraw-Hill.

Unit I	*Chapter 2*
Unit II	*Chapter 3 (Sec: 3.33-3.46),* *Chapter 4 (Sec: 4.5-4.24)* *Chapter 5 (Sec: 5.7-5.11, 5.13, and 5.15)*
Unit III	*Chapter 8 (Sec:8.1-8.8)*
Unit IV	*Chapter 8 (Sec: 8.9-8.22)*
Unit V	*Chapter 9 (Sec:9.1-9.25)*

Books for Reference

1. Apostol, T.M. (1974). *Mathematical Analysis.* Addison, Wesley Publishing Company.
2. Goldberg, R. R. (1970). *Methods of Real Analysis.* Oxford & IBH Publishing Company.

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K - Level)**
CO1	gain knowledge of concepts of modern analysis such as convergence, continuity, completeness and compactness in the Euclidean space and more general metric spaces.	**K1**
CO2	understand the properties of some special functions and the limits and how they used in convergence properties of sequence and series, continuity and derivative of real functions.	**K2**
CO3	identify the applications of integration, linear transformation And power series.	**K3**
CO4	analyze the abstract ideas and various methods in mathematical analysis and apply them to practical problems.	**K4**
CO5	construct mathematical proofs for basic results as associated with the Continuity and differentiability of real valued functions.	**K5**
CO6	evaluate problems on the concepts learned.	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
2	**23PMA2CC05**			**Core Course - 5:** Real Analysis - 2						**5**	**4**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2	1	1	1	2	2	2	1	1	**1.5**
CO2	3	2	2	1	1	3	2	2	1	1	**1.8**
CO3	1	1	3	3	1	2	2	3	3	1	**2**
CO4	2	3	2	2	1	2	2	2	2	1	**1.9**
CO5	2	2	2	1	1	2	1	3	2	2	**1.8**
CO6	2	2	1	2	2	2	3	3	2	2	**2.1**
Mean Overall Score											**1.85 (Medium)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	23PMA2CC06	**Core Course - 6:** Complex Analysis	6	5

Course Objectives
To develop Knowledge and understand the fundamental concepts of Analytic Functions
To enhance problem-solving skills with line integrals
To enable the use of singularities
To enrich a proper understanding of definite integrals
To develop Knowledge about power series expansion

UNIT I **(18 Hours)**

Concept of Analytic Function, Limits and Continuity - Analytic Functions - Polynomials-Rational Functions- Power series - Abel's Limit Theorem.

UNIT II **(18 Hours)**

Complex Integration - Fundamental Theorems - Line Integrals - Rectifiable arcs - Line integrals as Functions of Arcs - Cauchy's Theorem for a Rectangle - Cauchy's Theorem in a Disk.

UNIT III **(18 Hours)**

Cauchy's Integral Formula - The index of appoint with respect to a closed curve - The integral formula- Higher Derivatives - Removable Singularities Taylor's Theorem.

UNIT IV **(18 Hours)**

The Maximum principle - The Calculus of Residues - The Residue theorem - The Argument principle- Evaluation of Definite Integrals.

UNIT V **(18 Hours)**

Harmonic functions, Power Series expansion - Poisson's Formula - Schwarz's Theorem - Weier strass's Theorem - The Taylor series -The Laurent series

Teaching Methodology	Chalk and Talk, PPT

Book for Study

1. Ahlfors, L.V. (2013). *Complex Analysis: An Introduction to the Theory of Analytic Functions of One Complex Variable,* (3rd Ed.). Mac Millan Publishers.
   UNIT-I *Chapter 2 (sec:1.1-1.4,2.4 & 2.5 Pages 21-33, 38-42)*
   UNIT-II *Chapter 4 (sec1.1-1.5 Pages 101-114)*
   UNIT-III *Chapter 4 (sec2.1-2.3, 3.1 Pages 114-126)*
   UNIT-IV *Chapter 4 (sec3.4,5.1-5.3 Pages 133-137,148-161)*
   UNIT-V *Chapter 4 (sec 6.3 & 6.4) Chapter 5 (sec 1.1-1.3 Pages 166-172, 175-186)*

Books for Reference

1. Conway, J.B. (1978). *Function of one Complex Variable.* (2nd Ed.). Springer Graduate Texts in Mathematics.
2. Ponnusamy, S. (2005). *Foundations of Complex Analysis*, (2nd Ed.). Narosa Publishing House.

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K - Level)**
CO1	acquire knowledge on fundamental concepts of Analyticity, Complex integration and Harmonic Functions.	**K1**
CO2	understand the behavior of Analytic Functions, Taylor's and Laurent's Series expansions.	**K2**
CO3	apply C-R equations, Residue Theorem in solving problems involving complex function theory.	**K3**
CO4	demonstrate a good understanding of Mathematical reasoning through Cauchy's Theorem.	**K4**
CO5	evaluate integrals, region of convergence and contour integrals.	**K5**
CO6	analyze sequence and series of analytic functions, types of convergence, apply the concept and consequences of harmonic function, represent functions as Taylor and Laurent series	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**		**Credits**
2	**23PMA2CC06**			**Core Course - 6:** Complex Analysis					**6**		**5**
Course Outcomes	**Programme Outcomes (PO)**					**Programme Specific Outcomes (PSOs)**					**Mean Scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	1	2	2	3	2	3	2	3	**2.3**
CO2	3	2	2	2	2	3	2	2	2	2	**2.2**
CO3	3	2	2	2	2	2	2	3	2	3	**2.3**
CO4	2	2	2	2	2	2	2	2	2	3	**2.1**
CO5	2	2	2	2	2	2	2	3	2	3	**2.2**
CO6	2	2	2	2	2	2	2	3	2	2	**2.2**
										Mean Overall Score	**2.2 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	23PMA2SP01	**Self-paced Learning:** History of Mathematics	-	2

Course Outcomes
Knowledge on the History of Decimals and Limits
Acquaintance with the development of Algebra
Familiarity of Invention of Differential Calculus
The lives of Eratosthenes and Dirichlet
The lives of Henri Poincare and Emmy Noether

UNIT I

The Ancient Greeks - Pythagoras- Introduction to Pythagorean Ideas-Euclid - Introduction to Euclid - Archimedes - The Genius of Archimedes-Zeno's Paradox and the Concept of Limit- The Context of the Paradox? - Consideration of the Paradoxes - Decimal Notation and Limits -Infinite Sums and Limits-Finite Geometric Series.

UNIT II

The Arabs and the Development of Algebra - The Development of Algebra Al-Khwarizmi and the Basics of Algebra- The Life of Al- Khwarizmi- Omar Khay yam and the Resolution of the Cubic- Cardano, Abel, Galois, and the Solving of Equations - A Particular Equation - The General Case - The Brief and Tragic Lives of Abel and Galois - The Work of Abel and Galois in Context- Rene Descartes and the Idea of Coordinates- Introductory Remarks-The Life of Rene Descartes - The Real Number Line- The Cartesian Plane - Coordinates in Three- Dimensional Space.

UNIT III

The Invention of Differential Calculus - The Life of Fermat - Fermat's Method-Fermat's Lemma and Maximum/Minimum Problems - Complex Numbers and Polynomials-Progenitors of the Complex Number System - Cardano - Argand - Cauchy - Riemann - Complex Number Basics - The Fundamental Theorem of Algebra - Finding the Roots of a Polynomial- Cauchy and the Foundations of Analysis - Why Do We Need the Real Numbers?

UNIT IV

The Prime Numbers - The Sieve of Eratosthenes- The Infinitude of the Primes -Dirichletand How to Count - The Life of Dirichlet - The Pigeonhole Principle - Riemann and the Geometry of Surfaces- Introduction- Georg Cantor and the Orders of Infinity-Introductory Remarks- An Uncountable Set-Countable and Uncountable-The Existence of Transcendental Numbers.

UNIT V

Henri Poincare, Child Prodigy - Introductory Remarks - Emmy Noether and Algebra - The Life of Emmy Noether- Emmy Noether and Abstract Algebra: Groups-Emmy Noether and Abstract Algebra: Rings -The Idea of an Ideal-Cryptography- What is Cryptography?

Teaching Methodology	JOSTEL

Books for Study

1. Krantz, S.G. (2010). *An Episodic History of Mathematics.* The Mathematical Association of America.

   Unit I Sec: 1.1,1.1.1, 1.2, 1.2.1, 1.3,1.3.1, 2.1, 2.3, 2.4-2.6.
   Unit II Sec: 4.2,4.2.1, 4.2.2, 4.2.4, 5.6,5.7, 5.7.1, 5.7.2, 5.8.1, 5.9, 6.0-6.3, 6.5.
   Unit III Sec: 7.1,7.2, 7.4, 8.2, 8.2.1-8.2.5,8.3, 8.4, 8.5, 10.1,10.2.
   Unit IV Sec: 11.1,11.2, 12.1, 12.2,13.0,14.1, 14.2.1, 14.2.2,14.3.
   Unit V Sec: 16.1,18.1, 18.2,18.3, 18.3.1, 20.3.

Books for Reference

1. Boyer, C.B., Merzbach, U. (2011). *History of Mathematics,* (3rd Ed.). John Wiley & Sons.

2. Bell, E. T. (1986). *Men of Mathematics*. Simon & Schuster.

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K - Level)**
CO1	acquire knowledge on the history of mathematics	**K1**
CO2	understand the inter relations among the various branches of mathematics.	**K2**
CO3	predict the dynamic nature of mathematics including recent development in pure and applied mathematics.	**K3**
CO4	identify various proof techniques used in theorems.	**K4**
CO5	assess creative and flexible thinking by studying historical evidences that there are different ways to view a mathematical concept.	**K5**
CO6	construct abstract characterization of ideas from known examples.	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
2	**23PMA2SP01**			**Self-paced Learning:** History of Mathematics						**-**	**2**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	1	2	3	1	2	2	3	3	2	3	**2.2**
CO2	1	2	3	1	2	2	3	3	2	3	**2.2**
CO3	2	3	3	1	1	3	1	3	2	3	**2.2**
CO4	2	3	2	1	2	2	3	3	1	3	**2.2**
CO5	2	2	2	1	2	2	3	3	3	3	**2.3**
CO6	2	2	3	1	2	2	3	2	1	3	**2.1**
Mean Overall Score											**2.2 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	23PMA2ES03A	**Elective - 3:** Algebraic Number Theory	5	4

Course Objectives
To understand the basic concepts such as divisibility, primes, congruences and solutions in congruences
To know some techniques of abstract algebra to study integers
To highlight the knowledge on Quadratic residues
To highlight some of the Applications of the Theory of Numbers.
To get the more knowledge on Diophantine Equations

UNIT I **(15 Hours)**

Introduction - Divisibility - Primes - The Binomial Theorem - Congruences Euler's totient - Fermat's, Euler's and Wilson's Theorems - Solutions of Congruences - The Chinese Remainder theorem.

UNIT II **(15 Hours)**

Prime power Moduli - Primitive roots and Power Residues - Number theory from an Algebraic Viewpoint- Groups, rings and fields.

UNIT III **(15 Hours)**

Quadratic Residues - Quadratic Reciprocity - The Jacobi Symbol - Binary Quadratic Forms- Equivalence and Reduction of Binary Quadratic Forms-sum of two squares.

UNIT IV **(15 Hours)**

Greatest integer Function - Arithmetic Functions - The Mobius Inversion Formula Recurrence Functions-Combinatorial number theory

UNIT V **(15 Hours)**

Diophantine Equations - The equation $ax + by = c$ - Simultaneous Linear Diophantine Equations- Pythagorean Triangles- Assorted examples

Teaching Methodology	Chalk and Talk, PPT, Video Lecture

Book for Study

1. Niven, I., Zuckerman, H.S., & Montgomery, H.L. (2004). *An Introduction to the Theory of Numbers*, (5th Ed.). John Wiley & Sons Inc.
   - **Unit- I** *Chapter 1 and Chapter 2: Sections 2.1 to 2.3*
   - **Unit- II** *Chapter 2: Sections 2.6 to 2.11*
   - **Unit- III** *Chapter 3: Sections 3.1 to 3.6*
   - **Unit- IV** *Chapter 4*
   - **Unit- V** *Chapter 5: Sections 5.1 to5.4*

Books for Reference

1. Jones, G.A., & Jones, M. J. (2005). *Elementary Number Theory.* Springer Verlag,
2. Burton, D.M. (2007). *Elementary Number Theory,* (6th Ed.). McGraw-Hill.
3. Andrews, G. (1971). *Theory of Numbers.* Saunders.
4. William, J. (1977). *Fundamentals of Number Theory,* Leveque, Addison-Wesley.

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K - Level)**
CO1	have knowledge of divisibility, prime numbers, congruences, quadratic reciprocity and Diophantine equations.	**K1**
CO2	understand the concept of number theory toper form numerical and symbolic computations.	**K2**
CO3	solve problems and give short proofs associated with prime numbers, divisors, modulo arithmetic, primitive Roots and quadratic residues.	**K3**
CO4	analyze the theory of congruences, Power Residues, The Jacobi Symbol, The Mobius Inversion Formula and linear Diophantine equations.	**K4**
CO5	evaluate and produce rigorous arguments centered on the material of number theory, most notably in the use of mathematical Induction and/or the Well Ordering Principal in the proof of theorems.	**K5**
CO6	construct and produce rigorous arguments centered on the material of number theory in the proof of theorems.	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**					**Hours**	**Credits**	
2	**23PMA2ES03A**			**Elective - 3:** Algebraic Number Theory					**5**	**4**	
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2	1	2	2	3	2	2	3	3	**2.2**
CO2	2	1	2	1	2	2	3	3	3	2	**2.1**
CO3	1	2	2	3	1	2	3	3	3	2	**2.2**
CO4	3	2	1	2	3	2	3	3	2	1	**2.2**
CO5	2	3	2	3	1	3	3	2	3	3	**2.5**
CO6	3	2	1	2	3	2	3	3	2	1	**2.2**
Mean Overall Score											**2.23 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	23PMA2ES03B	**Elective - 3:** Optimization Techniques	5	4

Course Objectives
To explain the concepts and to simultaneously develop an understanding of problem Solving methods
To study the basic components of an optimization problem.
Formulation of design problems as mathematical programming problems
To highlight some of the Applications of the optimization techniques
To impart Optimization Techniques

UNIT I **(15 Hours)**

Optimization of functional - Gateaux and Fréchet Differentials - Fréchet derivatives - Extrema-Euler - Lagrange Equations- Problems with variable end points.

UNIT II **(15 Hours)**

Convex and concave functionals - Conjugate convex, concave functional - Dual optimization problems- Min - Max theorem of game theory.

UNIT III **(15 Hours)**

Lagrange multiplier theorem- Inverse function theorem- Equality and Inequality constraints - Kuhn- Tucker theorem.

UNIT IV **(15 Hours)**

Methods of solving equations - Successive approximation - Newton's method - Descent methods- Steepest descent.

UNIT V **(15 Hours)**

Conjugate gradient method - Methods for solving constrained problems - Projection method -The Primal - Dual method - Penalty Functions.

Teaching Methodology	Chalk and Talk, PPT, Video Lecture

Book for Study

1. Luenberger, D.G. (1997). *Optimization by Vector Space Methods.* Wiley Professional Paperback series.

   Unit- I *(Sec7.1-7.6 Pages 169-184)*
   Unit- II *(Sec7.8, 7.10-7.13 Pages 190, 191,195-208)*
   Unit-III *(Sec9.1-9.4 Pages 239-253)*
   Unit-IV *(Sec10.1-10.5 Pages 271-289)*
   Unit- V *(Sec10.8-10.11 Pages 294-307)*

Books for Reference

1. Dorney, C.N. (1986). *A Vector Space Approach to Models and Optimization.* Robert Krieger Publishing Co.
2. Mohan, C. & Deep, K. (2010). *Optimization Techniques.* New Age International.
3. Hamley, A. & Taha. (2011). *Operations Research: An introduction,* (19th Ed.). Prentice Hall.

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K - Level)**
CO1	relate the concepts of theory of optimization while solving problems.	**K1**
CO2	understand the theory behind optimization techniques.	**K2**
CO3	apply suitable theory in the optimal problem.	**K3**
CO4	compare the uses of different theories and methods available.	**K4**
CO5	evaluate the optimal solution for the given function.	**K5**
CO6	create some new techniques for optimization	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
2	**23PMA2ES03B**			**Elective - 3:** Optimization Techniques						**5**	**4**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Scores of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	2	2	1	2	3	2	2	2	2	**2.1**
CO2	2	3	1	2	2	3	2	3	2	2	**2.2**
CO3	3	3	2	2	2	3	2	3	1	2	**2.3**
CO4	2	2	3	3	2	2	1	2	2	2	**2.1**
CO5	3	2	2	2	1	3	2	3	2	3	**2.3**
CO6	3	3	2	2	2	3	2	3	1	2	**2.3**
Mean Overall Score											**2.2 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	23PSS2SE01	**Skill Enhancement Course:** Soft Skills	4	3

Course Objectives
To provide a focused training on soft skills for students in colleges for better job prospects
To communicate effectively and professionally
To help the students take active part in group dynamics
To familiarize students with numeracy skills for quick problem solving
To make the students appraise themselves and assess others

Unit I: Effective Communication & Professional Communication (12 Hours)

Definition of communication, Barriers of Communication, Non-verbal Communication; Effective Communication - Conversation Techniques, Good manners and Etiquettes; Speech Preparations & Presentations; Professional Communication.

Unit II: Resume Writing & Interview Skills (12 Hours)

Resume Writing: What is a résumé? Types of résumés, - Chronological, Functional and Mixed Resume, Purpose and Structure of a Resume, Model Resume.

Interview Skills: Types of Interviews, Preparation for an interview, Attire, Body Language, Common interview questions, Mock interviews & Practicum

Unit III: Group Discussion & Personal effectiveness (12 Hours)

Basics of Group Discussion, Parameters of GD, Topics for Practice, Mock GD & Practicum & Team Building.

Personal Effectiveness: Self Discovery; Goal Setting with questionnaires & Exercises

Unit IV: Numerical Ability (12 Hours)

Introducing concepts Average, Percentage; Profit and Loss, Simple Interest, Compound Interest; Time and Work, Pipes and Cisterns.

Unit V: Test of Reasoning (12 Hours)

Introducing Verbal Reasoning: Series Completion, Analogy; Data Sufficiency, Assertion and Reasoning; and Logical Deduction. Non-Verbal Reasoning: Series; and Classification

Teaching Methodology	Chalk and talk, Lectures, Demonstrations, PPT.

Book for study

1. Melchias G., Balaiah, J. & Joy, J. L. (Eds). (2018). *Winner in the Making: A Primer on soft Skills.* Trichy, India: St. Joseph's College.

Books for References

1. Aggarwal, R. S. (2010). *A Modern Approach to Verbal and Non-Verbal Reasoning.* S. Chand.
2. Covey, S. (2004). *7 Habits of Highly effective people.* Free Press.
3. Gerard, E. (1994). *The Skilled Helper* (5th Ed.). Brooks/Cole.
4. Khera, S. (2003). *You Can Win.* Macmillan Books.
5. Murphy, R. (1998). *Essential English Grammar*, (2nd Ed.). Cambridge University Press.
6. Sankaran, K., & Kumar, M. (2010). *Group Discussion and Public Speaking* (5th Ed.). M.I. Publications.
7. Trishna, K. S. (2012). *How to do well in GDs & Interview*s? (3rd Ed.). Pearson Education.
8. Yate, M. (2005). *Hiring the Best: A Manager's Guide to Effective Interviewing and Recruiting*

Course Outcomes		
CO No.	CO-Statements On successful completion of this course, students will be able to	Cognitive Levels (K - Level)
CO1	recall various soft skill sets	K1
CO2	understand personal effectiveness in any managerial positions	K2
CO3	apply verbal and non-verbal reasoning skills to solve problems	K3
CO4	differentiate problems at work and home; and design solutions to maintain work-life balance	K4
CO5	assess growth and sustainability and infuse creativity in employment that increases professional productivity	K5
CO6	construct plans and strategies to work for better human society	K6

Relationship Matrix											
Semester	Course Code			Title of the Course				Hours			Credits
2	23PSS2SE01			Skill Enhancement Course: Soft Skills				4			3
Course Outcomes	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	3	3	2	3	2	3	2	3	2.7
CO2	3	3	3	2	3	3	3	3	3	3	2.9
CO3	3	2	2	3	3	3	3	3	3	3	2.8
CO4	3	3	2	2	3	3	3	3	3	3	2.8
CO5	3	3	3	2	2	3	3	3	3	3	2.8
CO6	3	3	3	2	2	3	3	3	3	3	2.8
Mean Overall Score											2.8 (High)

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	23PMA2EG01A	**General Elective - 1: (WS)** Mathematical Foundations for Computer Applications	4	3

Course Objectives
To understand fundamental concepts of mathematical logic and numerical analysis
To study the basic properties functions and relations
To develop analytical skills through the study group theory
To understand different techniques in numerical computation.
To apply numerical techniques and solve problems in roots of equation and integration

UNIT I **(12 Hours)**

Relations - Equivalence Relation - Functions and Operators - One-to-one, Onto Functions - Special Types of Functions - Invertible Functions - Composition of Function.

UNIT II **(12 Hours)**

Binary Operations - Special type of binary operations, Groups - Integral powers of an elements of a group - abelian groups.

UNIT III **(12 Hours)**

Lattices - Some Properties of Lattices - New Lattices - Lattice Homomorphisms - Product Lattices of Two Lattices - Modular and Distributive Lattices-Boolean Algebra.

UNIT IV **(12 Hours)**

Iterative Methods: Birge - Vieta - Graeffe's Root squaring methods - System of linear algebraic equations: Gauss Elimination, Jacobi iteration method - Gauss-Seidel iteration method

UNIT V **(12 Hours)**

Interpolation: Lagrange interpolation - Newton's Forward Difference Interpolation - Newton's Backward Difference Interpolation - Trapezoidal Rule -Simpson Rule - Romberg integration.

Teaching Methodology	Chalk and talk, Lectures, Problem Solving, PPT.

Books for Study

1. Venkataraman, M.K., Sridharan, N., & Chandrasekaran, N. (2006) *Discrete Mathematics*, The National Publishing Company.
   Unit-I *Chapter II (Sec 2, 5), Chapter III (Sec 1, 2, 3, 4, 5).*
   Unit-II *Chapter VII (Sec 1,7)*
   Unit-III *Chapter X (Sec 1,2,3,4,5) (Only Definitions and examples in Sec 4 & Sec 5)*
2. Jain, M.K., Iyengar, S.R.K., & Jain R.K. (2003.) *Numerical Methods for Scientific and Engineering Computation*, (4th Ed.). New Age International (P) Limited.
   Unit-IV *Chapter 2 (Sec2.9,), Chapter 3 (Sec 3.2, 3.4).*
   Unit-V *Chapter4 (Sec4.2, 4.4), Chapter 5 (Sec 5.9, 5.10)*

Books for Reference

1. Tremblay, J.P., & Manohar, R. (1987). *Discrete Mathematical Structures with Applications to Computer Sciences*. McGraw-Hill.
2. Sastry, S.S. (2009). *Introductory Methods of Numerical Analysis,* (4th Ed.). PHI Learning Private Limited,
3. Kandasamy, P., Thilagavathy, K., & Gunavathi, K. (2008). *Numerical Methods.* S. Chand & Company Ltd

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K - Level)**
CO1	acquire knowledge of relations, functions, lattices and numerical methods	**K1**
CO2	understand the types of functions, groups and numerical techniques	**K2**
CO3	apply composition of functions, the concept of group theory and numerical formulae	**K3**
CO4	analyze various types of function, concept of Boolean algebra numerical methods to find solutions of linear equations and system of equations using different methods	**K4**
CO5	justify relations and functions, properties of groups and homomorphism of lattices.	**K5**
CO6	relate solutions of system of linear equations and numerical integration	**K6**

Relationship Matrix											
Semester	**Course Code**	**Title of the Course**								**Hours**	**Credits**
2	**23PMA2EG01A**	**General Elective - 1:** Mathematical Foundations for Computer Applications								**4**	**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	2	1	3	2	3	2	3	**2.5**
CO2	2	3	3	2	2	2	3	2	1	3	**2.3**
CO3	3	2	3	2	2	3	2	2	2	2	**2.3**
CO4	3	3	2	2	2	3	2	3	2	2	**2.4**
CO5	2	3	3	2	1	3	3	2	2	3	**2.4**
CO6	2	3	3	2	1	2	3	2	2	2	**2.2**
Mean Overall Score											**2.35 (High)**

Semester	Course Code	Title of the Course	Hours/Week	Credits
2	23PMA2EG01B	**General Elective - 1:(WS)** Mathematical Foundations for Computer Science	4	3

Course Objectives
To understand fundamental concepts of mathematical logic and numerical analysis
To study the basic properties functions and relations
To develop analytical skills through the study of truth table and tautology
To understand the relationship between functions and lattices
To apply numerical techniques and solve problems in roots of equation and integration

UNIT I **(12 Hours)**

Relations - Equivalence Relation - Functions and Operators - One-to-one, Onto Functions - Special Types of Functions-Invertible Functions- Composition of Function- Mathematical Induction.

UNIT II **(12 Hours)**

Logic: Introduction - TF - Statements - Connectives - Conjunction - Disjunction - Negation - Conditional Statements - Biconditional Statements - The Truth Table of a Formula -Tautology.

UNIT III **(12 Hours)**

Lattices - Some Properties of Lattices - New Lattices - Lattice Homomorphisms - Product Lattices of Two Lattices - Modular and Distributive Lattices-Boolean Algebra.

UNIT IV **(12 Hours)**

Iterative Methods: Birge-Vieta - Graeffe's Root Squaring Methods - System of linear algebraic equations: Gauss Elimination, Jacobi iteration method-Gauss-Seidel iteration method

UNITV **(12 Hours)**

Interpolation: Lagrange Interpolation - Newton's Forward Difference Interpolation - Newton's Backward Difference Interpolation-Trapezoidal Rule-Simpson Rule-Romberg integration.

Teaching Methodology	Chalk and talk, Lectures, Problem Solving, PPT.

Books for Study

1. Venkataraman, M.K., Sridharan, N., & Chandrasekaran, N. (2006). *Discrete Mathematics.* The National Publishing Company.
   Unit-I *Chapter II (Sec 2, 5), Chapter III (Sec 1, 2, 3, 4, 5), Chapter IV (Sec 2, Theorems are excluded).*
   Unit-II *Chapter IX (Sec 1, 2, 3,6, 7)*
   Unit-III *Chapter X (Sec 1,2,3,4,5) (Only Definitions and examples in Sec 4 & Sec 5)*
2. Jain, M.K., Iyengar, S.R.K. & Jain R.K. (2003.) *Numerical Methods for Scientific and Engineering Computation*, (4th Ed.). New Age International (P) Limited.
   Unit-IV*Chapter2 (Sec 2.9,), Chapter 3(Sec 3.2, 3.4).*
   Unit-V*Chapter4 (Sec 4.2,4.4), Chapter5(Sec 5.9,5.10)*

Books for Reference

1. Tremblay, J.P. & Manohar, R (1987). *Discrete Mathematical Structures with Applications to Computer Sciences*, McGraw-HillInternational.
2. Sastry, S.S. (2009). *Introductory Methods of Numerical Analysis,* (4th Ed.). PHI Learning Private Limited.
3. Kandasamy, P., Thilagavathy, K., & Gunavathi, K. (2008). *Numerical Methods,* S. Chand & Company Ltd.

Course Outcomes		
CO No.	**CO-Statements** On successful completion of this course, students will be able to	**Cognitive Levels (K - Level)**
CO1	acquire knowledge of relations, functions, mathematical logic, lattices and numerical methods	**K1**
CO2	understand the types of functions, conditional statements and numerical techniques	**K2**
CO3	apply mathematical induction, composition of functions and numerical formulae	**K3**
CO4	analyze various types of function, statements using truth tables, Boolean algebra numerical methods to find solutions of linear equations and system of equations using different methods	**K4**
CO5	justify relations and functions, to construct mathematical arguments using logical connectives and quantifiers, lattices.	**K5**
CO6	Relate solutions of system of linear equations and numerical integration	**K6**

Relationship Matrix											
Semester	**Course Code**			**Title of the Course**						**Hours**	**Credits**
2	**23PMA2EG01B**			**General Elective - 1:** Mathematical Foundations for Computer Science						**4**	**3**
Course Outcomes	**Programme Outcomes (POs)**					**Programme Specific Outcome (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	2	1	3	2	3	2	3	**2.5**
CO2	2	3	3	2	2	2	3	2	1	3	**2.3**
CO3	3	2	3	2	2	3	2	2	2	2	**2.3**
CO4	3	3	2	2	2	3	2	3	2	2	**2.4**
CO5	2	3	3	2	1	3	3	2	2	3	**2.4**
CO6	2	3	3	2	1	2	3	2	2	2	**2.2**
										Mean Overall Score	**2.35 (High)**