Thiagarajar College, Madurai - 625 009

(An Autonomous Institution Affiliated to Madurai Kamaraj University)
Re-Accredited with "A++" Grade by NAAC

Academic Council Meeting
June 2023

PG and Research Department of Mathematics

Syllabus 2023

B.Sc. Mathematics

Programme Code – UMA

Programme Outcome - PO (Aligned with Graduate Attributes)- Bachelor of Science (B.Sc.)

PO 1 Scientific Knowledge and Critical Thinking

Apply the knowledge of Life Science, Physical and Chemical Science, Mathematics, statistics, Computer science and humanities for the attainment of solutions to the problems that come across in our day-to-day life/activities.

PO 2 Problem Solving

Identify and analyze the problem and formulate solutions for problems using the principles of mathematics, natural sciences with appropriate consideration for the public health, safety and environmental considerations.

PO 3 Communication and Computer Literacy

Communicate the fundamental and advanced concepts of their discipline in written and oral form. Able to make appropriate and effective use of information and information technology relevant to their discipline.

PO 4 Life-Long Learning

Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PO 5 Ethical, Social and Professional Understanding

Commitment to principles, codes of conduct and social responsibility in order to behave consistently with personal respect. Acquire the responsibility to contribute for the personal development and for the development of the community. Respect the ethical values, social responsibilities and diversity.

PO 6 Innovative, Leadership and Entrepreneur Skill Development

Function as an individual, and as a member or leader in diverse teams and in multidisciplinary settings. Become an entrepreneur by acquiring technical, communicative, problem solving, intellectual skills.

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Vision:

To create an academically sound environment that nurtures, motivates and inspires excellence in research and teaching in Mathematics along with concern for society.

Mission:

- To impart quality education in Mathematics to rural and economical weaker students.
- To inspire, prepare and empower students to succeed in the ever-changing world.
- To make the students creative and research oriented.
- To educate and form the youth as liberated lifelong learners who are sensitive to gender and ecology, empowered to respond to global challenges.

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POSTGRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

Programme Educational Objectives (PEO) for B.Sc. Mathematics

The objectives of this programme is

PEO 1	To provide students with a thorough knowledge of fundamental mathematical facts and solve problems which can be analyzed mathematically.
PEO 2	To provide high quality and relevant education in the field of Mathematics.
PEO 3	To provide grounding in a coherent body of knowledge, a broad coverage of related academic skills, personal development and social skills.
PEO 4	To develop confidence to appear for SSC (CGL), IBPS, RRB and Civil Service Examinations and will occupy higher posts in administrative level.
PEO 5	To expose them to various contemporary issues which will enable them to become ethical and responsible towards themselves, co-workers, the Society and the Nation.

Programme Specific Outcomes (PSO) for B.Sc. Mathematics

On the successful completion of B.Sc. Mathematics, the students will be able to

PSO 1	Communicate mathematics effectively using various instructional strategies.
PSO 2	Demonstrate a computational ability in solving a wide array of mathematical problems.
PSO 3	Develop mathematical ideas from basic axioms and analyze valid mathematical reasoning.
PSO 4	Utilize mathematical skills to solve theoretical and applied problems.
PSO 5	Identify applications of mathematics in various disciplines and society.

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS
(For those who joined **B.Sc. Mathematics** on or after June 2023)
Programme Code: UMA
Semester – I

Course	Code No.	Subject	Contact Hours / Week	Credits	Total No. of Hours Allotted	Max. Marks CA	Max. Marks SE	Total
Part I - Tamil	U23P1TA11B	பMிF தமிழ் - I	6	3	90	25	75	100
Part II - English	U23P2EN11	General English – I	4	3	60	25	75	100
Core 1	UMA23CT11	Algebra & Trigonometry	5	4	75	25	75	100
Core 2	UMA23CT12	Differential Calculus	4	3	60	25	75	100
EC1	UCH23GT11M	Chemistry for Physical Sciences - I	3	2	75	25	75	100
	UCH23GL11M	Lab in Chemistry-1	2		30			
NME 1	UMA23NT11	Mathematics for Competitive Examinations –I	2	2	30	25	75	100
	UMA23FT11	Foundation Course	2	2	30	25	75	100
AECC-1	U23ATEN11	Soft Skills-1	2	2	30	25	75	100
TOTAL			**30**	**21**				

Semester – II

Course	Code No.	Subject	Contact Hours / Week	Credits	Total No. of Hours Allotted	Max. Marks CA	Max. Marks SE	Total
Part I– Tamil	U23P1TA21B	*பொதுத்தமிழ் - II*	6	3	90	25	75	100
Part II - English	U23P2EN21	General English II	4	3	60	25	75	100
Core 3	UMA23CT21	Analytical Geometry	5	4	75	25	75	100
Core 4	UMA23CT22	Integral Calculus	4	3	60	25	75	100
EC2	UCH23GT21M	Chemistry - II	3	2	75	25	75	100
	UCH23GL21M	Lab in Chemistry -II	2	2	30	25	75	100
NME 2	UMA23NT21	Mathematics for Competitive Examinations –II	2	2	30	25	75	100
SEC 1	UMA23ST21 (A / B)	Combinatorics	2	2	30	25	75	100
AECC-2	U23ATEN21	Soft Skills-II	2	2	30	25	75	100
TOTAL			**30**	**23**				
Extra Credit		**Naan Mudhalvan** Language Proficiency for Employability		**2**				

Non-Major Electives (NME):

1. Mathematics for Competitive Examinations –I
2. Mathematics for Competitive Examinations –II

Skill Enhancement Courses (SEC):

Semester - II

A) Combinatorics

B) Introduction to GeoGebra

Consolidation of Contact Hours and Credits: UG

Semester	Contact Hours / Week	Credits
I	30	23
II	30	25
Total	**60**	**48**

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POSTGRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined B.Sc. Mathematics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
UMA23CT11	**Algebra and Trigonometry**	**Core**	**4**	**1**	**-**	**4**

L – Lecture T – Tutorial P - Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	25	75	100

Preamble:

Algebra deals with the nature of the roots of an equation and summation of series using Binomial, Exponential and Logarithmic series. Trigonometry deals with the applications of De Moivre's theorem, hyperbolic functions and logarithm of complex numbers. Matrix theory provides the computation of eigenvalues and eigenvectors.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcomes	Expected Proficiency (%)	Expected Attainment (%)
CO1	Find the sum of the series by applying Binomial, Exponential and Logarithmic Series	80	70
CO2	Apply transformations of equations and solve the equations	80	75
CO3	Find the eigenvalues, eigen vectors and solve the matrices	80	75
CO4	Recall expressions for trigonometric functions	80	70
CO5	Relate circular trigonometric functions and hyperbolic functions	80	70

Mapping of COs with PSOs:

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	S	M	M	M
CO2	M	M	L	S	M
CO3	M	S	M	S	S
CO4	L	M	M	S	S
CO5	S	S	M	M	M

Mapping of COs with POs:

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	M	S	S	S	M	L
CO2	M	S	S	S	S	M
CO3	M	S	S	S	S	M
CO4	M	S	L	L	S	S
CO5	M	S	L	M	M	M

Bloom's Taxonomy:

#	CA		End of Semester
	First	Second	
Knowledge(K1)	40%	40%	40%
Understand(K2)	40%	40%	40%
Apply(K3)	20%	20%	20%

Contents:

Unit I **(15 Hours)**

Binomial theorem for a rational index – Application of the binomial theorem to summation of series – The Exponential theorem –Summation of series –The Logarithmic Series: Theorem –Modification of logarithmic series.

Unit II **(15 Hours)**

Reciprocal equation – Increasing or decreasing the roots of a given equation – Removal of terms – Horner's method.

Unit III **(15 Hours)**

Eigen values – Eigen vectors – Properties of Eigen values – Cayley - Hamilton theorem – Reduction to diagonal form – Similarity of matrices – Powers of a matrix.

Unit IV **(15 Hours)**

Expansions of $\sin n\theta$, $\cos n\theta$ and $\tan n\theta$ – Expansions of $\sin \alpha$ and $\cos \alpha$ in a series of ascending powers of α – Expansions of $\cos^n \theta$ and $\sin^n \theta$ in Cosines and Sines of multiples of θ – Expansions of $\sin n\theta$ and $\cos n\theta$ in series of descending and ascending powers of $\sin \theta$ and $\cos \theta$.

Unit V **(15 Hours)**

Hyperbolic functions – Inverse Circular and Hyperbolic function - Logarithm of complex quantities – Gregory's series - Summation of series.

Text Books:

1. Manicavachagom Pillay.T.K., Natarajan.T. and Ganapathy. K.S., 2016, Algebra, Vol.1, S.Viswanathan (Printers and Publishers) Pvt. Ltd., Chennai.
2. Grewal B.S, 2017, Higher Engineering Mathematics, 44th edition, Khanna Publishers, Delhi.
3. Loney S.L, 2021, Plane Trigonometry, Part II, G.K. Publications Pvt. Ltd.

Unit	Book	Chapter/Section/Pages
I	1	3 (5, 10) 4 (2, 3, 5, 6,7)
II	1	6 (16 to 19, 30)
III	2	2 (2.13 – 2.16)
IV	3	Page No. 32 to 40 and 54 to 73
V	3	Page No. 80 to 99, 106 to 109 and 114 to 123

References:

1. Arumugam. S and Thangapandi Isaac. A., 2011, Algebra: Theory of Equations, Theory of Numbers and Trigonometry, New Gamma Publishing House, Palayamkottai.
2. Rawat. K.S., 2008, Trigonometry, First Edition, Sarup Book Publishers Pvt. Ltd., New Delhi.
3. Narayanan. S. and Manickavachagom Pillay. T.K., 2001, Trigonometry, S. Viswanathan Publishers (Printers and Publishers), Pvt., Ltd., Chennai.
4. David C. Lay, 2007, Third Edition, Linear Algebra and its Applications, Pearson Education, Asia, Indian Reprint.

Course Designers:

1. Mrs. R. Latha
2. Mrs. P. Kalai Mathy

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POSTGRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined B.Sc. Mathematics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
UMA23CT12	**Differential Calculus**	**Core**	**3**	**1**	**-**	**3**

L – Lecture T – Tutorial P - Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	25	75	100

Preamble:

The course is about describing in a precise fashion, the ways in which related quantities change and it is an indispensable tool in every branch of science and engineering for curve sketching and for optimization and it deals with the theory and applications of differentials and explains the concept of differentiation in science and engineering.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Recall the basic concepts of differentiation, successive differentiation and partial differentiation	80	75
CO2	Develop problem solving skills using derivatives and partial derivatives	80	70
CO3	Apply the techniques of differentiation to find maxima and minima of functions of two variables and also obtain the envelope of family of curves	80	77
CO4	Analyze the various methods of finding envelopes, circle, radius, centre and circle of curvatures	80	65
CO5	Understand the basic knowledge on the notions of curvature in polar coordinates	80	70

Mapping of COs with PSOs:

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	L	M
CO2	S	M	M	M	L
CO3	M	L	M	S	S
CO4	M	S	S	L	L
CO5	L	L	S	M	M

Mapping of COs with POs:

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	S	S	M	M	M
CO2	M	M	S	S	L	M
CO3	L	S	M	M	M	L
CO4	S	M	S	L	M	M
CO5	L	M	S	M	S	L

Bloom's Taxonomy:

	CA		End of Semester
	First	Second	
Knowledge(K1)	40%	40%	40%
Understand(K2)	40%	40%	40%
Apply(K3)	20%	20%	20%

Contents:

Unit I **(12 Hours)**

Successive Differentiation: Introduction(Review of Basic concepts) – The n^{th} derivative – Standard Results – Fractional Expressions – Trignometrical Transformations – Formation of equation involving derivatives – Leibnitz formula for the nth derivative of a product.

Unit II **(12 Hours)**

Partial Differentiation: Partial Derivatives – Successive partial derivatives – Function of function rule – Total differentiation coefficient – A special case – Implicit functions.

Unit III **(12 Hours)**

Partial Differentiation: Homogenous functions – Partial: derivative of a function of two variables – Maxima and mimina of functions of two variables – Lagrange's method of undetermined multipliers.

Unit IV **(12 Hours)**

Envelope: Method of finding the envelope – Another definition of envelope – Envelope of family of curves which are quadratic in parameter.

Unit V **(12 Hours)**

Curvatures: Definition of curvature – Circle, radius and centre of curvature – Evolutes and Involutes – Radius of curvature in polar coordinates.

Text Book:

Narayanan. S and Manicavachagom Pillay. T.K., 2015, Calculus, Volume I, S. Viswanathan (Printers and Publishers) Pvt. Ltd.

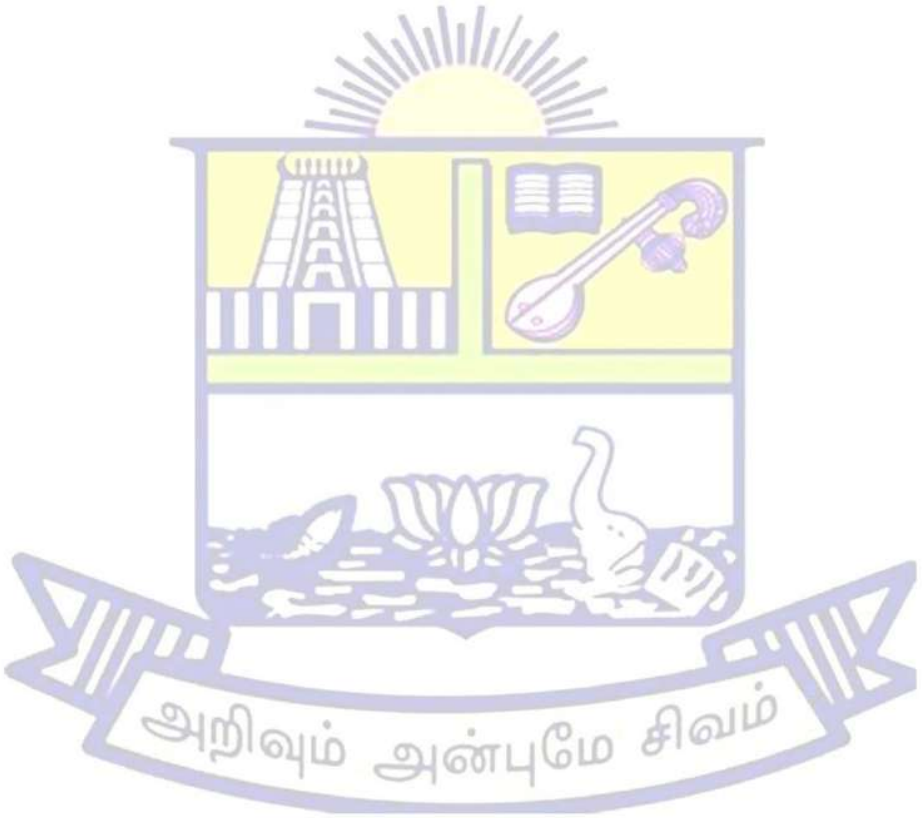
Unit	Chapter/Section
I	3 (1.1 – 1.6, 2.1 – 2.2)
II	8 (1.1 – 1.5)
III	8 (1.6 – 1.7, 4, 5)
IV	10 (1.1 – 1.3)
V	10 (2.1 – 2.2, 2.5 – 2.6)

References:

1. Vittal P.R. and Malini. V, 2012, Calculus, Third Edition, Margham Publications.
2. Tom M. Apostal, 2007, Calculus – Volumes I and II, Willey Student Publication.
3. R. Courant and F. John, 1989, Introduction to Calculus and Analysis (Volumes I & II), Springer- Verlag, New York, Inc.

Course Designers:

1. Dr. G. Prabakaran
2. Ms. P. Vanmathy



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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined B.Sc. Mathematics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
UMA23CT21	**Analytical Geometry**	**Core**	**4**	**1**	**-**	**4**

L – Lecture T – Tutorial P - Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	100

Preamble:

The course is to analyze characteristics and properties of two and three dimensional geometrical shapes such as Plane, Line, Circle and Sphere. The coordinate system is applied to manipulate equations for planes, straight lines, circles and sphere.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Illustrate the polar equation of ellipse and hyperbola in two dimensional spaces	80	70
CO2	Analyze some properties of polar equations	80	70
CO3	Utilize plane concepts in three dimensional spaces	80	75
CO4	Solve the problems related to lines and planes	80	70
CO5	Demonstrate the Sphere concepts and relate their properties	80	75

Mapping of COs with PSOs:

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	L	L	M
CO2	L	S	L	M	L
CO3	S	M	L	M	L
CO4	L	L	S	M	L
CO5	L	S	L	L	M

Mapping of COs with POs:

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	S	M	L	M	S
CO2	S	S	M	M	M	M
CO3	S	S	L	S	L	S
CO4	S	S	M	S	L	M
CO5	S	S	L	S	L	M

Bloom's Taxonomy:

#	CA		End of Semester
	First	Second	
Knowledge(K1)	40%	40%	40%
Understand(K2)	40%	40%	40%
Apply(K3)	20%	20%	20%

Contents:

Unit I (15 Hours)

Ellipse: The polar of a point with respect to the ellipse – The pole of a line with respect to the ellipse – The condition for two lines to be conjugate – Conjugate diameters (Definition and properties) – Equi-conjugate diameters. **Hyperbola:** Conjugate diameters.

Unit II (18 Hours)

Polar Equations: Polar co-ordinates – Equation of straight line – General equation of a line – Parallel straight lines – Perpendicular straight lines – Circle – The chord joining the points whose vertical angles are θ_1 and θ_2 on the circle $r = 2a \cos \theta$ – Polar equation of a conic – The equation of the chord of the conic joining two points – The asymptotes of the conic – Equation of the normal – Some properties of the general conic – The polar equation.

Unit III (12 Hours)

The Plane: Equations of a Plane - Angle between two planes - The ratio in which the plane divides the line joining two points - Equation of a plane through the line of intersection of two given planes – Length of perpendicular-The equation of the planes bisecting the angle between two planes.

Unit IV (17 Hours)

The Straight Line: A straight line may be determined as the intersection of two planes- Symmetrical form of the equations of a line – The Symmetrical form of the equations of the line in non-symmetric form - Equations of a straight line passing through two given points - The plane and the straight line-Angle between a plane and a straight line - Coplanar lines- The shortest distance between two given lines - The intersection of three planes - Volume of a tetrahedron.

Unit V (13 Hours)

The Sphere: Definition - Equations of a sphere – The length of the tangent from the point to the sphere –The plane section of a sphere is a circle - Equation of a circle on a sphere- Intersection of two spheres is a circle - The equation of the tangent plane to the sphere at a Point.

Text Books:

1. Manikavachagam Pillay.T.K. and Natarajan. T, 2016, A Text Book Analytical Geometry (Part I - Two dimensions), Ananda Book Depot, Chennai.
2. Manikavachagam Pillay.T.K. and Natarajan. T, 2017, A Text Book Analytical Geometry (Part II- Three dimensions), Ananda Book Depot, Chennai.

Unit	Book	Chapter/ Section
I	1	VII (7, 7.1, 7.2, 16, 16.3, 16.4) & VIII (9)
II	1	IX (1, 5, 6, 6.1, 6.2, 7, 8, 9, 10, 12, 13, 14)
III	2	II(Full)
IV	2	III(1 to 8, 10, 11)
V	2	IV(1to 8)

References:

1. Robert J. T. Bell, 2016, An Elementary Treatise on Coordinate Geometry of Three Dimensions, Macmillan and CO., Ltd., London.
2. Pandey. H.D., Dubey. S.K.D. and Pandey. S.N., 2011, A text book of Vector Analysis and Geometry, Wisdom Press, New Delhi.
3. Loney, S.L., 2019, The Elements of Coordinate Geometry, Math Valley Publishing.
4. George B. Thomas and Ross L. Finney, Ninth Edition, 2022, Calculus and Analytic Geometry, Pearson.

Course Designers:

1. Mrs. R. Latha
2. Ms. P. Vanmathy

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POSTGRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined B.Sc. Mathematics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
UMA23CT22	**Integral Calculus**	**Core**	**3**	**1**	**-**	**3**

L – Lecture T – Tutorial P - Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	100

Preamble:

The course is about describing in a precise fashion, the ways in which related quantities change and it is an indispensable tool in every branch of science and engineering for curve sketching and for optimization and it deals with the theory and applications of integrals and explains the concepts of integration in science and engineering.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Understand the concept of Reduction formulae and able to evaluate multiple integrals	80	70
CO2	Solve problems in integrals using transformation of one coordinate system to another.	80	70
CO3	Discuss various problems in integrals and their applications	85	75
CO4	Analyze the properties of Beta and Gamma functions.	85	70
CO5	Apply the techniques of integration geometrically and physically.	80	70

Mapping of COs with PSOs:

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	L	S	L	L
CO2	L	L	M	S	L
CO3	L	S	L	L	M
CO4	M	L	S	L	L
CO5	L	L	S	L	M

Mapping of COs with POs:

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	S	L	L	M	M
CO2	L	L	S	M	S	L
CO3	L	S	M	L	L	L
CO4	S	M	S	L	M	M
CO5	L	M	S	L	S	L

Bloom's Taxonomy:

#	CA		End of Semester
	First	Second	
Knowledge (K1)	40%	40%	40%
Understand (K2)	40%	40%	40%
Apply(K3)	20%	20%	20%

Contents:

Unit I **(12 Hours)**

Reduction formulae – Bernoulli's formula.

Unit II **(12 Hours)**

Multiple integrals – definition of double integrals – Evaluation of double integrals – Double integrals in polar coordinates – Change of order of integration.

Unit III **(12 Hours)**

Triple integrals – Application of multiple integrals – Volumes of solid revolution – Areas of curved surfaces – Change of variables – Jacobian.

Unit IV **(12 Hours)**

Beta and Gamma functions – Infinite integral – Definition – Recurrence formula of gamma function – Properties of Beta and Gamma functions – Applications.

Unit V **(12 Hours)**

Geometric and Physical applications of Integral Calculus.

Text Book:

Narayanan. S and Manicavachagom Pillay. T.K., 2015, Calculus, Volume II, Viswanathan (Printers and Publishers) Pvt. Ltd.

Unit	Chapter/Section
I	1(13, 15)
II	5(1, 2.1, 3.1. 3.2)
III	5(4, 5.1, 6.1, 7), 6
IV	7(1, 2.1, 2.3, 3, 6)
V	3(1. – 1.5, 2.1 – 2.6)

References:

1. Dr. S. Arumugam and Prof. A. Thangapandi Isaac, 2014, Calculus, New Gamma Publishing House.
2. Vittal. P.R. and Malini. V., 2012, Calculus, Third Edition, Margham Publications.
3. Tom M. Apostal, 2007, Calculus – Vol. II –Wiley Student publication.

4. Shanti Narayan, 2002, Integral Calculus, 9th Edition, S. Chand and Company Ltd.

Course Designers:

1. Dr. G. Prabakaran
2. Mrs. D. Princy

Generic Elective (Allied Papers)

Thiagarajar College (Autonomous):: Madurai – 625 009
PG and Research Department of Mathematics
Generic Elective Course Syllabus
For Other Major Students – w.e.f. 2023 June

Major	Year	Sem	Code No.	Title of the Paper	Contact Hrs/Week	Credits
Physics	I	I	UMA23GT11P	**Allied Mathematics - I for Physics**	5	3
		II	UMA23GT21P	**Allied Mathematics - II for Physics**	5	3
Computer Science/Computer Application /Information Technology/Data Science	I	I	UMA23GT11S	**Discrete Mathematical Structures**	5	3
		II	UMA23GT21S	**Basic Statistics**	5	3
Data Science	II	III	UMA22GT31D	**Numerical Methods**	5	5
		IV	UMA22GT41D	**Transforms and their Applications**	5	5

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined B.Sc. Physics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
UMA23GT11P	**Allied Mathematics - I for Physics**	**Generic Elective**	**3**	**2**	**-**	**3**

L - Lecture T – Tutorial P - Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	25	75	100

Preamble:

The course deals with the methods of solving algebraic equations, the concept of curvature and evolute to the given curve, followed by Interpolation by finite differences operators and evaluation of series.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment(%)
CO1	Find the nature of the roots of an equation	85	80
CO2	Solve higher degree equations using various methods	80	75
CO3	Define and Explain the concept of curvature and evolute	80	75
CO4	List the difference operators and apply interpolation techniques to real life problems	80	75
CO5	Demonstrate the pattern of the series and estimate sums of infinite series.	85	80

Mapping of COs with PSOs:

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	S	M
CO2	S	M	S	S	M
CO3	S	M	S	S	L
CO4	S	S	S	S	L
CO5	S	L	S	S	M

Mapping of COs with POs:

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	S	M	L	S	S
CO2	S	S	M	L	L	S
CO3	S	S	M	M	M	S
CO4	S	S	L	L	L	S
CO5	S	M	L	L	L	L

Bloom's Taxonomy:

	CA		End of Semester
	First	Second	
Knowledge(K1)	40%	40%	40%
Understand(K2)	40%	40%	40%
Apply(K3)	20%	20%	20%

Contents:

Unit I **(15 Hours)**

Theory of Equations: Nature of the roots - Relation between the coefficients and the roots of an algebraic equation – Transformations of equations.

Unit II **(15 Hours)**

Theory of Equations: Reciprocal equation – Transform in general – Horner's method – Newton's method.

Unit III **(15 Hours)**

Curvature – Circle, radius and centre of curvature – Evolute and Involute - p-r equation of a curve.

Unit IV **(15 Hours)**

Finite differences – Interpolation – Binomial method – Lagrange's interpolation formula.

Unit V **(15 Hours)**

Algebra: Exponential series – The Logarithmic series.

Text Book:

Narayanan. S, Hanumantha Rao. R, Manicavachagom Pillay. T. K. and Kandaswamy. P., Reprint June 2009, Ancillary Mathematics, Volume I, S. Viswanathan (Printers & Publishers) Pvt. Ltd., Chennai.

Unit	Chapter/ Section
I	2(2.1 - 2.3)
II	2(2.4 – 2.7)
III	6(6.4)
IV	4(4.1 – 4.3)
V	3(3.4 & 3.5)

References:

1. Arumugam. S. and Thangapandi Isaac. A, July 2011. Algebra: Theory of Equations, Theory of Numbers and Trigonometry, New Gamma Publishing House, Palayamkottai.
2. Manicavachagom Pillay .T. K., Natarajan. T. and Ganapathy. K.S. 2010, Algebra, Volume – I, S. Viswanathan (Printers & Publishers) Pvt. Ltd., Chennai.
3. Balasubrahmanyam. P. and Subramanian. K.G. 1996, Ancillary Mathematics, Volume – I, Tata McGraw-Hill Publishing Company Limited, New Delhi.

Course Designers:

1. Dr. R. Lakshmanan
2. Mr. K.V. Janarthanan

THIAGARAJAR COLLEGE, MADURAI – 9.

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined B.Sc. Physics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
UMA23GT21P	Allied Mathematics - II for Physics	Generic Elective	3	2	-	3

L - Lecture T – Tutorial P - Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	100

Preamble:

The course deals with reduction formulae, the methods of solving ordinary and partial differential equations, Laplace transform and Fourier series.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Classify the integrals and apply the appropriate techniques on integration	85	80
CO2	Solve ordinary differential equations using various methods	80	75
CO3	Formulate partial differential equations and solve them	80	75
CO4	Find the Laplace transform of various functions and solve linear differential equations	80	75
CO5	Construct Fourier series of a given periodic function by evaluating Fourier coefficients	85	80

Mapping of COs with PSOs:

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	L	S	S	S
CO2	L	L	S	S	S
CO3	S	L	S	S	S
CO4	L	M	L	L	L
CO5	L	L	M	L	M

Mapping of COs with POs:

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	S	M	M	S	S
CO2	S	S	M	M	M	S
CO3	S	S	M	M	M	S
CO4	M	M	M	L	L	M
CO5	S	S	M	M	S	M

Bloom's Taxonomy:

#	CA		End of Semester
	First	Second	
Knowledge(K1)	40%	40%	40%
Understand(K2)	40%	40%	40%
Apply(K3)	20%	20%	20%

Contents:

Unit I **(15 Hours)**

Integration: Reduction formulae - Bernoulli's formula.

Unit II **(15 Hours)**

Ordinary Differential Equations: Exact differential equations – Practical rule for solving an exact differential equation – First order higher degree equations.

Unit III **(15 Hours)**

Partial Differential Equations: Derivation of partial differential equations – Different integrals of partial differential equations –Standard type of first order equations – Lagrange's equation – Charpit's method.

Unit IV **(15 Hours)**

Laplace Transform: Definition – Inverse Laplace transform – Solving ordinary differential equations.

Unit V **(15 Hours)**

Fourier series – Even and odd functions – Half range Fourier series – Development in Cosine series -Development in sine series.

Text Book:

Narayanan. S., Hanumantha Rao. R., Manicavachagom Pillay T.K. and Kandaswamy. P. Reprint June 2008, Ancillary Mathematics, Volume II, S. Viswanathan (Printers & Publishers) Pvt. Ltd., Chennai.

Unit	Chapter/ Section
I	1(13 – 15)
II	4(6.1 – 6.4)
III	6(1 -3, 5 - 7)
IV	7(1 – 6)
V	2(1- 4, 5.1, 5.2)

References:

1. Arumugam. S. and Thangapandi Isaac. A. July 2011, Differential Equations, New Gamma Publishing House, Palayamkottai.
2. Manicavachagom Pillay. T.K., Natarajan. T. and Ganapathy. K.S. 2010, Calculus, Volume – II, S. Viswanathan (Printers & Publishers) Pvt. Ltd., Chennai.
3. Balasubrahmanyam. P. and Subramanian. K.G. 1996, Ancillary Mathematics, Volume – II, Tata McGraw-Hill Publishing Company Limited, New Delhi.

Course Designers:

1. Dr. R. Lakshmanan
2. Mr. K. V. Janarthanan

THIAGARAJAR COLLEGE, MADURAI – 9.

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined B.Sc. Computer Science /Data Science/B.C.A. / B.Sc. (I.T.) on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
UMA23GT11S	Discrete Mathematical Structures	Generic Elective	3	2	-	3

L – Lecture T – Tutorial P - Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	25	75	100

Preamble:

This course provides hands-on exploration of the relevancy of Set Theory, Functions, Mathematical Logic, Number Theory, Combinatorics and Relations.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Recall Set theory and understand its properties	80	75
CO2	Construct and classify logical sentence in terms of logical connectives and predicates	80	75
CO3	Apply division algorithm in integers and understand recursive algorithms	80	65
CO4	Demonstrate and apply the Pigeonhole Principle and to get an idea on Permutations and Combinations	80	70
CO5	Relate set theoretical concepts and analyze simple algorithms	80	75

Mapping of COs with PSOs:

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	M	L
CO2	M	S	L	S	M
CO3	M	S	M	S	S
CO4	L	L	M	S	S
CO5	S	L	M	M	M

Mapping of COs with POs:

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	L	L	M	L
CO2	S	S	S	M	S	M
CO3	S	S	S	M	M	M
CO4	M	S	S	S	L	L
CO5	S	M	L	L	L	M

Bloom's Taxonomy:

#	CA		End of Semester
	First	Second	
Knowledge(K1)	40%	40%	40%
Understand(K2)	40%	40%	40%
Apply(K3)	20%	20%	20%

Contents:

Unit I **(15 Hours)**

Basic Structures: Sets: Set Operations – Introduction – Set Identities – Generalized Unions and Intersections – Computer Representation of Sets – Functions – Introduction – One-to-one and Onto Functions – Inverse Functions and Composition of Functions – Sequences and Summations – Introduction - Sequences – Recurrence Relations – Special Integer Sequences – Summations – Cardinality of Sets – Introduction – Countable Sets. **(Problems Only)**

Unit II **(15 Hour)**

The Foundations: Logic: Propositional Logic – Introduction - Propositions – Conditional Statements – Truth Tables of Compound Propositions – Precedence of Logical Operators – Logic and Bit Operations – Applications of Propositional Logic – Introduction – Translating English Sentences - System Specifications – Boolean Searches – Logic Puzzles – Logic Circuits – Propositional Equivalences – Introduction – Logical Equivalences – Using De Morgan's Laws – Constructing New Logical Equivalences. **(Problems Only)**

Unit III **(15 Hours)**

Number Theory: Divisibility and Modular Arithmetic – Introduction – Division – The Division Algorithm – Modular Arithmetic – Arithmetic Modulo m - Integer Representations and Algorithms – Introduction – Representations of Integers – Algorithms for Integer Operations - Recursive Algorithms – Introduction – Proving Recursive Algorithms Correct – Recursion and Iteration. **(Problems Only)**

Unit IV **(15 Hours)**

Counting: The Basis of Counting – Introduction – Basic Counting Principles – The Subtraction Rule (Inclusion-Exclusion for Two Sets) – The Division Rule – The Pigeonhole Principle – Introduction – The Generalized Pigeonhole Principle – Some Elegant Application of the Pigeonhole Principle – Permutations and Combinations – Introduction – Permutations – Combinations – Generalized Permutations and Combinations – Introduction – Permutations with Repetition – Combinations with Reptition. **(Problems Only)**

Unit V **(15 Hours)**

Relations: Relations and their properties – Introduction – Functions as Relations – Relations on a Set – Properties of Relations – Combining Relations – Representing Relations – Introduction – Representing Relations Using Matrices – Representing Relations Using Digraphs – Closures of Relations – Introduction – Different Types of Closures – Transitive Closures - Warshall's Algorithm – Equivalence Relations – Introduction – Equivalence Relations – Equivalence Classes – Equivalence Classes and Partitions. **(Problems Only)**

Text Book:

Rosen K.H., 2021, Discrete Mathematics and its Applications, Special Indian Edition (8e), Tata McGraw – Hill Education (India) Pvt., Ltd.

Unit	Chapter / Section
I	2 - 2.2 (2.2.1 – 2.2.4), 2.3 (2.3.1 – 2.3.3), 2.5 (2.5.1 – 2.5.5), 2.6 (2.6.1 – 2.6.2)
II	1 - 1.1 (1.1.1 – 1.1.6), 1.2 (1.2.1 – 1.2.6), 1.3 (1.3.1 – 1.3.4)
III	4 - 4.1 (4.1.1 – 4.1.5), 4.2 (4.2.1 – 4.2.3), Chapter 5 - 5.4 (5.4.1 – 5.4.3)
IV	6 - 6.1 (6.1.1 – 6.1.2, 6.1.4, 6.1.5), 6.2 (6.2.1 – 6.2.3), 6.3 (6.3.1 – 6.3.3), 6.5 (6.5.1 – 6.5.3)
V	8 - 8.1 (8.1.1 – 8.1.5), 8.3 (8.3.1 – 8.3.3), 8.4 (8.4.1 – 8.4.2, 8.4.4 - 8.4.5), 8.5 (8.5.1 – 8.5.4)

References:

1. Johnson Baugh R and Carman R, 2003, Discrete Mathematics, 5th Edition, Person Education, New Delhi.
2. Kolman B, Busoy R.C. and Ross S.C, 2004, Discrete Mathematical Structures, 5th Edition, Pretitice - Hall of India.
3. Mott J.L, Kandel A and Bake T.P, 2002, Discrete Mathematics for Computer Scientists & Mathematicians, 2nd Edition, Prentice-Hall of India.

Course Designers:

1. Dr. R. Angeline Chella Rajathi
2. Ms. P. Vanmathy

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined B.Sc. Computer Science /Data Science/ B.C.A. / B.Sc. (I.T.) on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
UMA23GT21S	Basic Statistics	Generic Elective	3	2	-	3

L - LectureT - TutorialP – Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	100

Preamble:

Statistics is the systematic study of variation in data and the course is a foundation for probability and statistical ideas in exploratory data analysis and provides a concise and clear description of various statistical methods used for analysis.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Improve data handling skills and summarize statistical computations	80	75
CO2	Determine the relationship between quantitative variables and extend regression analysis	80	75
CO3	Recall and apply a comprehensive set of Probability ideas	80	75
CO4	Find, interpret and analyze the measure of central tendencies, Moment Generating function and Characteristic function of random variables	80	70
CO5	Relate, analyze and demonstrate the knowledge of using various distributions for statistical analysis	80	75

Mapping of COs with PSOs:

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	L	L	L	M
CO2	L	L	S	M	L
CO3	S	L	L	M	L
CO4	L	S	M	L	M
CO5	L	S	L	L	M

Mapping of COs with POs:

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	M	L	M	L
CO2	S	S	S	M	L	L
CO3	S	S	S	L	M	M
CO4	M	S	S	M	L	L
CO5	S	S	S	M	M	M

Bloom's Taxonomy:

#	CA		End of Semester
	First	Second	
Knowledge (K1)	40%	40%	40%
Understand (K2)	40%	40%	40%
Apply (K3)	20%	20%	20%

Contents:

(Formula Derivations are not required. Only problems need be dealt with)

Unit I **(15 Hours)**

Central Tendencies: Introduction – Arithmetic Mean. Measures of Dispersion: Introduction – Measures of Dispersion.

Unit II **(15 Hours)**

Correlation and Regression: Introduction – Correlation – Rank Correlation – Regression.

Unit III **(12 Hours)**

Probability: Introduction- Probability- Conditional Probability.

Unit IV **(15 Hours)**

Mathematical Expectation of random variables– Moment Generating Function – Characteristic Function.

Unit V **(18 Hours)**

Some Special Distributions**:** Introduction – Binomial Distribution – Poisson Distribution - Normal Distribution.

Text Book:

Arumugam. S. and Thangapandi Isaac. A., 2011, Statistics, New Gamma Publishing House, Palayamkottai.

Unit	Chapter/Section
I	2(2.0 - 2.1), 3(3.0, 3.1)
II	6(6.0 – 6.3)
III	11(11.0-11.2)
IV	12(12.4– 12.6)
V	13(13.0 –13.3)

References:

1. Vittal. P.R., 2013, Mathematical Statistics, Margham Publications, Chennai.
2. Gupta. S.C. and Kapoor. V.K., 2007, Fundamentals of Mathematical Statistics, Eleventh edition, Sultan Chand & sons, New Delhi.
3. Gupta. S.C. and Kapoor. V.K., 2015, Elements of Mathematical Statistics, Third Edition, Sultan Chand & Sons, Educational Publishers, New Delhi.

Course Designers:

1. Dr. R. Angeline Chella Rajathi
2. Ms. P. Vanmathy

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined B.Sc. Data Science on or after June 2022)

Course Code	Course Title	Category	L	T	P	Credit
UMA22GT31D	Numerical Methods	Generic Elective	5		-	5

L – Lecture T – Tutorial P - Practical

Year	Semester	Int. Marks	Ext. Marks	Total
Second	Third	25	75	100

Preamble:

The course provides an introduction to the basic concepts and techniques of solving algebraic, transcendental equations and system of simultaneous linear equations numerically. Also it covers interpolation, numerical differentiation, numerical integration and methods for solving differential equations.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Recall some basic methods to find the root of algebraic and transcendental equations and to solve simultaneous equations.	90	85
CO2	Apply concepts of eigenvalues and eigenvectors to find the dominant and smallest Eigen value.	90	85
CO3	Build an interpolating polynomial using appropriate numerical methods.	85	80
CO4	Apply numerical methods to find the derivatives and integrals of functions.	85	80
CO5	Demonstrate numerical methods to solve Differential equations	80	75

Mapping of COs with PSOs:

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	L	L	M
CO2	S	L	M	S	L
CO3	S	M	M	M	S
CO4	S	L	L	L	S
CO5	S	M	L	M	L

Mapping of COs with POs:

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	M	S	M	L	S	L
CO2	M	S	S	M	L	M
CO3	S	M	M	M	M	L
CO4	S	M	L	S	M	L
CO5	S	S	L	L	L	M

Bloom's Taxonomy:

#	CA		End of Semester
	First	Second	
Knowledge(K1)	40%	40%	40%
Understand(K2)	40%	40%	40%
Apply(K3)	20%	20%	20%

Contents:

Unit I **(15 Hours)**

Solution of Algebraic and Transcendental Equations: Introduction - Bisection Method – Method of False Position – Iteration method – Newton-Raphson Method. **Solution of Simultaneous Algebraic Equations:** Gauss Elimination Method – Gauss Jordon method – Jacobi's method – Gauss-Seidel method.

Unit II **(15 Hours)**

Matrix Inversion and Eigen Value Problem: Matrix Inversion – Gauss Jordon method – Eigen Values and Eigen Vectors – Properties of Eigen Values – Power method – Jacobi's method

Unit III **(15 Hours)**

Interpolation: Introduction – Newton's Forward Interpolation Formula – Newton's Backward Interpolation Formula – Interpolation with Unequal intervals – Lagrange's interpolation formula – Divided differences – Newton's divided difference formula – Spline Interpolation – Cubic Spline.

Unit IV **(15 Hours)**

Numerical Differentiation and Integration: Numerical differentiation – Formulae for derivatives: Derivatives using Newton's forward difference formula – Derivatives using Newton's backward difference formula – Numerical integration – Newton-Cotes quadrature formula: Trapezoidal rule – Simpson's 1/3 rule – Simpson's 3/8 rule – Romberg's method.

Unit V **(15 Hours)**

Numerical Solution of Ordinary Differential Equations: Introduction – Taylor's series method – Euler's method – Modified Euler's method – Runge-Kutta method – Predictor Corrector methods – Milne's method – Adams-Bashforth method.

Text Book:

Grewal. B.S., 2015, Numerical Methods in Engineering & Science, Khanna Publishers, New Delhi.

Unit	Chapter / Section
I	2 (2.1, 2.8, 2.9, 2.11, 2.12) 3 (3.4(3, 4), 3.5(1, 2))
II	4 (4.2, 4.8(1), 4.9, 4.11, 4.12)
III	7 (7.1 – 7.3, 7.11 –7.14, 7.17(1, 2))
IV	8(8.1, 8.2(1, 2), 8.4, 8.5(I, II,III), 8.7)
V	10(10.1, 10.3 – 10.5, 10.7-10.10)

References:

1. Arumugam. S., Thangapandi Isaac. A. and Somasundaram. A., 2015, Numerical Methods, Second Edition, SciTech Publications (India) Pvt. Ltd., Chennai.
2. Venkataraman. M.K., 2013, Numerical Methods in Science and Engineering, 5th Edition, The National Publishing company, Chennai.
3. Kandasamy.P., Thilagavathy. K. and Gunavathy. K., 2007. Numerical Methods, S. Chand & Company Pvt. Ltd., New Delhi.
4. Balagurusamy. E., 2002, Numerical methods, Tata McGraw Hill Publishing Company Ltd., India.

Web Resources:

1. https://nm.mathforcollege.com/
2. https://www.coursera.org/learn/numerical-methods-engineers
3. http://www.tonysaad.net/chen-2450-numerical-methods-spring-2020/

Course Designers:

1. Mrs. V. Kanchana Devi
2. Mrs. B. Ambika

THIAGARAJAR COLLEGE, MADURAI – 9.

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined B.Sc. Data Science on or after June 2022)

Course Code	Course Title	Category	L	T	P	Credits
UMA22GT41D	**Transforms and their Applications**	**Core**	**5**	**-**	**-**	**5**

L – Lecture T – Tutorial P - Practical

Year	Semester	Int. Marks	Ext. Marks	Total
Second	Fourth	25	75	100

Preamble:

The course deals with some of the well-known transforms like Laplace transform, Fourier transform and Z-transform and its applications.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Apply Laplace transform technique to solve the given ordinary differential equations and integral equations.	95	90
CO2	Apply Inverse Laplace transform technique to solve the given ordinary differential equations and integral equations.	90	85
CO3	Build a Fourier series of a given periodic function by evaluating Fourier coefficients.	95	90
CO4	Recall the structure of Fourier series and construct the Fourier integral Transform.	90	85
CO5	Relate the Fourier transform and Laplace transform and solve the problems.	85	80

Mapping of COs with PSOs:

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	L	M	S
CO2	S	L	M	S	S
CO3	S	S	S	L	M
CO4	M	S	S	S	S
CO5	M	S	S	S	M

Mapping of COs with POs:

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	S	S	S	M	M
CO2	S	S	S	M	S	M
CO3	S	S	M	S	S	S
CO4	S	M	S	S	M	M
CO5	S	M	S	S	S	S

Bloom's Taxonomy:

#	CA		End of Semester
	First	Second	
Knowledge(K1)	40%	40%	40%
Understand(K2)	40%	40%	40%
Apply(K3)	20%	20%	20%

Contents:

Unit I **(15 Hours)**

Laplace Transform: Introduction -Definition - Transforms of elementary Functions – Properties of Laplace Transforms – Transforms of Periodic functions-Transforms of derivatives Transforms of integrals.

Unit II **(15 Hours)**

Inverse Laplace transforms: Convolution Theorem– Applications to differential Equations: Simultaneous linear differential equations with constant coefficients – Unit step function.

Unit III **(15 Hours)**

Fourier Series: Introduction–Euler's Formulae – Change of Interval - Even and Odd Functions – Half range Fourier Series.

Unit IV **(15 Hours)**

Fourier Transform: Introduction – Definition - Fourier integral Theorem– Fourier Transforms-Properties of Fourier transforms –Convolution- Parseval's Identity for Fourier Transformation.

Unit V **(15 Hours)**

Relation between Fourier and Laplace Transforms – Fourier Transforms of the Derivatives of a Function.

Text Book:

Grewal B. S., 2017, Higher Engineering Mathematics, 44th Edition, Khanna Publishers.

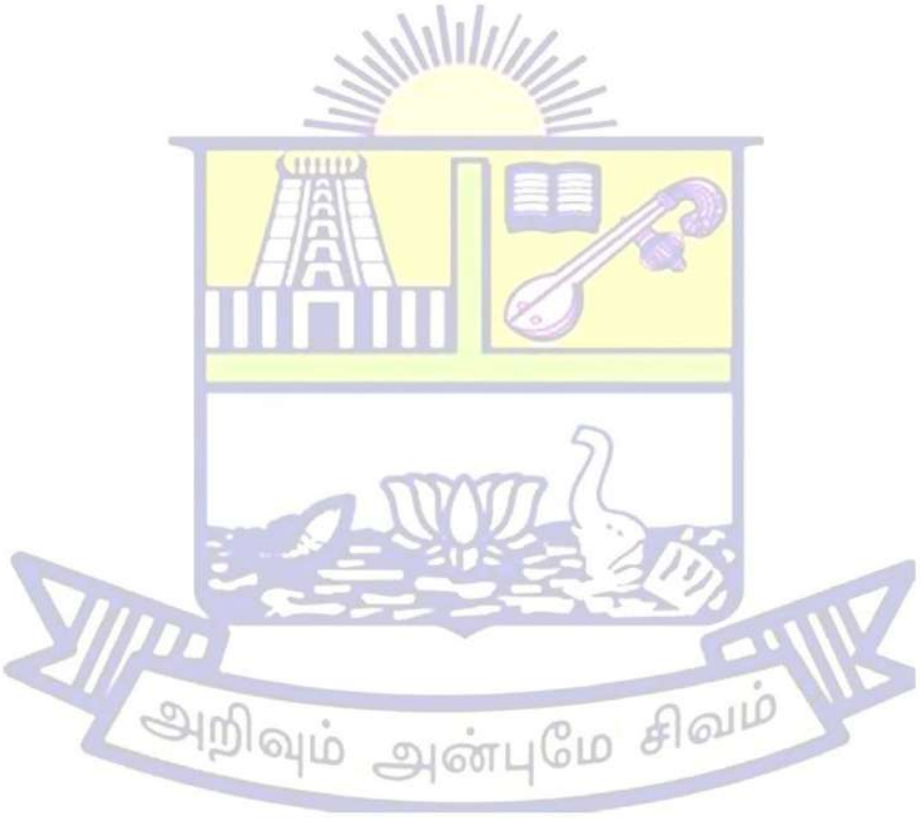
Unit	Chapter/Section
I	21(21.1-21.5,21.7,21.8)
II	21(21.14-21.17)
III	10(10.1,10.2,10.5-10.7)
IV	22(22.1-22.7)
V	22(22.8-22.9)

References:

1. Veerarajan T, 2000, Mathematics IV, Tata McGraw Hill.
2. S. Narayanan, R. Hanumantha Rao, T. K. Manicavachagom Pillay and Dr. P. Kandaswamy, Reprint, June 2009, Ancillary Mathematics, Volume II, S. Viswanathan (Printers and Publishers) Pvt. Ltd, Chennai.
3. Venkatraman M.K., 2000, Higher Engineering Mathematics, National Publishing Co.

Course Designers:

1. Dr. P. Krishnaveni
2. Mrs. D. Princy



Non Major Electives

(NME)

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined B.Sc on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
UMA23NT11	Mathematics for Competitive Examinations-I	**NME**	**2**	**-**	**-**	**2**

L-Lecture T-Tutorial P–Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	25	75	100

Preamble:

The course provides various mathematical techniques for solving quantitative problems, using short-cut methods.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Apply appropriate arithmetical methods to solve the problems on Numbers.	85	80
CO2	Demonstrate various methods involved in solving decimal fractions.	85	80
CO3	Evaluate various arithmetic operations, using simplifications.	80	75
CO4	Find the usage of averages in all spheres of careers.	85	80
CO5	Relate various data, using ratio and proportions.	80	75

Mapping of COs with PSOs:

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	S	M
CO2	M	M	S	M	M
CO3	S	S	S	M	M
CO4	S	M	M	S	S
CO5	S	S	M	M	S

Mapping of COs with POs:

B.Sc. P.O.

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	S	S	M	L
CO2	M	S	M	S	S	M
CO3	S	M	S	M	S	M
CO4	S	S	M	M	S	S
CO5	S	S	M	M	S	S

B.A. P.O.

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	S	M	S	S
CO2	S	S	M	M	S	S
CO3	M	S	S	S	S	M
CO4	S	S	S	M	S	S
CO5	S	M	S	M	M	S

B.B.A. P.O.

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	M	S	M	M	M	M
CO2	S	M	S	S	S	M
CO3	M	S	S	S	S	M
CO4	S	M	S	S	S	S
CO5	S	S	S	S	S	S

B.C.A. P.O.

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	M	S	S	L
CO2	M	S	S	M	S	M
CO3	S	M	S	S	M	S
CO4	S	S	S	M	M	S
CO5	S	S	S	M	M	S

B.Com. P.O.

#	PO1	PO2	PO3	PO4	PO5
CO1	M	S	S	M	S
CO2	S	M	S	S	M
CO3	M	S	S	S	M
CO4	M	S	S	S	M
CO5	S	S	M	S	S

Bloom's Taxonomy:

#	CA		End of Semester
	First	Second	
Knowledge (K1)	40%	40%	40%
Understand (K2)	40%	40%	40%
Apply (K3)	20%	20%	20%

Contents:

Unit I **(6Hours)**

Number System - Divisibility

Unit II **(6 Hours)**

HCF and LCM of Numbers - Decimal Fractions.

Unit III **(6 Hours)**

Simplification.

Unit IV **(6 Hours)**

Average - Problems on Ages.

Unit V **(6 Hours)**

Ratio and Proportion.

Text Book:

Dr. Aggarwal. R.S., 2017, Quantitative Aptitude for Competitive Examinations, S. Chand and Co., New Delhi.

Unit	Section(Chapter)
I	I(1)
II	I(2,3)
III	I(4)
IV	I(6,8)
V	I(13)

References:

1. M. Tyra and K. Kundan, 2018, Magical Book on Quicker Maths, Tyrasons Publication, Delhi.
2. Abhijit Guha, 2016, Quantitative Aptitude for Competitive Examinations, Third Edition, Tata McGraw- Hill Publishing company Limited, New Delhi.
3. Arora. P.N. and Arora. S, 2009, Quantitative Aptitude Mathematics, Volume- 1, S Chand & Company Ltd., New Delhi.

Web Resources:

1. https://bankersway.com/quantitative-aptitude-maths-free-study-materials-pdf-competitive-exam/
2. https://www.careerbless.com/aptitude/qa/home.php
3. https://www.sawaal.com/aptitude-reasoning/quantitative-aptitude-arithmetic-ability/problems-on-ages-questions-and-answers.html

Course Designers:

1. Dr. K. Kayathri
2. Mrs. D. Princy

THIAGARAJAR COLLEGE, MADURAI – 9.

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined B.Sc. on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
UMA23NT21	**Mathematics for Competitive Examinations - II**	**NME**	**2**	**-**	**-**	**2**

L - Lecture T - Tutorial P–Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	100

Preamble:

The course provides many mathematical facts, formulas and various mathematical techniques for solving quantitative problems.

Course Outcomes:

#	Course Outcome	Expected Proficiency(%)	Expected Attainment (%)
CO1	Formulate the problem quantitatively and recall appropriate arithmetical methods to solve the problem.	85	80
CO2	Demonstrate various methods involved in solving mathematical problems.	85	75
CO3	Evaluate various real life situations by resorting to analysis of key issues and factors.	80	70
CO4	Find the use of aptitude in all spheres of careers and prepare for them precisely.	85	80
CO5	Compare the permutations and combinations in different cases. Apply the principle of counting to solve the problems.	80	70

Mapping of COs with PSOs:

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	M	S
CO2	M	S	M	L	L
CO3	M	L	L	S	M
CO4	M	M	S	S	M
CO5	M	L	M	S	M

Mapping of COs with POs:

B.Sc.P.O.

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	M	S	M	M	M	M
CO2	M	S	M	M	S	S
CO3	S	M	M	S	S	M
CO4	M	S	M	M	M	S
CO5	M	S	S	M	M	M

B.A. P.O.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	S	M	S	S
CO2	S	S	M	M	S	S
CO3	M	S	S	S	S	M
CO4	S	S	S	M	S	S
CO5	S	M	S	M	M	S

B.B.A. P.O.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	M	S	M	M	M	M
CO2	S	M	S	S	S	M
CO3	M	S	S	S	S	M
CO4	S	M	S	S	S	S
CO5	S	S	S	S	S	S

B.C.A. P.O.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	M	S	M	S	M	M
CO2	M	S	S	M	M	S
CO3	S	M	S	S	S	M
CO4	M	S	M	S	M	S
CO5	M	S	M	S	M	M

B.Com. P.O.

	PO1	PO2	PO3	PO4	PO5
CO1	M	S	S	M	S
CO2	S	M	S	S	M
CO3	M	S	S	S	M
CO4	M	S	S	S	M
CO5	S	S	M	S	S

Bloom's Taxonomy:

#	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%

Contents:

Unit I **(6 Hours)**

Percentage - Profit and Loss.

Unit II **(6 Hours)**

Time and Work - Time and Distance.

Unit III **(6 Hours)**

Problems on trains - Alligation or Mixture.

Unit IV **(6 Hours)**

Simple interest – Compound interest.

Unit V **(6 Hours)**

Permutations and Combinations.

Text Book:

Dr. R. S. Aggarwal. R.S., 2017, Quantitative Aptitude for competitive Examinations, S. Chand and Co., New Delhi.

Unit	Section
I	I(11,12)
II	I(17,18)
III	I(20,21)
IV	I(22,23)
V	I(30)

References:

1. M. Tyra and K. Kundan, 2018, Magical Book on Quicker Maths, Tyrasons Publication, Delhi.
2. Abhijit Guha, 2016, Quantitative Aptitude for Competitive Examinations, Third Edition, TataMcGraw- Hill Publishing company Limited, New Delhi.
3. Arora. P.N. and Arora. S., 2009, Quantitative Aptitude Mathematics, Volume- 1 S Chand & Company Ltd., New Delhi.

Web Resources:

1. https://bankersway.com/quantitative-aptitude-maths-free-study-materials-pdf-competitive-exam/
2. https://www.careerbless.com/aptitude/qa/home.php
3. https://www.sawaal.com/aptitude-reasoning/quantitative-aptitude-arithmetic-ability/problems-on-ages-questions-and-answers.html

Course Designers:

1. Mrs. S. Shanavas Parvin
2. Mr. K. V. Janarthanan

Skill Enhancement Courses (SEC)

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(For those who joined B.Sc. Mathematics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
UMA23ST21(A)	**Combinatorics**	**SEC**	**2**	**-**	**-**	**2**

L - Lecture T - Tutorial P–Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	100

Preamble:

The course deals with fundamental principles of counting which has important applications in all the areas of mathematics as well as natural sciences. It deals with problems related to the Pigeonhole Principle, Permutation and Combination and Sum and Product rules which have applications in all the fields.

Course Outcomes:

#	Course Outcome	Expected Proficiency(%)	Expected Attainment (%)
CO1	Relate and apply sum and product rules to problems	80	70
CO2	Analyze and solve problems related to Permutation and Combination	70	65
CO3	Solve problems related to the Pigeonhole Principle	65	60
CO4	Classify and solve various problems using product rules	70	60
CO5	Distinguish the difference between Permutation and Combination	70	60

Mapping of COs with PSOs:

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	S	L
CO2	L	M	M	S	S
CO3	L	S	S	M	M
CO4	S	M	S	M	L
CO5	M	S	M	M	S

Mapping of COs with POs:

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	S	M	M	L	L
CO2	S	S	M	M	M	M
CO3	M	S	M	M	L	L
CO4	M	S	M	L	L	M
CO5	S	S	M	M	M	M

Bloom's Taxonomy:

#	CA		End of Semester
	First	Second	
Knowledge(K1)	40%	40%	40%
Understand(K2)	40%	40%	40%
Apply(K3)	20%	20%	20%

Contents:

Unit I **(6 Hours)**

The Sum Rule and the Product Rule - Solved Problems on the Sum Rule and the Product Rule.

Unit II **(6 Hours)**

Permutations and Combinations.

Unit III **(6 Hours)**

Solved Problems on Permutations and Combinations.

Unit IV **(6 Hours)**

The Pigeonhole Principle.

Unit V **(6 Hours)**

Solved Problems on the Pigeonhole Principle.

Text Book:

Balakrishnan V. K., 2005, Theory and Problems of Combinatorics, Schaum's Outline Series, Tata McGraw- Hill Publishing Company Limited, New Delhi.

Unit	Chapter/Sections
I	Chapter 1 (1.1)
II	Chapter 1(1.2)
III	Chapter 1(1.2)
IV	Chapter 1(1.3)
V	Chapter 1(1.3)

References:

1. Alan Tucker, 2012, Applied Combinatorics, 6th Edition, Wiley, New Jersey.
2. Krishnamurthy V., 1985, Combinatorics Theory and Applications, East- West Press Pvt. Ltd India.
3. Ralph P. Grimaldi, and RamanaB.V., 2004, Discrete and Combinatorial Mathematics, PearsonEducation, Inc., Copyright 2007, Dorling Kindersley (India) Pvt. Ltd.
4. Vasudev C., 2005, Theory and Problems of Combinatorics, New Age international Publishers, NewDelhi.

Web Resources:

1. http://www.cs.iit.edu/~wan/cs330/Chapter6-counting.pdf
2. http://pages.stat.wisc.edu/~ifischer/Intro_Stat/Lecture_Notes/APPENDIX/A1._Basic_Reviews/A1.2_-_Perms_and_Combos.pdf
3. http://www.cs.cornell.edu/courses/cs280/2004fa/280wk6_x4.pdf
4. https://homepage.cs.uri.edu/faculty/hamel/courses/2012/fall2012/csc447/lecture-notes/csc447-ln015a.pdf

Course Designers:

1. Mr. M. Madhavan
2. Dr. D. Murugeswari

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined B.Sc. Mathematics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
UMA23ST21(B)	**Introduction to GeoGebra**	**SEC**	**2**	**-**	**-**	**2**

L - Lecture T - Tutorial P–Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	100

Preamble:

The course helps to explore, visualize and construct the mathematical concepts.

Course Outcomes:

On the completion of the course the student will be able to

	Course Outcome	Expected Proficiency(%)	Expected Attainment(%)
CO1	Demonstrate understanding of functions and shapes in analytical geometry	85	80
CO2	Analyze and graph functions and shapes	85	80
CO3	Generate new functions and shapes	85	80
CO4	Communicate mathematical concepts and solutions effectively both orally and in writing	85	80
CO5	Graph and analyze two and three dimensional curves	85	80

Mapping of COs with PSOs:

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	L	L
CO2	M	S	M	M	M
CO3	L	S	L	M	L
CO4	M	S	M	M	M
CO5	L	M	L	S	M

Mapping of COs with POs:

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	M	S	S	S	L	M
CO2	S	S	L	S	M	L
CO3	S	S	L	M	L	M
CO4	S	M	S	L	M	L
CO5	M	S	S	M	S	L

Bloom's Taxonomy:

#	CA		End of Semester
	First	Second	
Knowledge(K1)	40%	40%	40%
Understand(K2)	40%	40%	40%
Apply(K3)	20%	20%	20%

Contents:

List of Programs:

1. Plot the graph of a given function.
2. Find the intercept of a given function.
3. Analyze the symmetry (odd/even) of a given function.
4. Investigate the domain and range of a given function.
5. Check the one-one and onto of a given function.
6. Find the inverse of a given function and plot the inverse function in the same graph.
7. Transform a given function into another through such as translation, reflection.
8. Combine two or more functions.
9. Investigate the limits at specific points of a given function.
10. Investigate the continuity of a given function and find the discontinuity points.
11. Analyze the behavior of a given function using first and second order derivatives.
12. Fit a curve.
13. Plot trigonometric functions and its inverse.
14. Graph the functions in polar coordinates and analyze their behavior.
15. Graph the functions in parametric form and analyze their behavior.
16. Graph and analyze two dimensional curves.
17. Graph and analyze three dimensional solids.
18. Find the distance between two points and midpoints of a line segment in two and three dimensions.
19. Graph parallel and perpendicular lines and analyze their properties such as slope and intercepts.
20. Find the equation of a plane in standard form, point normal form or intercept form, given three collinear points or a point and two lines.

References:

Judith Hohenwarter, Markus Hohenwarter, 2011, Introduction to GeoGebra, International GeoGebra Institute.

Web Resources:

1. http://ir.riemysore.ac.in:8080/jspui/bitstream/123456789/44/1/Geogebra%20and%20EXE%20Training%20Handbook-2015.pdf
2. https://matek.fazekas.hu/images/konyvek/GeoGebra-en-Manual_2016.pdf

Course Designers:

1. Mrs. K. Ponmari
2. Dr. R. Lakshmanan

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined B.Sc. Mathematics on or after June 2023)

CourseCode	Course Title	Category	L	T	P	Credits
UMA23FT11	**Foundation Course**		**2**	**-**	**-**	**2**

L-Lecture T-Tutorial P–Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	25	75	100

Preamble:

This course bridges the gap and facilitates transition from higher secondary to tertiary education. It instils confidence among stakeholders and inculcates interest for problem solving abilities, logical and analytical thinking.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Relate logic theory to frame logical statements	85	80
CO2	Demonstrate Mathematical Statements and Proofs	85	75
CO3	Define and analyze functions between Mathematical Structures	80	70
CO4	Classify various types of relations between Sets	85	75
CO5	Apply Principles of Induction for proving Mathematical results	85	80

Mapping of COs with PSOs:

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	M	M	L
CO2	L	S	M	S	M
CO3	M	L	S	S	M
CO4	M	M	S	S	L
CO5	L	S	M	M	S

Mapping of COs with POs:

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	S	M	M	M	L
CO2	M	S	M	L	M	L
CO3	L	S	S	M	M	M
CO4	M	M	M	M	S	L
CO5	S	M	L	M	S	S

Bloom's Taxonomy:

	CA		End of Semester
	First	Second	
Knowledge	40%	40%	40%
Understand	40%	40%	40%
Apply	20%	20%	20%

Contents:

Unit I **(6 Hours)**

Statements and Logic

Statements- Statements with quantifiers - Compound Statements.

Unit II **(6 Hours)**

Implications – Proofs in Mathematics.

Unit III **(6 Hours)**

Functions

Basic definitions – One - one, onto functions and bijections.

Unit IV **(6 Hours)**

Relation

Relations on sets- Types of relations- Equivalence relations.

Unit V **(6 Hours)**

Induction Principles

The Induction Principle – The Strong Induction Principle.

Text Book:

Ajit Kumar, S. Kumaresan, Bhaba Kumar Sarma, 2018, A Foundation Course in Mathematics, Narosa Publishing House Pvt. Ltd, New Delhi, India.

Unit	Section
I	1(1.1, 1.2, 1.3)
II	1(1.4, 1.5)
III	3(3.1, 3.2)
IV	4(4.1, 4.2, 4.3)
V	5(5.1, 5.2)

Reference Books:

1. Daniel Ashlock, Colin Lee, 2020, An Introduction to Proofs with Set Theory, Morgan & Claypool Publishers, California, USA.
2. David Makinson, 2020, Sets, Logic and Maths for Computing, Springer International Publishing, New York, USA.
3. Daniel W. Cunningham, 2012, A Logical Introduction to Proof, Springer, New York, USA.

Web Resources:

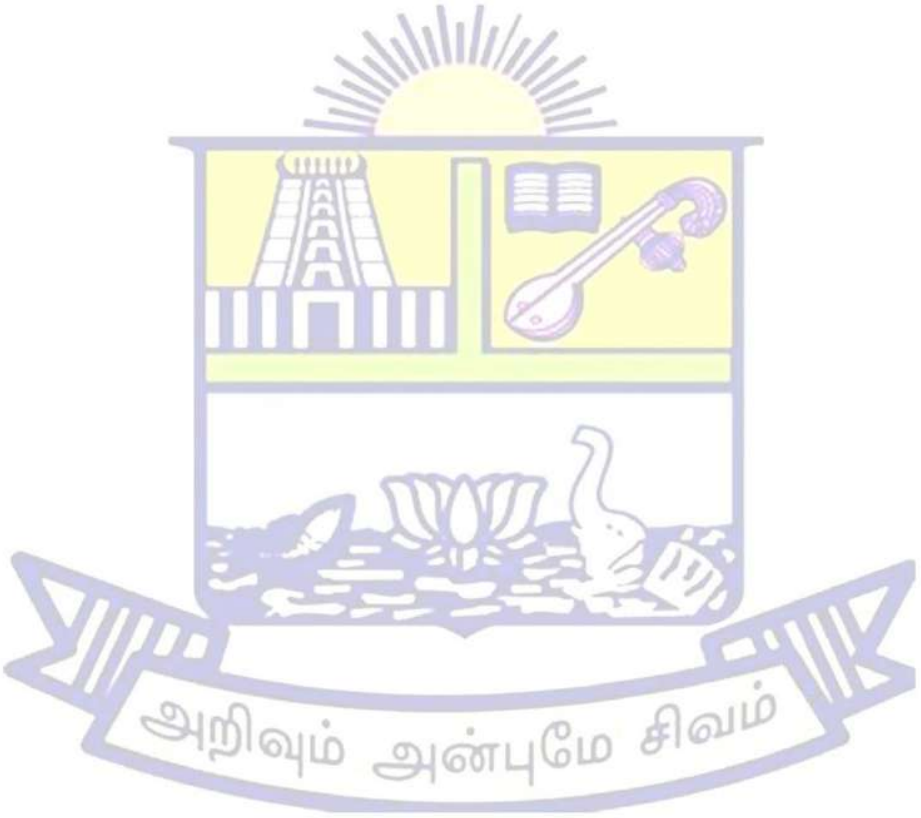
1. https://books.google.com/books?id=4DLnDwAAQBAJ&printsec=frontcover&dq=logic,+functions,+relations,+induction+principle&hl=en&newbks=1&newbks_redir=1&sa=X&ved=2ahUKEwi76vjpq8z-AhUC-jgGHYMUD20Q6AF6BAgFEAI

2. https://mtts.org.in/training-programmes/foundation-course-in-mathematics

3. https://mtts.org.in/programme/online-foundation-course-in-mathematics-ofcm-2021

Course Designers:

1. Dr. K. Kayathri
2. Mrs. S. Shanavas Parvin



Value Added Course

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined B.Sc. Mathematics on or after June 2023)

Course	Certificate course	Int. Marks	25
Class	I Year	Ext. Marks	75
Semester	I and II	Max. Marks	100
Hours	20 Hours / Semester		

Course Title / Code : **Certificate Course in LATEX / UMA23COPL**

Text formatting

TEX and its offspring – What's different in LaTex 2ε – Distinguishing LATEX 2ε –Basics of LATEX file.

Commands and environments

Command names arguments – Environments – Declarations – Lengths – SpecialCharacters – Exercise – Fine-tuning text – Word division.

Document Layout and Organization

Document class – Page style – Parts of the document – Table of contents.

Displayed Text

Changing font – Centering and indenting – Lists – Generalizes lists – Theorem-likedeclarations – Tabular stops – Boxes.

Mathematical formulae

Mathematical environments – Main elements of Math mode – Mathematical symbols – Additional elements – Fine-tuning Mathematics.

Graphics inclusion

The graphics packages.

Floating tables and figures

Float placement – Postponing floats – Style parameters for floats – Float captions – Float examples – References to figures and tables in text – Some float packages.

Reference Book:

H. Kopka and P.W. Daly, 1999, A Guide to LATEX , 4th Edition, Addision-Wesley.

M.Sc. Mathematics

Programme Code - PMA

Programme Outcome - PO (Aligned with Graduate Attributes)- Master of Science (M.Sc.)

PO 1 Knowledge

Acquire an overview of concepts, fundamentals and advancements of science across a range of fields, with in-depth knowledge in at least one area of study. Develop focused field knowledge and amalgamate knowledge across different disciplines.

PO 2 Complementary Skills

Students will be able to engage in critical investigation through principle approaches or methods and through effective information search and evaluation strategies. Employ highly developed conceptual, analytical, quantitative and technical skills and are adept with a range of technologies.

PO 3 Applied Learning

Students will be able to apply disciplinary or interdisciplinary learning across multiple contexts, integrating knowledge and practice. Recognize the need for information; effectively search for, evaluate, manage and apply that information in support of scientific investigation or scholarly debate.

PO 4 Communication

Communicate effectively on scientific achievements, basic concepts and recent developments with experts and with society at large. Able to comprehend and write reports, documents, make effective presentation by oral and/or written form.

PO 5 Problem Solving

Investigate, design and apply appropriate methods to solve problems in science, mathematics, technology and/or engineering.

PO 6 Environment and Sustainability

Understand the impact of the solutions in ethical, societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.

PO 7 Teamwork, Collaborative and Management Skills

Recognise the opportunities and contribute positively in collaborative scientific research. Engage in intellectual exchange of ideas with researchers of other disciplines to address important research issues.

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(For those who joined M.Sc. Mathematics on or after June 2023)

Programme Educational Objectives (PEO) for M.Sc. Mathematics

The objectives of this programme is

PEO 1	To provide students with advanced mathematical and computational skills that prepares them to pursue higher studies and conduct research.
PEO 2	To train students to deal with the problems faced by software industry through knowledge of mathematics and scientific computational techniques.
PEO 3	To develop independent learning skills and transferable skills among the students
PEO 4	To increase students self-confidence in conducting research independently or within a team
PEO 5	To develop an in-depth understanding of the fundamentals of Mathematics and create a foundation of lifelong learning to facilitate progressive careers in industry.

Programme Specific Outcomes for M.Sc. Mathematics

On the successful completion of M.Sc. Mathematics, the students will be able to

PSO 1	Formulate complete, concise and correct mathematical proofs.
PSO 2	Frame problems using multiple mathematical structures and relationships and solve using standard techniques.
PSO 3	Create quantitative models to solve real world problems in appropriate contexts.
PSO 4	Recognize and appreciate the connections between theory and applications and effectively use professional level technological tools to support the study of mathematics.
PSO 5	Clearly communicate quantitative and theoretical ideas in mathematics.

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2023)

COURSE STRUCTURE (w.e.f. 2023 batch onwards)

M.Sc. Mathematics - Programme Code: PMA

SEMESTER – I

Code No.	Subject	Contact Hours / Week	Credits	Total Number of Hours Allotted	Max. Marks CA	Max. Marks SE	Total
PMA23CT11	Algebraic Structures	5	4	75	25	75	100
PMA23CT12	Real Analysis – I	5	4	75	25	75	100
PMA23CT13	Ordinary Differential Equations	5	4	75	25	75	100
PMA23ET11 (A/B/C/D)	A Course from Group I	5	3	75	25	75	100
PMA23ET12 (A/B/C/D)	A Course from Group II	5	3	75	25	75	100
PMA23SL11 (A/B/C)	A Course from SEC 1	3	2	45	25	75	100
PMA23AT11	Basic Soft Skills	2	2	30	25	75	100
TOTAL		**30**	**22**				

SEMESTER - II

Code No.	Subject	Hours / Week	Credits	Total Hours Allotted	Max. Marks CA	Max. Marks SE	Total
PMA23CT21	Advanced Algebra	5	4	75	25	75	100
PMA23CT22	Real Analysis -II	5	4	75	25	75	100
PMA23CT23	Partial Differential Equations	5	4	75	25	75	100
PMA23ET21 (A/B/C/D)	A Course from Group III	5	3	75	25	75	100
PMA23ET22 (A/B/C/D)	A Course from Group IV	5	3	75	25	75	100
PMA23SL21 (A/B)	A Course from SEC 2	3	2	45	25	75	100
PMA23AT21	Academic Soft Skills	2	2	30	25	75	100
TOTAL		**30**	**22**				

Elective Courses are opted from the Groups

Group I

A) Number Theory and Cryptography
B) Computer Algorithms and Data Structure
C) Object Oriented Program with C++
D) Formal Languages and Automata Theory

Group II

A) Graph Theory and its Applications
B) Fuzzy Sets and its Applications
C) Discrete Mathematics
D) Programming in Java

Group III

A) Numerical Analysis
B) Fluid Dynamics
C) Coding Theory
D) Algebraic Graph Theory

Group IV

A) Mathematical Python
B) Neural Networks
C) Dynamical Systems
D) Data Mining

Skill Enhancement Courses (SEC) for I and II Semester

SEC 1: Semester -I

A) Differential Equations using SCILAB
B) Lab in C++
C) Lab in JAVA Programming

SEC 2: Semester –II

A) Lab in Python
B) Numerical Analysis using SCILAB

Ability Enhancement Compulsory Courses (AECC)

1) Basic Soft Skills
2) Academic Soft Skills

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POSTGRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
PMA23CT11	**Algebraic Structures**	**Core**	**4**	**1**	**-**	**4**

L – Lecture T – Tutorial P – Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	25	75	100

Course Designers:

The course demonstrates the method of counting the number of Sylow subgroups, solvability of groups and the structure theorem for finite abelian groups. The irreducibility of polynomials are discusses. The various types of linear transformations are elaborately discussed.

Prerequisite:

Basic knowledge in Groups, Rings and Vector spaces.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Find the number of Sylow subgroups in a group and class equation of a group	90	85
CO2	Explain the direct product of groups and the structure of finite Abelian groups	80	80
CO3	Examine advanced ideas in the algebraic structures	90	85
CO4	Demonstrate and analyze the various forms of a linear transformation	85	80
CO5	Analyse the trace and transpose of various types of linear transformation	85	81

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**S**	**L**	**M**
CO2	**S**	**M**	**M**	**L**	**S**
CO3	**L**	**S**	**S**	**M**	**M**
CO4	**M**	**M**	**S**	**S**	**L**
CO5	**S**	**S**	**M**	**L**	**M**

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M	M	L	L	M	M
CO2	S	S	M	L	M	L	M
CO3	M	M	L	M	S	S	M
CO4	L	L	M	S	S	S	L
CO5	L	M	S	S	M	L	L

Bloom's Taxonomy:

	CA		End of Semester
	First	Second	
Knowledge – K1	15%	15%	20%
Understand – K2	15%	15%	20%
Apply – K3	30%	30%	20%
Analyze –K4	20%	20%	20%
Evaluate- K5	20%	20%	20%

Contents:

Unit - I **(15 Hours)**

Another counting principle – Sylow's theorem (For theorem 2.12.1, first proof only and omit Lemma 2.12.5)

Unit - II **(15 Hours)**

Solvable Groups(Lemmas 5.7.1, 5.7.2 and Theorem 5.7.1 only) – Direct products – Finite Abelian groups

Unit - III **(15 Hours)**

Linear Transformations: Canonical forms –Triangular form - Nilpotent transformations

Unit - IV **(15 Hours)**

Jordan form - Rational canonical form.

Unit – V **(15 Hours)**

Trace and transpose – Hermitian, unitary, normal transformations, Real Quadratic forms.

Text Book:

Herstein. I.N., 2014, Topics in Algebra, Wiley Student Edition, India.

Unit	Chapter/Section
I	2(2.11 – 2.12)
II	2(2.13 – 2.14), 5(5.7)
III	6(6.4, 6.5)
IV	6(6.6 – 6.7)
V	6(6.8, 6.10, 6.11)

References:

1. Richard M. Foote and David S. Dummit , 2011, Abstract Algebra, John Wiley Publications.
2. Joseph A Gallian, 1999, Contemporary Abstract Algebra, Narosa Publication, 1999.
3. Vijay K Khanna and S.K. Bhambri , 2015, A course in Abstract Algebra, Vikas Publishing House Pvt. Ltd., New Delhi.

Course Designers:

1. Dr. G. Prabakaran
2. Mr. G. Gowtham

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
PMA23CT12	**Real Analysis-I**	**Core**	**4**	**1**	**-**	**4**

L - Lecture T - Tutorial P–Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	25	75	100

Preamble:

The course presents the analysis of integration, uniform convergence of sequences and series of functions. Uniform convergence plays a key role in finding approximate solutions to theoretical and practical problems.

Prerequisite:

Basic knowledge in set theoretic concepts, functions, sequences, series, limit, continuity, discontinuity, compactness and connectedness in metric spaces and familiar with methods of proofs.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Analyze and evaluate functions of bounded variation.	85	80
CO2	Describe the concept of Riemann-Stieltjes integral and its properties.	80	75
CO3	Identify the existence of Riemann-Stieltjes integral and estimate the integral using Mean Value theorems.	80	75
CO4	Recall and describe the double sequences and power series development.	85	80
CO5	Identify and Classify the sequence of functions which are pointwise and uniform convergence.	85	80

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**L**	**L**	**S**	**M**	**L**
CO2	**S**	**L**	**L**	**L**	**L**
CO3	**S**	**L**	**L**	**L**	**L**
CO4	**L**	**M**	**L**	**L**	**S**
CO5	**M**	**M**	**M**	**S**	**M**

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	S	M	M	M
CO2	S	M	M	M	L	L	L
CO3	S	M	M	M	M	L	L
CO4	S	M	S	M	S	M	M
CO5	S	S	S	M	S	L	M

Bloom's Taxonomy:

	CA		End of Semester (Marks)
	First(Marks)	Second(Marks)	
Knowledge – K1	15%	15%	20%
Understand – K2	15%	15%	20%
Apply – K3	30%	30%	20%
Analyze –K4	20%	20%	20%
Evaluate- K5	20%	20%	20%

Contents:

Unit I **(13 Hours)**

Functions of Bounded Variation: 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.

Infinite Series: Alternating series - Absolute and conditional convergence – Dirichlet's test and Abel's test – Rearrangement of series – Riemann's theorem on conditionally convergent series.

Unit II **(15 Hours)**

The Riemann – Stieltjes Integral: 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 – Step functions as integrators – Reduction of a Riemann Stieltjes integral to a finite sum - Euler's summation formula – Monotonically increasing integrators, Upper and lower integrals – Additive and linearity properties of upper and lower integrals – Riemann's condition – Comparison theorems.

Unit III **(16 Hours)**

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

Interchanging the order of integration - Lebesgue's criterion for existence of Riemann integrals.

Unit IV **(16 Hours)**

Infinite Series and Infinite Products: Double sequences – Double series – Rearrangement theorem for double series - A sufficient condition for equality of iterated series – Multiplication of series – Cesaro summability – Infinite products.

Power series: Power series - Multiplication of power series – The Taylor's series generated by a function – Bernstein's theorem – Abel's limit theorem – Tauber's theorem.

Unit V **(15 Hours)**

Sequences of Functions: Pointwise convergence of sequences of functions – Examples of sequences of real valued functions – Definition of Uniform convergence – Uniform convergences and continuity – The Cauchy condition for uniform convergence – Uniform convergence of infinite series of functions - Uniform convergence and Riemann – Stieltjes integration – Non-uniformly convergence sequences that can be integrated term by term – Uniform convergence and differentiation – Sufficient conditions for uniform convergence of a series – Mean convergence.

Text Book:

Tom M. Apostal, 1986, Mathematical Analysis, 2nd Edition, Narosa Publishing House, New Delhi.

Unit	Chapter/Sections
I	6(6.1 to 6.8), 8(8.7, 8.8, 8.15, 8.17, 8.18)
II	7(7.1 to 7.14)
III	7 (7.15 to 7.26)
IV	8(8.20-8.26), 9(9.14, 9.15, 9.19, 9.20, 9.22, 9.23)
V	9 (9.1 to 9.6, 9.8 to 9.11, 9.13)

References:

1. Walter Rudin, 2013, Principles of Mathematical Analysis, Third Edition McGraw - Hill Education (India) Pvt. Ltd., New Delhi.
2. Robert G. Bartle, Donald R. Sherbert, 2011, Introduction to real analysis, 4th edition, John Wiley & sons, Inc.
3. Stephen Abbott, 2010, Understanding Analysis, Springer Verlag, New York.

Web Resources:

1. https://mathcs.org/analysis/reals/integ/riemann.html
2. https://www.coursera.org/lecture/mathematical-thinking/lecture-10c-real-analysis-3-yQjDP
3. https://www.digimat.in/nptel/courses/video/111106142/L01.html
4. https://youtube.com/playlist?list=PLOzRYVm0a65cpVtcdj_5SBEh6VQvC_BvR

Course Designers:

1. Mrs. R. Latha
2. Mr. K.V. Janarthanan

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POSTGRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
PMA23CT13	**Ordinary Differential Equations**	**Core**	**4**	**1**	**-**	**4**

L – Lecture T – Tutorial P - Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	25	75	100

Preamble:

To develop strong background on finding solutions to linear differential equations with constant and variable coefficients and also with singular points, to study existence and uniqueness of the solutions of first order differential equations.

Prerequisite:

Knowledge in differential calculus.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Define wronskian and solve initial value problem of second order equations	80	65
CO2	Apply the method of annihilator to solve the non-homogeneous equations	80	70
CO3	Analyze the existence and uniqueness of solutions of a non – homogeneous equation	80	70
CO4	Demonstrate the concepts of linear equations with regular singular points	80	60
CO5	Explain the Lipschitz condition and convergence of the successive approximations	80	60

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**L**	**S**	**M**	**L**	**L**
CO2	**S**	**L**	**L**	**L**	**L**
CO3	**S**	**S**	**L**	**M**	**L**
CO4	**L**	**L**	**L**	**S**	**M**
CO5	**S**	**L**	**M**	**M**	**L**

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	L	S	L	S	L	L
CO2	S	L	L	L	M	M	L
CO3	S	L	L	L	S	L	L
CO4	L	S	L	S	L	L	L
CO5	L	M	L	L	S	M	S

Bloom's Taxonomy:

	CA		End of Semester
	First	Second	
Knowledge – K1	15%	15%	20%
Understand – K2	15%	15%	20%
Apply – K3	30%	30%	20%
Analyze –K4	20%	20%	20%
Evaluate- K5	20%	20%	20%

Contents:

Unit I **(15 Hours)**

Linear Equations with Constant Coefficients: Introduction - The second order homogeneous equation - Initial value problems for second order equations - Linear dependence and independence - A formula for the Wronskian - The non-homogeneous equation of order two.

Unit II **(15 Hours)**

Linear Equations with Constant Coefficients: The homogeneous equation of order n – Initial value problems for n-th order equations - Equations with real constants - The non-homogeneous equation of order n - A special method (Annihilator method) for solving the non-homogeneous equation - Algebra of constant coefficient operators.

Unit III **(15 Hours)**

Linear Equations with Variable Coefficients: Introduction - Initial value problems for the homogeneous equation - Solutions of the homogeneous equation - The wronskian and linear independence - Reduction of the order of a homogeneous equation - The non-homogeneous equation - Homogeneous equations with analytic coefficients - The Legendre equation.

Unit IV **(15 Hours)**

Linear Equations with Regular Singular Points: Introduction - The Euler equation – Second order equations with regular singular points – The exceptional cases – The Bessel equation.

Unit V **(15 Hours)**

Existence and Uniqueness of Solutions to First Order Equations: Introduction – Equations with variables separated - Exact equations - The method of uccessive approximations – The Lipschitz condition - Convergence of the successive approximations**.**

Text Book:

E. A. Coddington, 2012, An Introduction to Ordinary Differential Equations, Prentice - Hall of India Ltd., New Delhi.

Unit	Chapter/Section
I	2 (1 - 6)
II	2 (7 - 12)
III	3 (1 - 8)
IV	4 (1 – 4, 6 - 8)
V	5 (1 - 6)

References:

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

Course Designers:

1. Dr. M. Senthilkumaran
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THIAGARAJAR COLLEGE, MADURAI – 9

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
PMA23CT21	Advanced Algebra	Core	4	1	-	4

L – Lecture T – Tutorial P - Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	100

Preamble:

This course provides hands-on exploration of the relevancy of Extension of Field, Roots of Polynomials, Galois Theory and Properties of Finite Fields.

Prerequisite:

Knowledge in basic definitions and properties of algebra.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Classify the types of polynomial rings and analyse the polynomial rings over a rational field and a commutative field.	80	70
CO2	Recall and construct extensions of a given field	80	75
CO3	List and identify the extensions such as finite, algebraic, simple and normal	80	75
CO4	Find the degree of the splitting field of a polynomial and explain the properties of finite fields	80	65
CO5	Gain in depth knowledge on the theory of numbers through the algebraic concepts	80	70

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	M	L
CO2	S	M	L	M	L
CO3	M	L	M	S	S
CO4	S	S	S	L	L
CO5	S	M	S	L	M

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M	S	L	M	M	L
CO2	M	L	S	S	L	L	M
CO3	M	S	M	S	M	L	L
CO4	S	M	S	L	M	S	M
CO5	M	L	S	M	M	L	L

Bloom's Taxonomy:

	CA		End of Semester
	First	Second	
Knowledge – K1	15%	15%	20%
Understand – K2	15%	15%	20%
Apply – K3	30%	30%	20%
Analyze –K4	20%	20%	20%
Evaluate- K5	20%	20%	20%

Contents:

Unit - I **(15 Hours)**

Polynomial Rings - Polynomials over the Rational field – Polynomial Rings over Commutative Rings

Unit - II **(15 Hours)**

Extension Fields – The Transcendence of e.

Unit - III **(15 Hours)**

Roots of polynomials – More about roots.

Unit – IV **(15 Hours)**

The elements of Galois Theory – Finite Fields.

Unit – V **(15 Hours)**

A theorem of Frobenius – Integral Quaternions and the Four-Square theorem.

Text Book:

Herstein. I.N., 2014, Topics in Algebra, Wiley Student Edition.

Unit	Chapter/Section
I	3(3.9, 3.10, 3.11)
II	5(5.1, 5.2)
III	5(5.3, 5.5)
IV	5(5.6), 7(7.1)
V	7(7.3, 7.4)

References:

1. Vijay K Khanna and S.K. Bhambri, 2015, A course in Abstract Algebra, Vikas Publishing House Pvt. Ltd., New Delhi.
2. Richard M. Foote and David S. Dummit, 2011, Abstract Algebra, John Wiley Publications.
3. Joseph A Gallian, 1999, Contemporary Abstract Algebra, Narosa Publication.

Course Designers:

1. Dr. G. Prabakaran
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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
PMA23CT22	Real Analysis - II	**Core**	**4**	**1**	**-**	**4**

L - Lecture T - Tutorial P–Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	100

Preamble:

The course provides a study of Lebesgue measure. It elaborates the concepts of measurable sets and measurable functions. It gives characterizations of Lebesgue integrable functions. It deals with some decomposition theorems in measurable space. It gives in-depth knowledge in multivariable calculus.

Prerequisite:

Basic knowledge in analysis including the Riemann Integral, basic knowledge of metric and topological spaces.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficieny (%)	Expected Attainment (%)
CO1	Explain the concepts of Lebesgue measure, measurable sets and measurable functions	85	80
CO2	Infer the ideas of measurable functions and explore approximations	80	75
CO3	Analyze and evaluate Fourier series and Fourier integrals	80	75
CO4	Perform differential calculus operations on functions of several variables including continuity, partial derivatives and directional derivatives.	85	80
CO5	Gain in depth knowledge on functions of several variables and the use of implicit function theorem.	80	75

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**L**	**L**	**M**	**S**
CO2	**S**	**M**	**L**	**L**	**M**
CO3	**M**	**M**	**L**	**L**	**M**
CO4	**S**	**L**	**L**	**L**	**M**
CO5	**M**	**L**	**L**	**S**	**L**

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	L	M	M	L	L	S
CO2	M	S	L	S	L	L	L
CO3	S	M	M	L	S	L	M
CO4	S	M	M	L	M	L	M
CO5	M	L	M	M	M	L	L

Bloom's Taxonomy:

	CA		End of Semester (Marks)
	First(Marks)	Second(Marks)	
Knowledge – K1	15%	15%	20%
Understand – K2	15%	15%	20%
Apply – K3	30%	30%	20%
Analyze –K4	20%	20%	20%
***Evaluate*-** **K5**	20%	20%	20%

Contents:

Unit I **(15 Hours)**

Measure on the Real Line – Lebesgue Outer Measure – Measurable Sets – Regularity – Measurable Function – Borel and Lebesgue Measurability.

Unit II **(13 Hours)**

Integration of Functions of a Real Variable – Introduction of Non – negative Functions – The General Integral – Riemann and Lebesgue Integrals.

Unit III **(16 Hours)**

Fourier Series and Fourier Integrals – Introduction – Orthogonal system of functions – The theorem on best approximation – The Fourier series of a function relative to an orthogonal system – Properties of Fourier Coefficients – The Riesz-Fischer Theorem – The convergence and representation problems for trigonometric series – The Riemann-Lebesgue Lemma – The Dirichlet Integrals – An integral representation for the partial sums of a Fourier series – Riemann's localization theorem – Sufficient conditions for convergence of a Fourier series at a particular point – Cesaro summability of Fourier series – Consequences of Fejes's theorem – The Weierstrass approximation theorem.

Unit IV **(16 Hours)**

Multivariable Differential Calculus – Introduction – The directional derivative – directional derivative and continuity – The total derivative – The total derivative expressed in terms of partial derivatives – An application to complex valued functions - The matrix of a linear function – The Jacobian matrix – The chain rule – Matrix form of the chain rule – The Mean-Value theorem for differentiable functions – A sufficient conditions for differentiability – A sufficient condition for equality of mixed partial derivatives – Taylor's theorem for functions from R^n to R^1.

Unit V **(15 Hours)**

Implicit Functions and Extremum Problems – Introduction - Functions with non zero Jacobian determinants – The inverse function theorem – The implicit function theorem – Extrema of real-valued functions of one variable - Extrema of real-valued functions of severable variables – Extremum problems with side conditions.

Text Books:

1. de Barra. G, 2013, Measure and Integration, Second Edition, Ellis Horwood Ltd.,Chichester.
2. Tom M. Apostol, 1986, Mathematical Analysis, Second Edition, Addison Wesley Publishing Company Inc. New York.

Unit	Book	Chapter/Page
I	1	2(2.1 to 2.5)
II	1	3(3.1,3.2 and 3.4)
III	1	11(11.1-11.15)
IV	2	12(12.1 to 12.14)
V	2	13 (13.1 to 13.7)

References:

1. Royden H.L., Fitzpatrick P.M., 2015, Real Analysis, Fourth Edition - PHI Learning Private Limited, Delhi.
2. Pawan Kumar Jain, Pawan Gupta V.P., Pankaj Jain, 2012, Lebesgue Measure and Integration, Anshan Ltd., Tunbridgewell , UnitedKingdom.
3. Robert G.Bartle, 2014, The Elements of Integration and Lebesgue Measure, John Wiley&Sons, NewYork.

Web Resources:

1. https://faculty.etsu.edu/gardnerr/5337/notes/Chapter2-22.pdf
2. https://personalpages.manchester.ac.uk/staff/mark.coleman/old/341/not3b.pdf
3. https://mathweb.ucsd.edu/~nwallach/inverse[1].pdf

Course Designers:

1. Mrs. R. Latha
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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
PMA23CT23	**Partial Differential Equations**	**Core**	**4**	**1**	**-**	**4**

L - Lecture T - Tutorial P - Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	100

Preamble:

The course deals with Cauchy problem, method of separation of variables, boundary value problems and focus on elliptic, parabolic and hyperbolic partial differential equations.

Prerequisite:

Knowledge in multivariable calculus and ordinary differential equations.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Match the physical situations with real wor problems to construct mathematical models using partia differential equations	85	80
CO2	Explain and Solve different kinds of partial differential equations	85	80
CO3	Classify second order partial differential equations	90	85
CO4	Apply separation of variables method to so Laplace's and Diffusion equations	75	70
CO5	Select the most appropriate method to solve particular partial differential equations	80	75

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**M**	**M**	**S**	**S**	**L**
CO2	**S**	**S**	**M**	**L**	**M**
CO3	**L**	**M**	**S**	**M**	**S**
CO4	**M**	**M**	**M**	**S**	**S**
CO5	**M**	**M**	**S**	**S**	**L**

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	M	M	S	M	L	S	S
CO2	S	M	S	M	S	M	L
CO3	S	L	M	M	M	S	M
CO4	L	M	S	S	S	M	M
CO5	M	M	S	L	S	M	M

Bloom's Taxonomy:

	CA		End of Semester
	First	Second	
Knowledge – K1	15%	15%	20%
Understand – K2	15%	15%	20%
Apply – K3	30%	30%	20%
Analyze –K4	20%	20%	20%
Evaluate- K5	20%	20%	20%

Contents:

UNIT-I Mathematical Models and Classification of Second Order Linear Equations : (15 Hours)

Classical equations-Vibrating string – Vibrating membrane – waves in elastic medium – Conduction of heat in solids –The Gravitational potential – Second order equations in two independent variables – canonical forms – equations with constant coefficients – general solutions.

UNIT-II The Cauchy Problem and Wave equations : (15 Hours)

The Cauchy problem – The Cauchy-Kowalewskaya theorem – Homogeneous wave equation – Initial Boundary value problem- Equations with Non-homogeneous boundary conditions – Vibration of Finite string with fixed ends – Non-homogeneous wave equation – The Riemann method – Solution of the Goursat problem – Spherical wave equation – Cylindrical wave equation.

UNIT-III Method of Separation of Variables: (15 Hours)

Separation of variables- The Vibrating string problem – Existence and uniqueness of solution of the vibrating string problem. The Heat conduction problem – Existence and uniqueness of solution of the heat conduction problem – The Laplace and Beam equations

UNIT-IV Boundary Value Problems and Applications : (15 Hours)

Boundary value problems – Maximum and minimum principles – Uniqueness and continuity theorem – Dirichlet Problem for a circle - Dirichlet Problem for a circular annulus- Neumann problem for a circle - Dirichlet problem for a rectangle- Dirichlet problem involving the Poisson equation –The Neumann problem for a rectangle.

UNIT-V Green's Functions and Boundary Value Problems: (15 Hours)

The Dirac Delta function – Properties of Green's functions – Method of Green's functions – Dirichlet Problem for the Laplace operator – Dirichlet Problem for the Helmholtz Operator-Method of images – Method of eigen functions – Higher dimensional problems – Neumann Problem.

Text Book:

Tyn Myint-U and Lokenath Debnath, 2009, Linear Partial Differential Equations for Scientists and (Fourth Edition), Springer, North Hollan, New York.

Unit	Chapter/ Section
I	**3(3.1-3.6)** **4(4.1 - 4.4)**
II	**5(5.1 - 5.11)**
III	**7(7.2 - 7.7)**
IV	**9(9.1 - 9.9)**
V	**11(11.2 - 11.10)**

References:

1. S. Sankara Rao, 2004 , Partial Differential Equations, Second Edition, Prentice Hall of India, New Delhi.
2. M. D. Raisinghania,2001, Advanced Differential Equations, S.Chand & Company Ltd., New Delhi.
3. I. N. Sneddon,1983, Elements of Partial Differential Equations, McGraw Hill, New Delhi.
4. R. Dennemeyer, 1968, Introduction to Partial Differential Equations and Boundary Value Problems, McGraw Hill, New York.
5. M. M. Smirnov, 1964, Second Order partial Differential Equations, Leningrad.

Web Resources:

1. https://www.usb.ac.ir/FileStaff/3223_2019-10-28-13-12-55.pdf
2. https://www.math.uni-leipzig.de/~miersemann/pdebook.pdf
3. https://s2pnd-matematika.fkip.unpatti.ac.id/wp-content/uploads/2019/03/Walter-A-Strauss-Partial-differential-equations-_-an-introduction-Wiley-2009.pdf

Course Designers:

1. Mrs. S. Shanavas Parvin
2. Dr. D. Murugeswari

ELECTIVE COURSES
GROUP -I

THIAGARAJAR COLLEGE, MADURAI – 9.

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
PMA23ET11A	Number Theory and Cryptography	Elective	3	2	-	3

L - Lecture T - Tutorial P - Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	25	75	100

Preamble:

This course covers number theory and cryptography, including divisibility, congruences, quadratic reciprocity, classical and public-key cryptography.

Prerequisite:

A strong foundation in algebra, including knowledge of elementary number theory.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Apply the concepts of divisibility and prime numbers to solve problems related to number theory	95	90
CO2	Demonstrate an understanding of congruences, including the solutions of congruences and the Chinese remainder theorem.	90	80
CO3	Apply quadratic reciprocity to solve problems related to quadratic residues and the Jacobian symbol.	90	85
CO4	Analyse classical cryptography systems and cryptanalysis techniques to understand their vulnerabilities and limitations.	90	80
CO5	Demonstrate an understanding of public-key cryptography, including the RSA and Rabin cryptosystems	85	80

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	S	S
CO2	M	S	M	M	S
CO3	M	S	S	M	S
CO4	S	M	S	M	M
CO5	S	M	M	S	M

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	M	M	M	S	M
CO2	S	M	S	S	S	M	S
CO3	M	S	M	M	S	M	M
CO4	S	M	S	M	M	M	M
CO5	S	M	M	S	M	S	M

Bloom's Taxonomy:

	CA		End of Semester
	First	Second	
Knowledge – K1	15%	15%	20%
Understand – K2	15%	15%	20%
Apply – K3	30%	30%	20%
Analyze –K4	20%	20%	20%
Evaluate- K5	20%	20%	20%

Contents:

Unit I **(15 Hours)**

Divisibility : Introduction – Divisibility - Primes

Unit II **(15 Hours)**

Congruences : Congruences – Solutions of congruences – The Chinese remainder theorem

Unit III **(15 Hours)**

Quadratic reciprocity : Quadratic residues – Quadratic reciprocity – The Jacobi symbol

Unit IV **(15 Hours)**

Classical Cryptography: Introduction- Some Simple Cryptosystems – Cryptanalysis

Unit V **(15 Hours)**

Introduction to Public-key Cryptography-The RSA Cryptosystem - Factoring Algorithms-The Rabin Cryptosystem. Public-Key Cryptography and Discrete Logarithms: Introduction - Algorithms for the Discrete Logarithm Problem.

Text Books:

1. Ivan Niven, Herbert S. Zuckerman and Hugh L. Montgomery, 2013, An Introduction to the Theory of Numbers, Wiley India Pvt. Ltd., Fifth Edition, Chennai.

2. Douglas R. Stinson Maura B. Paterson, 2019, Cryptography Theory and Practice, Fourth Edition, CRC Press, Taylor & Francis Group.

Unit	Text Book	Chapter/Sections
I	1	1.1-1.3
II	1	2.1-2.3
III	1	3.1-3.3
IV	2	2.1-2.2
V	2	6.1,6.3, 6.6,6.8,7.1,7.2

References:

1. David M. Burton, 2010, Elementary Number Theory, Tata McGraw-Hill Education Pvt. Ltd., Sixth Edition, New Delhi.
2. George E. Andrews, 1992, Number Theory, Hindustan Publishing Corporation, New Delhi.
3. Martin Erickson and Anthony Vazzana, 2009, Introduction to Analytic Number Theory, Chapman and Hall /CRC publications, New Delhi.
4. Kenneth Ireland and Michael Rosen, 2021, A Classical Introduction to Modern Number Theory, 2nd Edition, published by Springer.
5. Richard A. Mollin , 2020, An Introduction to Cryptography, 3rd Edition, published by CRC Press.

Course Designers:

1. Dr. R. Lakshmanan
2. Mrs.A. Ambika

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
PMA23ET11B	Computer Algorithms and Data Structures	**Elective**	**3**	**2**	**--**	**3**
	L - Lecture T - Tutorial P – Practicals					

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	**25**	**75**	**100**

Preamble:

The Course aims at facilitating the students to understand the various basic types of data structures like Stacks, Queues, Trees, Priority Queues and Graphs etc. It also deals with designing and analyzing of some kinds of computer algorithms such as Quick sort, Binary search , Knapsack problem, Multi stage graphs and 8- Queens problems etc.

Prerequisite:

Fundamental knowledge in any computer programming language.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Recall some basic programming principles and Summarize algorithm design techniques	80	75
CO2	Demonstrate the correctness of divide and conquer algorithms and solve some problems	90	85
CO3	Classify Greedy strategy algorithms and solve some problems	80	75
CO4	Solve dynamic programming problems	80	75
CO5	Construct algorithms for 8- Queens problem, Sum of subsets and Graph coloring problems	80	75

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**M**	**M**	**M**
CO2	**S**	**M**	**M**	**S**	**M**
CO3	**S**	**M**	**M**	**M**	**S**
CO4	**S**	**M**	**M**	**M**	**S**
CO5	**S**	**M**	**S**	**M**	**M**

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	M	M	M	M	M
CO2	S	M	M	S	S	M	M
CO3	S	M	M	M	S	M	M
CO4	S	M	M	S	S	S	S
CO5	S	M	S	M	S	S	S

Bloom's Taxonomy:

	CA		End of Semester
	First	Second	
Knowledge – K1	15%	15%	20%
Understand – K2	15%	15%	20%
Apply – K3	30%	30%	20%
Analyze –K4	20%	20%	20%
Evaluate- K5	20%	20%	20%

Contents:

Unit I Introduction **(15 Hours)**

What is an algorithm? – Algorithm specification – Pseudo code conventions – Recursive Algorithms - Performance analysis –Space Complexity – Time complexity – Amortized complexity – Asymptotic notations – Practical complexities – Performance measurement- Randomized algorithms- Basics of Probability Theory – Randomized algorithms: An informal description – Primality testing – Advantageous and Disadvantages.

Unit II Elementary Data Structures **(15 Hours)**

Stacks and Queues – Trees-Terminology - Binary Trees – Dictionaries – Binary search trees – Priority Queues – Heaps – Heap sort – Sets and Disjoint set – Introduction - Union – Introduction - Union and Find operations – Graphs – Introduction – Definitions – Graph Representations.

Unit III Divide – and – Conquer **(15 Hours)**

General method – Defective chessboard –Binary search – Finding the Maximum and Minimum – Merge sort – Quick sort – - Performance Measurement – Randomized Sorting algorithms.

Unit IV The Greedy Method **(15 Hours)**

The General method – Container loading- Knapsack Problem – Tree vertex splitting – Job sequencing with deadlines – Minimum cost Spanning trees – Prim's algorithm – Kruskal's algorithm – An optimal Randomized Algorithm.

Unit V Dynamic Programming **(15 Hours)**

The General method – Multistage graphs – All pairs shortest paths – Single source shortest paths: General weights

Backtracking The General method – The 8 –Queens problem – Sum of Subsets - Graph coloring– Hamiltonian cycles.

Text Book:

Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran , 2019, Fundamentals of Computer Algorithms, 2nd Edition, Universities Press (India) Private Limited , Hyderabad.

Unit	Chapter/Section
I	1 (1.1 – 1.4)
II	2 (2.1 – 2.6)
III	3 (3.1 – 3.6)
IV	4 (4.1 – 4.6)
V	5(5.1 – 5.4) & 7 (7.1 – 7.5)

References:

1. Thomas H.Corman, Charles E.Leiserson, Ronald L.Rivest, Clifford Stein , 2010, Introduction to Algorithms,Third Edition , PHI Learning Private Limited, New Delhi
2. G.A.Vijayalakshmi Pai, 2008, Data Structures and Algorithms Concepts, Techniques and Applications Tata McGraw- Hill Publishing Company Limited, New Delhi.
3. R.C.T. Lee, S.S.Tseng, R.C.Chang, Y.T.Tsai,2013, Introduction to Design and Analysis of Algorithms A Strategic Approach,McGraw Hill Education (India) Private Limited, New Delhi
4. Debasis Samanta, 2009, Classic Data Structure,Second Edition, PHI Learning Private Limited , New Delhi

Course Designers:

1. Dr. B. Arivazhagan
2. Dr. D. Princy

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
PMA23ET11C	Object Oriented Program with C++	**Elective**	**3**	**2**	**-**	**3**

L - Lecture T - Tutorial P – Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	**25**	**75**	**100**

Preamble:

Develop programming skills in C++ and its object oriented concepts.

Prerequisite:

Knowledge of programming and C language.

Course Outcomes:

On the completion of the course the student will be able to

#	Course outcomes	Expected Proficiency	Expected Attainment
CO1	Understand the concept of Object-Oriented Programing and its benefits and able to write simple C++ program.	85	80
CO2	Describe the uses of function overloading, classes and Objects.	80	75
CO3	Write moderate level programs using Object concept.	90	85
CO4	Demonstrate and understanding to apply operator overloading concept.	80	75
CO5	Apply the concepts of inheritance, pointers and virtual functions.	85	80

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**S**	**M**	**S**
CO2	**M**	**S**	**S**	**S**	**S**
CO3	**S**	**M**	**M**	**S**	**S**
CO4	**S**	**M**	**S**	**S**	**S**
CO5	**S**	**M**	**S**	**M**	**S**

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**S**	**M**	**M**	**M**	**S**
CO2	**S**	**S**	**S**	**S**	**M**	**M**	**S**
CO3	**S**	**S**	**S**	**S**	**M**	**M**	**S**
CO4	**S**	**S**	**S**	**S**	**M**	**M**	**S**
CO5	**S**	**S**	**M**	**S**	**M**	**M**	**M**

Bloom's Taxonomy:

	CA		End of Semester
	First	Second	
Knowledge – K1	15%	15%	20%
Understand – K2	15%	15%	20%
Apply – K3	30%	30%	20%
Analyze –K4	20%	20%	20%
Evaluate- K5	20%	20%	20%

Contents:

Unit I **(15 Hours)**

Beginning with C++and Tokens, Expressions and Control Structures: Basic concept of Object Oriented Programming – Benefits of OOP – Object oriented Languages – Applications of C++ – A Simple C++ Program – More C++ statements – An Example with Class – Structure of C++ Program – Creating the source file – Compiling and Linking – Tokens – keywords – Basic Data types – Operators in C++ – Control structure.

Unit II **(15 Hours)**

Functions in C++ and Classes: Introduction – The Main function - Function Prototyping – Call by reference – Return by reference – Inline functions – Default Arguments – Const Arguments – Function Overloading – Friend and Virtual Functions – Math Library Functions – Specifying a class – Defining member functions – C++ program with Class.

Unit III **(15 Hours)**

Objects, Constructors: Memory allocation for Objects – Static Data Members – Static Member Functions – Arrays of Objects – Objects as function Arguments – Friendly functions – Returning Objects – Const Member Functions – Pointer to Members – Local classes – Constructors – Parameterized Constructors – Multiple Constructors in a Class – Constructors with Default Arguments.

Unit IV **(15 Hours)**

Destructors and Operator Overloading and Types Conversions: Dynamic Initialization of Objects - Copy Constructor – Dynamic Constructors – Constructing Two – Dimensional Arrays – Const Objects - Destructors – Introduction - Defining Operator Overloading – Overloading Unary Operators – Overloading Binary Operators – Overloading Binary Operators using Friends – Manipulation of Strings Using Operators – Rules for Overloading Operators – Type conversions.

Unit V **(15 Hours)**

Inheritance: Extending Classes: Introduction – Defining Derived Classes – Single Inheritance – Making a Private Member Inheritance – Multilevel Inheritance – Multiple Inheritance –

Hierarchical Inheritance – Hybrid Inheritance –Virtual Base Classes – Abstract Classes – Constructors in Derived Classes – Member Classes: Nesting of Classes.

Text Book:

E. Balagurusamy, 2019, Object - Oriented Programming with C++, 7th Edition, The McGraw–Hill Company Ltd, New Delhi.

Unit	Chapter / Section
I	1 (1.5-1.7), 2 (2.2 – 2.8) & 3 (3.2, 3.3, 3.5, 3.14 & 3.25)
II	4 (4.1 to 4.8 & 4.10-4.12) & 5 (5.3 - 5.5)
III	5 (5.10 – 5.19) & 6 (6.2 – 6.5)
IV	6 (6.6 – 6.11) & 7 (7.1 – 7.6, 7.8 & 7.9)
V	8 (8.1 – 8.12)

References:

1. V. Ravichandran, 2006, Programming with C++, Second Edition Tata McGraw – Hill, New Delhi.
2. H. Schildt, 2003, The complete Reference of C++, Tata–McGraw–Hill publishing Company Ltd. New Delhi.
3. S.B. Lipman and J. Lafer, 1998, C++ Primer, Addition Wesley, Mass.
4. Ashok N. Kamthane, 2003, Object Oriented Programming with ANSI and TURBO C++, Pearson Education(P) Ltd.
5. Bjarme Stroustrup, 1998, The C++ Programming Language, AT & T Labs, Murray Hills, New Jersey.

Web Resources:

1. https://www.tutorialspoint.com/cplusplus/cpp_object_oriented.htm
2. https://www.simplilearn.com/tutorials/cpp-tutorial/oops-concepts-in-cpp
3. https://www.w3schools.com/cpp/cpp_oop.asp

Course Designers:

1. Mr. M. Madhavan.
2. Mrs. V. Kanchana Devi.

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
PMA23ET11D	**Formal Languages and Automata Theory**	**Elective**	**3**	**2**	**-**	**3**

L - Lecture T - Tutorial P - Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	25	75	100

Preamble:

The course deals with finite automaton, properties of regular sets, context-free grammars, push down automaton and Turing machines.

Prerequisite:

Knowledge in computer fundamentals.

Course Outcomes:

On the completion of the course the student will be able to

	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Classify deterministic and non- deterministic finite automatons	95	90
CO2	Explain the properties of regular sets	90	80
CO3	Demonstrate derivation trees	90	85
CO4	Define and construct Pushdown Automaton.	90	80
CO5	Develop a Turing machine	85	80

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	S	S
CO2	M	S	M	M	S
CO3	M	S	S	M	S
CO4	S	M	S	M	M
CO5	S	M	M	S	M

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	M	M	M	S	M
CO2	S	M	S	S	S	M	S
CO3	M	S	M	M	S	M	M
CO4	S	M	S	M	M	M	M
CO5	S	M	M	S	M	S	M

Bloom's Taxonomy:

	CA		End of Semester (Marks)
	First(Marks)	Second(Marks)	
Knowledge – K1	15%	15%	20%
Understand – K2	15%	15%	20%
Apply – K3	30%	30%	20%
Analyze –K4	20%	20%	20%
Evaluate- K5	20%	20%	20%

Contents:

Unit I **(15 Hours)**

Finite Automata: Deterministic finite automata – Nondeterministic finite automata – Finite automata with Є transitions. Regular expressions: Regular expressions – Finite Automata and regular expressions – Algebraic Laws for regular expressions.

Unit II **(15 Hours)**

Properties of Regular Languages: Proving languages not to be regular - Closure properties of regular languages – Decision Properties of Regular Languages – Equivalence and Minimization of Automata.

Unit III **(15 Hours)**

Context-Free grammars and Languages: Context free grammars – Parse trees – Ambiguity in Grammars and Languages. Pushdown Automata: Definition of the Pushdown Automaton – The Languages of a PDA - Equivalence of PDA's and CFG's - Deterministic Pushdown Automata.

Unit IV **(15 Hours)**

Properties of Context-Free Languages: Normal Forms for Context Free Grammars – The Pumping Lemma for Context-Free Languages - Closure properties of Context-Free Languages - Decision Properties of CFL's.

Unit V **(15 Hours)**

Introduction to Turing Machines: The Turing Machine – Programming Techniques for Turing Machines – Extensions to the basic Turing Machines. Undecidability: A language that is not recursively enumerable – An undecidable problem that is RE – Undecidable problems about Turing Machines.

Text Book:

John E. Hopcroft, Rajeev Motwani and Jeffery D. Ullman, 2013, "Introduction to Automata Theory, Languages, and Computation", Pearson Education, India.

Unit	Chapter/section
I	Chapter 2: 2.2, 2.3, 2.5 Chapter 3: 3.1, 3.2, 3.4
II	Chapter 4: 4.1, 4.2, 4.3, 4.4
III	Chapter 5: 5.1, 5.2, 5.4 Chapter 6: 6.1, 6.2, 6.3, 6.4
IV	Chapter 7: 7.1, 7.2, 7.3, 7.4
V	Chapter 8: 8.2, 8.3, 8.4 Chapter 9: 9.1, 9.2, 9.3

References:

1. Peter Linz, Jones and Bartlett, 2006, An Introduction to Formal Languages and Automata.
2. Raymond Greenlaw and H. James Hoover, 2009, Fundamentals of the Theory of Computation: Principles and Practice, Morgan Kaufmann Publishers.
3. Acharjya. D.P.,2010, Theory of Computation, MJP Publishers.

Course Designers:

1. Dr. B. Arivazhagan
2. Dr. S. Vijaya

ELECTIVE COURSES
GROUP -II

THIAGARAJAR COLLEGE, MADURAI – 9.
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POSTGRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS
(For those who joined M.Sc. Mathematics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
PMA23ET12A	**Graph Theory and its Applications**	**Elective**	**3**	**2**	**-**	**3**

L - Lecture T - Tutorial P - Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	25	75	100

Preamble:

The course deals with the graph theoretical concepts such as connectivity, planarity and domination that help to model real life situations.

Prerequisite:

Knowledge in basic definitions and properties of graph theory.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainmen (%)
CO1	Relate connectivity concepts in the theory of Network Flow problems	80	75
CO2	Apply spanning tree properties and algorithms in Connector Problem that involve designing railroad networks and water-line transports	85	80
CO3	Explain matching concepts in job assignment problems	80	75
CO4	Analyze and Apply coloring concepts in Storage problem and SchedulingProblem	80	75
CO5	Understand domination concepts and develop mathematical models of real life problems	80	75

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**L**	**M**	**S**	**S**	**S**
CO2	**S**	**M**	**M**	**S**	**S**
CO3	**S**	**L**	**M**	**S**	**M**
CO4	**M**	**M**	**M**	**S**	**M**
CO5	**S**	**L**	**L**	**S**	**M**

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	M	M	S	M	M	S	S
CO2	L	M	M	M	S	M	S
CO3	L	L	M	M	S	M	M
CO4	M	L	M	M	S	M	M
CO5	S	M	S	S	M	M	S

Bloom's Taxonomy:

	CA		End of Semester
	First	Second	
Knowledge – K1	15%	15%	20%
Understand – K2	15%	15%	20%
Apply – K3	30%	30%	20%
Analyze –K4	20%	20%	20%
Evaluate- K5	20%	20%	20%

Contents:

Unit I **(15 Hours)**

Connectivity: Introduction – Vertex Cuts and Edge Cuts – Connectivity and Edge connectivity – Blocks – Menger's Theorem.

Unit II **(15 Hours)**

Trees: Counting the Number of Spanning Trees – Cayley's Formula – Applications: The Connector Problem – Kruskal's Algorithm – Prim's Algorithm.

Unit III **(15 Hours)**

Independent Sets and Matchings: Introduction – Vertex-Independent Sets and Vertex Coverings – Edge-Independent Sets – Matchings and Factors – Matchings in Bipartite Graphs.

Unit IV **(15 Hours)**

Graph Colorings: Introduction – Vertex Colourings – Edge Colorings of Graphs. Planarity: Introduction – Planar and Nonplanar Graphs – Euler Formula and its Consequences – K_5 and $K_{3,3}$ are Nonplanar Graphs.

Unit V **(15 Hours)**

Domination in Graphs: Introduction – Domination in Graphs – Bounds for the Domination Number – Bound for the Size m in Terms of Order n and Domination Number $\gamma(G)$ – Independent Domination and Irredundance.

Text Book:

Balakrishnan. R. and Ranganathan. K., 2019, A Textbook of Graph Theory, Second South Asian Edition, Springer Science + Business Media, New York.

Unit	Chapter/ Sections
I	3(3.1-3.4, 3.6)
II	4(4.4, 4.5, 4.7.1, 4.7.2, 4.7.3)
III	5(5.1-5.5)
IV	7(7.1, 7.2, 7.6), 8(8.1-8.4)
V	10(10.1-10.5)

References:

1. Gary Chartrand and Ping Zhang, 2006. Introduction to Graph Theory, Tata McGraw – Hill, New Delhi.
2. Bondy, J.A. and Murthy, U.S.R., 2008, Graph Theory, Springer-Verlag, London.
3. Douglas B. West, 2001, Introduction to Graph Theory - Prentice–Hall of India, Singapore.
4. Harary, 1989, Graph Theory, Narosa Publishing House, New Delhi.

Web Resources:

1. http://diestel-graph-theory.com/basic.html.
2. http://www.maths.lse.ac.uk/Personal/jozef/LTCC/Graph_Theory_Bondy_Murty.pdf
3. http://www.freetechbooks.com/graph-theory-f67.html

Course Designers:

1. Dr. K. Kayathri
2. Ms. P. Vanmathy

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

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Course Code	Course Title	Category	L	T	P	Credits
PMA23ET12B	**Fuzzy Sets and its Applications**	**Elective**	**3**	**2**	**-**	**3**

L - Lecture T - Tutorial P – Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	25	75	100

Preamble:

The course deals with the concept of uncertainty, fuzziness and enhance their applications in fuzzy systems and fuzzy decision making.

Prerequisite:

Fundamentals in set theory and logic.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Define and illustrate the concept of fuzzy sets and crisp sets	90	85
CO2	Analyze the axioms and build operations on fuzzy sets	90	85
CO3	Apply rules of inference and infer from various types of fuzzy propositions	80	75
CO4	Develop fuzzy controllers for real life problems and implement it in appropriate hardware	80	75
CO5	Apply and assess multistage decision making in dynamic systems	80	75

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**L**	**L**	**L**	**L**	**L**	**L**
CO2	**S**	**M**	**L**	**L**	**M**	**L**	**M**
CO3	**M**	**S**	**L**	**M**	**L**	**L**	**M**
CO4	**M**	**S**	**M**	**S**	**M**	**M**	**S**
CO5	**M**	**S**	**S**	**S**	**M**	**M**	**S**

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	L	L	S	S
CO2	S	S	M	L	S
CO3	M	L	L	S	S
CO4	L	S	S	M	M
CO5	L	S	S	M	M

Bloom's Taxonomy:

	CA		End of Semester
	First	Second	
Knowledge – K1	15%	15%	20%
Understand – K2	15%	15%	20%
Apply – K3	30%	30%	20%
Analyze –K4	20%	20%	20%
Evaluate- K5	20%	20%	20%

Contents:

Unit I **(15 Hours)**

Fuzzy Set: Introduction- Crisp Sets: an overview – Fuzzy sets: basic types – basic concepts- Fuzzy sets versus crisp sets - Additional properties of α - Cuts – Representation of Fuzzy sets – Extension Principle for fuzzy sets.

Unit II **(15 Hours)**

Operations on Fuzzy Sets: Types of Operations – Fuzzy Complements – Fuzzy Intersections: t-Norms – Fuzzy Unions: t-conorms – Fuzzy arithmetic – Fuzzy numbers – linguistic variables – arithmetic operations on intervals – arithmetic operations on Fuzzy numbers.

Unit III **(15 Hours)**

Fuzzy logic – Fuzzy Propositions –Fuzzy quantifiers – Linguistic Hedges - Inference from Conditional Fuzzy Propositions - Inference from Conditional and Qualified Propositions - Inference from Quantified Propositions.

Unit IV **(15 Hours)**

Fuzzy Systems – General discussion – Fuzzy Controllers: an overview – an example – Fuzzy Automata – Fuzzy Dynamic systems.

Unit V **(15 Hours)**

Fuzzy Decision Making – General Discussion - Individual Decision Making – Multiperson Decision Making – Multicriteria Decision Making – Multistage Decision Making – Fuzzy ranking methods.

Text Book:

George J. Klir and Bo Yuan, 2015, Fuzzy Sets and Fuzzy Logic - Theory and Applications, First Editiion, Pearson education India.

Unit	Chapter/Sections
I	1.1- 1.4, 2.1- 2.3
II	3.1-3.4, 4.1- 4.4
III	8.3 – 8.8
IV	12.1 – 12.3, 12.6, 12.7
V	15.1 – 15.6

References:

1. Zimmermann, H.J. 1996. Fuzzy Set Theory and its Applications, Allied Publishers Ltd., Chennai.
2. Ganesh, M. 2015, Introduction to Fuzzy Sets and Fuzzy Logic, Prentice-Hall of India.
3. Hung T. Nguyen and Elbert A. Walker A First Course in Fuzzy Logic Chapman and Hall/CRC. 2006, India.

Web Resources:

1. https://cours.etsmtl.ca/sys843/REFS/Books/ZimmermannFuzzySetTheory2001.pdf
2. www.pdfdrive.com/fuzzy-logic-books.html
3. https://www-liphy.ujf-grenoble.fr > biblio

Course Designers:

1. Dr. K. Kayathri
2. Mrs. D. Princy

THIAGARAJAR COLLEGE, MADURAI – 9.

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POSTGRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
PMA23ET12C	**Discrete Mathematics**	**Elective**	**3**	**2**	**-**	**3**

L - Lecture T - Tutorial P–Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	25	75	100

Preamble:

The course deals with advanced counting principles and enhance the significance of Boolean algebra.

Prerequisite:

Fundamentals in Set theory.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected	Expected
CO1	Recall basic counting principles and generalize the ideas	80	75
CO2	Interpret recurrence relations and design algorithms	80	75
CO3	Make use of advanced counting technique to solve real life problems	80	75
CO4	Recall and analyse the concepts of relation and find the closures	80	75
CO5	Apply the ideas of Boolean algebras in Logic gates	80	75

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**M**	**M**	**S**	**M**	**M**	**S**	**S**
CO2	**L**	**M**	**M**	**M**	**S**	**M**	**S**
CO3	**L**	**L**	**M**	**M**	**S**	**M**	**M**
CO4	**M**	**L**	**M**	**M**	**S**	**M**	**M**
CO5	**S**	**M**	**S**	**S**	**M**	**M**	**S**

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**M**	**M**	**S**	**S**
CO2	**M**	**S**	**M**	**M**	**S**
CO3	**M**	**S**	**S**	**M**	**S**
CO4	**S**	**M**	**S**	**M**	**M**
CO5	**S**	**M**	**M**	**S**	**M**

Bloom's Taxonomy:

	CA		End of Semester (Marks)
	First(Marks)	Second(Marks)	
Knowledge – K1	15%	15%	15%
Understand – K2	15%	15%	15%
Apply – K3	30%	30%	30%
Analyze –K4	20%	20%	20%
Evaluate- K5	20%	20%	20%

Contents:

Unit I **(15 Hours)**

Counting: The Basics of Counting – The Pigeonhole Principle – Permutations and Combinations– Binomial Coefficients and Identities – Generalized Permutations and Combinations.

Unit II **(15 Hours)**

Advanced Counting Techniques**:** Applications of Recurrence Relations – Solving Linear Recurrence Relations – Divide and Conquer Algorithms and Recurrence Relations.

Unit III **(15 Hours)**

Advanced Counting Techniques**:** Generating Functions – Inclusion-Exclusion – Applications of Inclusion-Exclusion.

Unit IV **(15 Hours)**

Relations: Relations and their properties – n-ary relations and their applications – Representing relations-– Closures of Relations – Equivalence Relations.

Unit V **(15 Hours)**

Boolean Algebra: Boolean Functions – Representing Boolean Functions – Logic Gates.

Text Book:

Kenneth H. Rosen, 2022, "Discrete Mathematics and its Applications", McGraw Hill Education Private Limited, India.

Unit	Chapter/Sections
I	6(6.1 – 6.5)
II	7(7.1 – 7.3)
III	7(7.4 – 7.6)
IV	8(8.1 – 8.5)
V	11(11.1 – 11.3)

References:

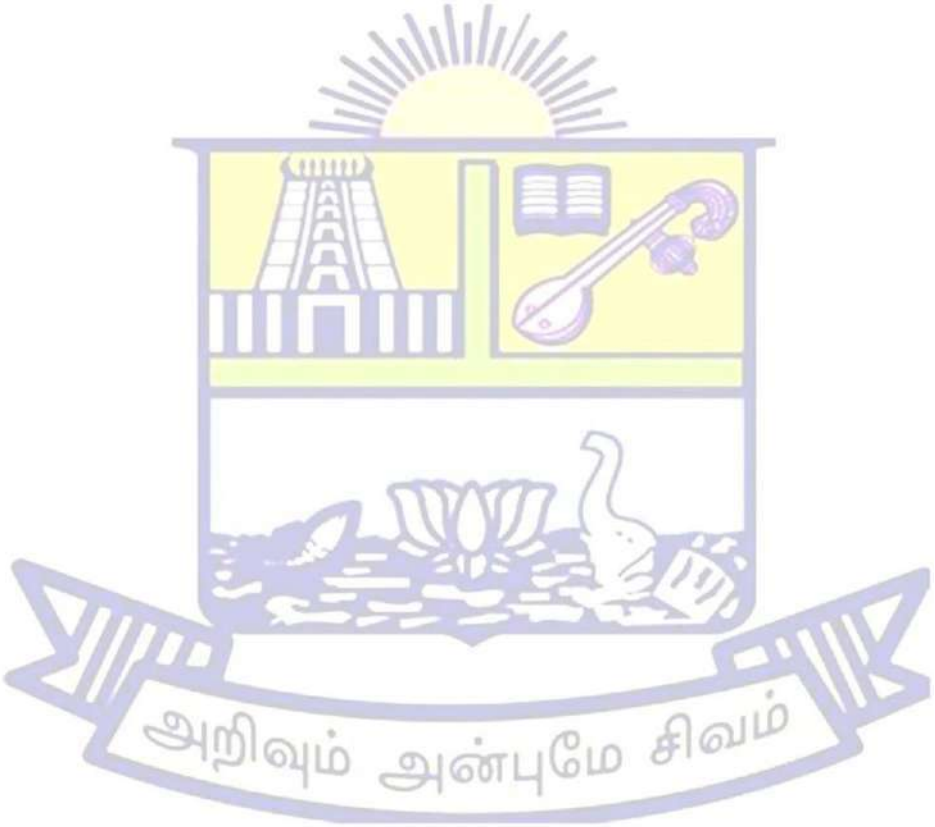
1. Susanna S.Epp, 2010, "Discrete Mathematics with Applications", 4th Edition, Brooks/Cole Cengage Learning, Nelson Education Ltd, Canada.
2. J.P. Tremblay, R. Manohar, 2008, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Publishing Company Limited, New Delhi, India.
3. Richard Johnsonbaugh, 2018, "Discrete Mathematics", 8th Edition, Pearson Education Limited, Harlow, USA.
4. Sharon C. Ross, Bernard Kolman, Robert Busby, 2015, "Discrete Mathematical Structures", 6th Edition, Pearson, India.

Web Resources:

1. https://faculty.uml.edu//klevasseur/ads2/chapters/Chapter_13.pdf
2. http://www.cs.iit.edu/~wan/cs330/Chapter8-counting-ad.pdf

Course Designers:

1. Dr. R. Angeline Chella Rajathi
2. Dr. S. Vijaya



THIAGARAJAR COLLEGE, MADURAI – 9.

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POSTGRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
PMA23ET12D	Programming in Java	Elective	**3**	**2**	**-**	**3**

L-Lecture T-Tutorial P–Practicals

Year	Semester	Internal	External	Total
First	**Second**	**25**	**75**	**100**

Preamble:

The course describes the basic features of java with application, applet and AWT programming and inculcate the ability to develop projects in java.

Prerequisite:

C -Program

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Identify the importance of java with its data types, control statements and class	90	85
CO2	Find the importance of java with its data types, control statements and class fundamentals	80	75
CO3	Explain exception handling and multithreading	85	80
CO4	Apply string and string buffer handling functions and analyze the concept of interfaces and stream classes	85	80
CO5	Build applet programming through AWT controls, layout managers and menus.	75	70

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	S	S	M	M
CO2	S	S	M	M	M
CO3	S	M	L	L	M
CO4	S	M	M	S	L
CO5	S	L	L	L	M

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	S	M	M	M
CO2	S	M	M	M	L	L	L
CO3	S	M	M	M	M	L	L
CO4	S	M	S	M	S	M	M
CO5	S	S	S	M	S	L	M

Bloom's Taxonomy:

	CA		End of Semester
	First	Second	
Knowledge – K1	15%	15%	20%
Understand – K2	15%	15%	20%
Apply – K3	30%	30%	20%
Analyze –K4	20%	20%	20%
Evaluate- K5	20%	20%	20%

Contents:

Unit-I: **(12-hours)**

The Genesis of Java: Java's Lineage – The creation of java - Why Java is important to internet – Java's Magic: The Byte code – The Java buzz words. Data types, Variables and Arrays. Operators. Control statements - Introducing classes: Class Fundamentals - Declaring objects – Assigning object reference variables - Introducing Methods -.Constructors - The this Keyword - Garbage Collection - finalize( ) Method.

Unit-II: **(16 hours)**

Inheritance : Inheritance Basics – Using super – Creating a multilevel Hierarchy –When constructors are called - Method overriding - Dynamic method dispatch - Using Abstract classes- using final with inheritance – The Object class. Packages and Interfaces: Packages- Access protection – Importing packages - interfaces.

Unit-III: **(17 hours)**

Exception Handling: Exception Handling Fundamentals – Exception types-Uncaught Exceptions - using try and catch - user – Multiple catch Clauses - Nested try Statements - throw-throws – finally – Java's built in exceptions - Creating your own exception sub classes. Multi threaded Programming : The Java Thread Model - main thread - creating a Thread - Creating multiple threads – Using is Alive( ) and join ( ) – Thread priorities – synchronization – Inter thread communication - Suspending, Resuming and stopping Threads.

Unit-IV: **(13 hours)**

String handling : String constructor – Special String operations – character extraction – String comparison - Searching Strings - modifying a String - Date conversion using value of ( )- String Buffer. Exploring java.lang : Simple type wrappers. Input/Output: Exploring java.io: File-Directory – Stream Classes – File Input Stream – File Output Stream – File Reader - Character Streams – File Reader – File Writer – Bufered Reader - Writer.

The Applet Class: Applet Basics – Architecture - An Applet skeleton - Simple Applet display methods - Requesting repainting - Using the status window-The Html applet Tag – passing parameter to applets – get Document Base( ) and get Code Base( ).

Unit-V: **(17 hours)**

Using AWT Controls, Layout Managers and Menus: Control Fundamentals – Labels - Using Buttons – Applying Check Boxes – Check Box Group – Choice controls – Using Lists – Managing Scroll bars - Using a Text Field – Using a Text Area - Understanding Layout Managers - Menu Bars and Menus.

Event Handling – Event Class – Action Event – Adjustment Event –Source of Event - Event Listener Interface – Handling Mouse Event.

Text Book:

Herbert schildt, 2014, Java2: The Complete Reference 5th edition, Tata McGraw Hill Education Private Limited.

UNIT	Chapter/Sections
I	1,3,4,5,6
II	8, 9
III	10, 11
IV	13, 14(Pg.379-401), 17(Pg.537-551), 17(562-570), 19(Pg. 627-648)
V	22(Pg.735-775), 20(654-675)

References:

1. Adan Dodson,2016 ,Java: Java programming for Beginners Teaching You Basic to Advance Java Programming Skills ,Create space Independent Publishing Platform.
2. Balagurusamy, 2014, programming with Java, 5th edition, Tata McGraw Hill Education Private Limited.
3. Yashwant Kanetkar, 2012, Let Us Java, 2nd edition, BPB publications.

Web Resources:

1.https://www.javatpoint.com/exception-handling-in-java

2.https://www.edureka.co/blog/java-string/

3.http://www2.gsu.edu/~matpxp/SwIG/talks/java_applets.pdf

Course Designers:

1. Dr. R.Lakshmanan
2. Dr. P. Krishnaveni

ELECTIVE COURSES
GROUP – III

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POSTGRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credis
PMA23ET21A	**Numerical Analysis**	**Elective**	**3**	**2**		**3**

L - Lecture T - Tutorial P–Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	**25**	**75**	**100**

Preamble:

The course deals with the methods of solving Transcendental and polynomial equations, system of linear algebraic equations and eigen value problems. Evaluation of definite integrals and solving initial value problems are dealt with.

Prerequisite:

Knowledge in solving system of equations, interpolation and differential equations.

On the completion of the course the student will be able to

#	Course outcomes	Expected Proficiency (%)	Expected Attainment (%)
CO1	Solve transcendental and polynomial equations and system of linear algebraic equations	85	80
CO2	Explain Lagrange and Newton's interpolation procedure	85	80
CO3	Make use of numerical techniques to find the derivative at a point and evaluate definite integrals	90	85
CO4	Demonstrate and match Mathematical preliminaries to solve ordinary differential equations	75	70
CO5	Illustrate the numerical solutions of initial value problems	80	75

Mapping of Cos with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**M**	**S**	**M**	**L**	**M**
CO2	**M**	**M**	**S**	**M**	**L**
CO3	**M**	**M**	**M**	**S**	**M**
CO4	**L**	**M**	**M**	**S**	**M**
CO5	**M**	**M**	**L**	**M**	**S**

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M	S	M	L	M	M
CO2	M	S	S	L	M	M	M
CO3	M	L	S	S	M	S	M
CO4	S	S	M	S	M	S	L
CO5	S	M	M	L	S	S	S

Bloom's Taxonomy:

	CA		End of Semester
	First	Second	
Knowledge – K1	15%	15%	20%
Understand – K2	15%	15%	20%
Apply – K3	30%	30%	20%
Analyze –K4	20%	20%	20%
Evaluate- K5	20%	20%	20%

Contents:

Unit I **(15 Hours)**

Transcendental and Polynomial Equations : Introduction – Bisection Method – Iteration Methods based on First Degree Equation – Iteration Methods based on Second Degree Equation – Rate of Convergence – General Iteration Methods.

Unit II **(15 Hours)**

System of Linear algebraic Equations and Eigen value problems : Introduction. – Direct Methods- Error Analysis for Direct Methods – Iteration Methods – Eigen values and Eigenvectors.

Unit III **(15 Hours)**

Interpolation and Approximation : Introduction - Lagrange and Newton Interpolations-– Finite Difference Operators – Interpolating polynomials using finite differences – Hermite interpolation.

Unit IV **(15 Hours)**

Differentiation and Integration: Introduction – Numerical Differentiation – Optimum choice of step–length- Extrapolation methods – Partial differentiation – Numerical Integration – Methods based on interpolation.

Unit V **(15 Hours)**

Ordinary Differential Equations (Initial value problems) : Introduction- Difference equations - Numerical methods – Single step methods.

Text Book:

Jain. M.K., Iyengar. S.R.K. and Jain. R.K., 2018, Numerical Methods for Scientific and Engineering Computation, Sixth Edition, 6th Edition, New Age International Publishers, New Delhi.

Unit	Chapter / Section
I	2 (2.1 – 2.6)
II	3 (3.1-3.5)
III	4 (4.1 - 4.5)
IV	5 (5.1 –5.7)
V	6 (6.1- 6.4)

References:

1. Devi Prasad, 2009, An Introduction to Numerical Analysis, Third Edition, Narosa Publishing House, New Delhi
2. Grewal. B.S., 2015, Numerical Methods in Engineering and Science with Programs in C, C++ & MATLAB, Khanna Publishers.
3. Samuel D. Conte and Carl De Boor, 2009, Third Edition, Elementary Numerical Analysis : An Algorithmic Approach, Tata McGraw- Hill Edition, New Delhi

Course Designers:

1. Mrs. K. Ponmari
2. Dr. D. Murugeswari

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
PMA23ET21B	**Fluid Dynamics**	**Elective**	**3**	**2**	**-**	**3**

L - Lecture T - Tutorial P–Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	100

Preamble:

The course deals with the physical properties of fluids and relates the principles of continuity, momentum and energy as applied to fluid motions. It also focuses on the Kinematics of fluid motions, two dimensional flows and three-dimensional flows.

Prerequisite:

Knowledge in Vector Algebra and Calculus.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Demonstrate the Physical Properties of Fluids	90	80
CO2	Identify the Euler's equations of motion and equations of continuity	80	70
CO3	Solve the equations of motion of a fluid when it is at rest and in motion\	75	70
CO4	Analyze and Explain two dimensional and three dimensional flows	80	70
CO5	Recall and Explain the curvilinear coordinates, orthogonal coordinates and cylindrical Polar coordinates	75	70

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	S	M
CO2	S	S	M	M	L
CO3	S	S	S	M	M
CO4	S	S	S	M	M
CO5	S	S	S	S	S

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	S	S	S	S
CO2	S	M	S	M	S	M	M
CO3	S	M	M	M	S	S	M
CO4	M	M	M	S	S	M	M
CO5	S	S	S	M	S	M	M

Bloom's Taxonomy:

	CA		End of Semester
	First	Second	
Knowledge – K1	15%	15%	20%
Understand – K2	15%	15%	20%
Apply – K3	30%	30%	20%
Analyze –K4	20%	20%	20%
Evaluate- K5	20%	20%	20%

Contents:

Unit I **(15 Hours)**

Vector Analysis: General orthogonal curvilinear coordinates–Arc length in Orthogonal coordinates–Gradient in orthogonal coordinates–Divergence in orthogonal coordinates– Laplacian in orthogonal coordinates – Curl of a vector function in orthogonal coordinates – worked examples – Some cartesian tensor notation.

Unit II **(15 Hours)**

Kinematics of fluids in Motion: Real fluids and Ideal fluids – Velocity of a fluid at a point – Streamlines and Path lines, steady and unsteady flows – The velocity potential – The vorticity vector –Local and particle rates of change – The equation of continuity – worked examples – Acceleration of a fluid–Conditions at a rigid boundary.

Unit III **(15 Hours)**

Equations of Motion of a Fluid: Pressure at a point in a fluid at rest – Pressure at a point in a moving fluid – Conditions at a boundary of two in viscid Immiscible fluids – Euler's equations of motion –Bernoulli‟s equation – worked examples – discussion of the case of steady motion under conservative body forces– some flows involving axial symmetry – Some special two-dimensional flows–Impulsive motion.

Unit IV **(15 Hours)**

Some Three-Dimensional flows: Introduction– Sources, Sinks and doublets–Images in a rigid infinite plane–Images in solid spheres–Axi-Symmetric flows, Stoke's Stream function.

Unit V **(15 Hours)**

Some Two-Dimensional flows: Meaning of Two-Dimensional Flow – Use of Cylindrical Polar coordinates – The stream function– The complex potential for Two– Dimensional Irrotational, In compressible flow–Complex velocity potentials for standard two dimensional flows–Some worked examples –Two-Dimensional image systems-The Milne Thomson circle theorem.

Text Book:

Frank Chorlton, 2004, Textbook of Fluid Dynamics, CBS Publishers and Distributors Pvt. Ltd. New Delhi.

Unit	Chapter/Section
I	1(1.19-120)
II	2(2.1 - 2.10)
III	3(3.1-3.7, 3.9 - 3.11)
IV	4(4.1 -4.5)
V	5(5.1 -5.8)

References:

1. Goyal J.K. and Gupta K.P.,1998, Fluid Dynamics,Seventh Edition,Pragati Prakashan Publications, Meerat.
2. Paterson A.R.,1977, A First Course in Fluid Dynamics, Cambridge University Press, India (Pvt)Ltd.
3. Raisinghania M.D.,2006, Fluid Dynamics,S. Chand & Company Ltd, New Delhi

Course Designers:

1. Dr. M. Senthilkumaran
2. Mr. G. Gowtham

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
PMA23ET21C	Coding Theory	**Elective**	**3**	**2**	**-**	**3**

L - Lecture T - Tutorial P – Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	**25**	**75**	**100**

Preamble

The course deals with different types of codes such as Linear codes, Hamming codes, Cyclic codes, BCH codes, Reed – Solomon codes, Quadratic residue codes and Goppa codes. It also deals with properties of codes and their respective fitness for specific applications like, data transmission, data compression, error finding and rectification.

Prerequisite

Knowledge in Finite fields and Linear Algebra.

Course Outcomes

On the completion of the course the student will be able to

#	Course outcomes	Expected Proficiency (%)	Expected Attainment (%)
CO1	Demonstrate error detection, correction and decoding principles and Recall Finite fields properties.	85	80
CO2	Apply Linear code properties to solve transmission problems.	80	75
CO3	Analyze some bounds in coding theory such as Sphere –covering bound, Gilbert Varshamov bound etc	90	85
CO4	Explain the properties of Generator polynomials and solve some problems based on Cyclic codes	80	75
CO5	Determine some special cyclic codes to solve problems in coding theory	85	80

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**S**	**M**	**S**
CO2	**M**	**S**	**S**	**S**	**S**
CO3	**S**	**M**	**M**	**S**	**S**
CO4	**S**	**M**	**S**	**S**	**S**
CO5	**S**	**M**	**S**	**M**	**S**

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	M	M	M	S
CO2	S	S	S	S	M	M	S
CO3	S	S	S	S	M	M	S
CO4	S	S	S	S	M	M	S
CO5	S	S	M	S	M	M	M

Bloom's Taxonomy:

	CA		End of Semester
	First	Second	
Knowledge K1	15%	15%	20%
Understand – K2	15%	15%	20%
Apply-K3	30%	30%	20%
Analyze-K4	20%	20%	20%
Evaluate –K5	20%	20%	20%

Contents:

Unit I **(15 Hours)**

Error Detection - Correction and Decoding: Communication channels – Maximum likelihood decoding – Hamming distance – Nearest neighbour/minimum distance decoding – Distance of a code. **Finite fields**: Fields – Polynomial rings – Structure of finite fields – Minimal polynomials

Unit II **(15 Hours)**

Linear Codes: Vector spaces over finite fields – Linear codes – Hamming weight – Bases for linear codes – Generator matrix and parity check matrix – Equivalence of liner codes – Encoding with a linear code – Decoding of linear codes

Unit III **(15 Hours)**

Bounds in Coding theory: The main coding theory problem – Lower bounds – Hamming bound and perfect codes – Singleton bound and MDS codes. **Construction of Linear codes:** Propagation rules – Reed Muller codes – Subfield codes

Unit IV **(15 Hours)**

Cyclic codes: Definitions – Generator polynomials – Generator and parity –check matrices –

Decoding of cyclic codes – Burst –error – correcting codes.

Unit V **(15 Hours)**

Some special cyclic codes : BCH codes - Definitions - Parameter of BCH codes – Decoding of BCH codes – Reed- Solomon codes – Quadratic – residue codes. **Goppa Codes**: Generalized Reed – Solomon codes – Alternate codes – Goppa codes.

Text Book:

San Ling, Chaoping Xing, 2004, "Coding Theory A First Course", Cambridge University Press

Unit	Chapter / Section
I	2 (2.1 – 2.5) & 3 (3.1 – 3.4)
II	4 (4.1 to 4.8)
III	5 (5.1 – 5.4) & 6 (6.1 – 6.3)
IV	7 (7.1 – 7.5)
V	8 (8.1 – 8.3) & 9(9.1 – 9.3)

References:

1. P.K.Ghosh & Kapil Gupta , 2013, Principles of Error correcting code , Platinum Publishers, Kolkata.
2. Stefan M.Moser, PO-Ning Chen, 2012, A Student's Guide to Coding and Information Theory,
Cambridge University Press, New Delhi
3. S. Veluswamy, 2014, Information Theory and coding Basics and Practices, New Age International Publishers,
New Delhi

Course Designers:

1. Dr. B. Arivazhagan
2. Dr. S. Vijaya

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POSTGRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
PMA23ET21D	**Algebraic Graph theory**	**Elective**	**3**	**2**	**-**	**3**

L - Lecture T - Tutorial P–Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	100

Preamble

To know about the relationship between Matrix theory and Graph theory and to study the properties of a graph by its eigen values.

Prerequisite

Knowledge in graph theory and linear algebra.

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency	Expected Attainment
CO1	Recall the fundamental properties of graphs and line	90	85
CO2	Analyze matrix representation of graphs.	80	75
CO3	Apply eigen values to study the stability of Fullerenes.	75	70
CO4	Understand the properties of Strongly Regular	80	75
CO5	Apply Laplacian Matrix to determine the number of spanning trees in a graph.	80	75

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**S**	**M**	**S**
CO2	**S**	**S**	**M**	**M**	**S**
CO3	**M**	**M**	**S**	**S**	**M**
CO4	**S**	**M**	**M**	**M**	**S**
CO5	**S**	**S**	**S**	**S**	**M**

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**S**	**S**	**S**	**S**	**M**	**M**
CO2	**S**	**S**	**S**	**S**	**L**	**M**
CO3	**S**	**S**	**S**	**S**	**S**	**S**
CO4	**M**	**M**	**M**	**S**	**M**	**S**
CO5	**S**	**S**	**S**	**S**	**M**	**S**

Bloom's Taxonomy:

	CA		End of Semester
	First	Second	
Knowledge – K1	15%	15%	20%
Understand – K2	15%	15%	20%
Apply – K3	30%	30%	20%
Analyze –K4	20%	20%	20%
Evaluate- K5	20%	20%	20%

Contents:

Unit I **(12 Hours)**

Graphs – Subgraphs – Automorphisms – Homomorphisms – Line Graphs.

Unit II **(18 Hours)**

The Adjacency Matrix – The Incidence Matrix – Symmetric Matrices – Eigenvectors – Positive Semidefinite Matrices - Spectral Decomposition – Rational functions.

Unit III **(15 Hours)**

Interlacing – Inside and Outside the Petersen Graph – Equitable Partitions – Fullerenes - Stability of Fullerenes.

Unit IV **(15 Hours)**

Strongly Regular Graphs: Parameters – Eigenvalues – Some characterizations – Small Strongly Regular Graphs.

Unit V **(15 Hours)**

The Laplacian Matrix – Trees – Representations – Energy and Eigen values – Connectivity.

Text Book:

Chris Godsil and Gordon Royle, 2001, Algebraic Graph Theory, Springer verlag.

Unit	Chapter/Sections
I	1(1.1 – 1.4, 1.7)
II	8(8.1 – 8.2, 8.4 – 8.6, 8.12 - 8.13)
III	9(9.1 – 9.3, 9.8 – 9.9)
IV	10(10.1 – 10.3, 10.5)
V	13(13.1 – 13.5)

References:

1. Dragos M. Covetkovic, Michael Doob, and Horst Sachs, 1979, Spectra of graphs: Theory and application.
2. Norman Biggs, 2001, Algebraic Graph Theory, Second edition, Cambridge University Press.

Web Resources:

1. https://assets.cambridge.org/97805218/01973/sample/9780521801973ws.pdf
2. https://www.geneseo.edu/~aguilar/public/assets/courses/310/algebraic-graph-theory

Course Designers:

1. Dr. K. Kayathri
2. Mrs. V. Kanchana Devi

ELECTIVE COURSES
GROUP- IV

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
PMA23ET22A	**Mathematical Python**	**Elective**	**3**	**2**	**-**	**3**

L - Lecture T - Tutorial P–Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	100

Preamble

The course deals with fundamental concepts of Python that will provide a foundational background for programming in a mathematical setting.

Pre-requisite

Knowledge in fundamental computer programming concepts and some mathematical principles.

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Demonstrate the basic concepts of python programming with the help of data types, operators and expressions.	90	85
CO2	Divide a Python program into functions and solve mathematical problems.	80	75
CO3	Make use of control statements for altering the sequential execution of programs in solving problems.	85	80
CO4	Classify Python lists, tuples and dictionaries for compound data.	85	80
CO5	Explain Object Oriented Programming in Python.	75	70

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	L	M	L	M
CO2	S	S	M	M	M
CO3	M	M	S	M	S
CO4	M	S	M	M	S
CO5	L	M	S	S	M

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M	M	M	M	M	L
CO2	M	L	S	M	S	M	M
CO3	M	M	S	M	M	S	L
CO4	M	M	S	S	S	L	M
CO5	M	L	M	M	M	M	S

Bloom's Taxonomy:

	CA		End of Semester
	First	Second	
Knowledge – K1	15%	15%	20%
Understand – K2	15%	15%	20%
Apply – K3	30%	30%	20%
Analyze –K4	20%	20%	20%
Evaluate- K5	20%	20%	20%

Contents:

Unit I **(12 hours)**

The Way of the Program: What is a Program? - Running Python – The First Program – Arithmetic Operators –Values and Types – Formal and Natural Languages.

Variables Expressions and Statements: Assignment statements – Variable Names – Expressions and Statements – Script Mode – Order of Operations – String Operations – Comments.

Unit II **(15 hours)**

Functions: Function Calls – Math Functions – Composition – Adding New Functions – Definitions and Uses – Flow of Execution – Parameters and Arguments – Variables and Parameters Are Local – Stack Diagrams – Fruitful Functions and Void Functions – Why Functions?

Conditionals and Recursion: Floor Division and Modulus – Boolean Expressions – Logical Operators – Conditional Execution – Alternative Execution – Chained Conditionals – Nested Conditionals – Recursion – Stack Diagram for Recursive Functions – Infinite Recursion – Keyboard Input.

Fruitful Functions: Return Values – Incremental Development –Composition – Boolean Functions – More Recursion – Leap of Faith – One More Example – Checking Types.

Unit III **(12 hours)**

Iteration: Reassignment – Updating Variables – The While Statement – break – Square Roots – Algorithms.

Strings: A String is a Sequence – len – Traversal with a for Loop – String Slices – Strings are Immutable – Searching – Looping and Counting – String Methods – The in Operator – String Comparison.

Unit IV **(18 hours)**

Lists: A List Is a Sequence – Lists Are Mutable – Traversing a List – List Operations – List Slices – List Methods – Map, Filter and Reduce – Deleting Elements – Lists and Strings – Objects and Values – Aliasing – List Arguments.

Dictionaries: A Dictionary Is a Mapping – Dictionary as a Collection of Counters – Looping and Dictionaries – Reverse Lookup – Dictionaries and Lists – Memos – Global Variables.

Tuples: Tuples Are Immutable – Tuple Assignment – Tuples as Return Values – Variable Length Assignment Tuples – Lists and Tuples – Dictionaries and Tuples –Sequences of Sequences.

Files: Persistence – Reading and Writing – Format Operator – Filenames and Paths – Catching Exceptions – Databases – Pickling – Pipes – Writing Modules.

Unit V **(18 Hours)**

Classes and Objects: Programmer Defined Types – Attributes – Rectangles – Instances as Return Values – Objects Are Mutable – Copying.

Classes and Functions: Time – Pure Functions – Modifiers – Prototyping versus Planning.

Classes and Methods: Object-Oriented Features –Printing Objects – Another Example – A more Complicated Example – The init Method – The _str_ method – Operator Overloading – Type based Dispatch – Polymorphism – Interface and Implementation.

Inheritance: Card Object – Class Attributes – Comparing Cards – Decks – Printing the Deck – Add, Remove, Shuffle and Sort – Inheritance – Class Diagrams – Data Encapsulation.

Text Book:

Allen B. Downey, 2019, Think Python, 2nd Edition, Shroff Publishers and Distributors Pvt. Ltd., India, Sixth Reprint.

Unit	Chapter/Section
I	1 & 2 (Except Debugging)
II	3, 5 & 6 (Except Debugging)
III	7 & 8 (Except Debugging)
IV	10, 11, 12 & 14 (Except Debugging)
V	15, 16, 17 & 18 (Except Debugging)

References:

1. M. Lutz and D. Ascher, 2009, Learning Python: Powerful Object-Oriented Programming, 4th Edition, O'Reilly.
2. R. Thareja, 2017, Python Programming: Using Problem Solving Approach, Oxford University Press.
3.H.P. Langtangen, 2016, A Primer on Scientific Programming with Python, Springer- Verlag, Berlin.
4. K.V.Namboothiri, March2013, Python for Mathematics Students, Version2.1.
5. Y. Zhang, 2015, An Introduction to Python and Computer Programming, Springer, Singapore.

Course Designers:

1. Dr. R. Lakshmanan
2. Mrs. B. Ambika

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
PMA23ET22B	**Neural Networks**	**Elective**	**3**	**2**	**-**	**3**

L - Lecture T - Tutorial P–Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	100

Preamble

The course deals with fundamental concepts of Neural Networks and helps the students gain exposure in the field.

Pre-requisite

Basic computer programming skills and machine learning concepts.

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Acquire the basic concepts of neuron model and network architecture	90	85
CO2	Understand the structure and design concepts of neural network applications	80	75
CO3	Analyze the algorithms associated with neuron network models	85	80
CO4	Grasp the neural networks for pattern classification and association	85	80
CO5	Design simple associative network and simple recognition network models	75	70

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**M**	**S**	**M**	**L**
CO2	**M**	**S**	**L**	**S**	**M**
CO3	**S**	**M**	**S**	**M**	**S**
CO4	**S**	**M**	**S**	**M**	**S**
CO5	**L**	**S**	**M**	**L**	**M**

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**M**	**S**	**M**	**S**	**M**	**L**
CO2	**S**	**S**	**L**	**S**	**L**	**S**	**S**
CO3	**M**	**L**	**M**	**L**	**M**	**M**	**M**
CO4	**S**	**M**	**S**	**S**	**S**	**L**	**M**
CO5	**L**	**S**	**S**	**S**	**M**	**S**	**S**

Bloom's Taxonomy:

	CA		End of Semester
	First	Second	
Knowledge – K1	15%	15%	20%
Understand – K2	15%	15%	20%
Apply – K3	30%	30%	20%
Analyze –K4	20%	20%	20%
Evaluate- K5	20%	20%	20%

Contents:

Unit I **(15 hours)**

Introduction: Objectives – History – Applications - Biological Inspiration.

Neuron Model and Network Architectures: Objectives – Theory and Examples – Notations – Neuron Models – Single Input Neuron – Transfer Functions – Multiple-Input Neuron – Network Architectures – A layer of Neurons – Multiple Layers of Neurons - Recurrent Networks.

Unit II **(15 hours)**

Perceptron Learning Rule: Objectives – Theory and Examples – Learning Rules – Perceptron Architecture – Single Neuron Perceptron – Multi - Neuron Perceptron– Perceptron Learning Rule – Test Problem – Constructing Learning Rules – Unified Learning Rule – Training Multiple-Neuron Perceptrons – Proof of Convergence – Notation - Proof – Limitations.

Unit III **(15 hours)**

Widrow Hoff Learning: Objectives – Theory and Examples - Adaline Network **–** Single Adaline Network – Mean Square Error – LMS Algorithm – Analysis of Convergence – Adaptive Filtering – Adaptive Noise Cancellation – Echo Cancellation.

Unit IV **(15 hours)**

Back Propagation: Objectives – Theory and Examples – Multi layer Perceptrons – Pattern Classification – Function Approximation – The Backpropagation Algorithm – Performance Index – Chain Rule – Back Propagating the sensitives – Summary – Example – Batch vs Incremental Training – Using Back Propagation – Choice of Network Architecture – Convergence – Generalization.

Unit V **(15 Hours)**

Associative Learning: Objectives – Theory and Examples – Simple Associative Network – Unsupervised Hebb rule – Hebb Rule with Decay – Simple Recognition Network – Instar Rule – Kohonen Rule – Simple Recall Network – Outstar Rule.

Text Book:

Hagan Demuth Beale, 2014, 'Neural network design', 2nd Edition.

Unit	Chapter/Section
I	Chapter 1 & 2
II	Chapter 4
III	Chapter 10
IV	Chapter 11
V	Chapter 15

References:

1. Freeman, J.A and Skapura, D.M., 1991, 'Neural Networks - Algorithms, Applications and Programming Techniques', Addison Wesley Publications, Digitized Reprint (2007).
2. Satish Kumar, 2013, 'Neural Networks–A Classroom Approach', Tata McGraw-Hill Publishing Company Limited.
3. Andrew Glassner, February 20, 2018 "Deep Learning: From Basics to Practice" Vol-2, The Imaginary Institute, Seattle, WA,.
4. Simon Haykins, 2008, 'Neural Networks: A Comprehensive Foundation', Prentice-Hall Inc., 3rd Edition.

Course Designers:

1. Mr. M. Madhavan
2. Mrs. B. Ambika

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2023)

CourseCode	Course Title	Category	L	T	P	Credits
PMA23ET22C	**Dynamical Systems**	**Elective**	**3**	**2**	**-**	**3**

L - Lecture T - Tutorial P–Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	100

Preamble:

The course provides the basic knowledge about dynamical systems and a qualitative insight to differential equations.

Prerequisite:

Knowledge in basic linear algebra and familiarity with differential equations.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	List the basic existence and uniqueness theorem for initial value problems.	85	80
CO2	Develop the knowledge to analyze the dynamical behavior of systems using differential equations.	85	80
CO3	Interpret the concept of nonlinear systems, global existence theorem, Periodic orbits and The Poincare map.	90	85
CO4	Improve their problem solving skills in nonlinear dynamical systems.	75	70
CO5	Build a mathematical models of relevan real-world problems based on differential equations.	80	75

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**M**	**M**	**S**	**S**	**L**
CO2	**S**	**S**	**M**	**L**	**M**
CO3	**L**	**M**	**S**	**M**	**S**
CO4	**M**	**M**	**M**	**S**	**S**
CO5	**M**	**M**	**S**	**S**	**L**

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	M	M	S	M	L	S	S
CO2	S	M	S	M	S	M	L
CO3	S	L	M	M	M	S	M
CO4	L	M	S	S	S	M	M
CO5	M	M	S	L	S	M	M

Bloom's Taxonomy:

	CA		End of Semester
	First	Second	
Knowledge – K1	15%	15%	20%
Understand – K2	15%	15%	20%
Apply – K3	30%	30%	20%
Analyze –K4	20%	20%	20%
Evaluate- K5	20%	20%	20%

Contents:

Unit I **(15 Hours)**

Linear systems: Uncoupled linear systems – Diagonalization – Exponential of operators – The Fundamental theorem for linear systems – Linear systems in R^2.

Unit II **(15 Hours)**

Linear Systems: Complex Eigenvalues – Multiple Eigen values – Jordan forms –Stability theory – Nonhomogeneous Linear Systems.

Unit III **(15 Hours)**

Nonlinear Systems : Local Theory : Some preliminary Concepts and Definitions –The fundamental Existense - Uniqueness theorem – Dependence on initial conditions andparameters – The maximal Interval of Existence.

Unit IV **(15 Hours)**

Nonlinear Systems: Local theory:The flow defined by a Differential equation – Linearization – The stable manifold theorem – The Hartman-Grogman theorem – Saddles,Nodes, Foci and Centers.

Unit V **(15 Hours)**

Nonlinear Systems: Global theory: Dynamical Systems and Global Existence Theorem – Limit sets and Attractors – Periodic Orbits, Limit Cycles and Separatrix Cycles –The Poincare map

Text Book:

Lawrence Perko, 2001, Differential Equations and Dynamical Systems, 3rdEdition,Springer, New York, USA.

Unit	Chapter/Section
I	Chapter 1: 1.1 to 1.5
II	Chapter 1 : 1.6 to 1.10
III	Chapter 2 : 2.1 to 2.4
IV	Chapter 2 : 2.5 to 2.10
V	Chapter 3: 3.1 to 3.4

References:

1. Gerald Teschl, 2011, Ordinary Differential Equations and Dynamical Systems, AMS, Providence,US.
2. Morris W. Hirsch, Stephen Smale and Robert L Devaney, 2013, Differential Equations, Dynamical Systems and An Introduction to Chaos, 3rd Edition, Academic Press, Cambridge.
3. Stephen L. Caompbell and Richard Haberman, 2008, Introduction to Differential Equations with Dynamical Systems, Princeton University Press, Princeton, US.

Course Designers:

1. Mrs. K. Ponmari
2. Dr. D. Murugeswari

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
PMA23ET22D	**Data Mining**	**Elective**	**3**	**2**	**-**	**3**

L - Lecture T - Tutorial P - Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	100

Preamble:

The course covers Data Preprocessing, Mining Frequent Patterns, Associations, and Correlations, Classification and Cluster Analysis.

Prerequisite:

Knowledge in Database Management Systems, probability and statistics.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Identify the types of the data to be mined and present a general classification of tasks and primitives to integrate a data mining system.	95	90
CO2	Apply preprocessing methods for any given raw data.	85	80
CO3	Extract interesting patterns from large amounts of data.	90	85
CO4	Discover the role played by data mining in various fields.	75	70
CO5	Choose and employ suitable data mining algorithms to build analytical applications	80	75

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**L**	**M**	**M**	**M**
CO2	**L**	**S**	**S**	**M**	**S**
CO3	**S**	**S**	**M**	**L**	**S**
CO4	**S**	**M**	**L**	**M**	**M**
CO5	**S**	**M**	**S**	**S**	**L**

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	M	L	M	M
CO2	S	M	S	L	S	M	M
CO3	S	L	M	M	S	M	M
CO4	S	M	S	M	L	M	M
CO5	S	S	S	M	M	L	M

Bloom's Taxonomy:

	CA		End of Semester
	First	Second	
Knowledge – K1	15%	15%	20%
Understand – K2	15%	15%	20%
Apply – K3	30%	30%	20%
Analyze –K4	20%	20%	20%
Evaluate- K5	20%	20%	20%

Contents:

Unit I **(15 Hours)**

Introduction: Why Data Mining -What is Data Mining -What Kinds of Data Can Be Mined- What Kinds of Patterns Can Be Mined- Which Technologies Are Used-Which Kinds of Applications Are Targeted

Unit II **(15 Hours)**

Getting to Know Your Data and Data Preprocessing: Data Objects and Attribute Types-Basic Statistical Descriptions of Data-Data Visualization. Data Preprocessing: An Overview-Data Cleaning-Data Integration-Data Reduction.

Unit III **(15 ours)**

Mining Frequent Patterns, Associations, and Correlations: Basic Concepts and Methods: Basic Concepts-Frequent Itemset Mining Methods-Which Patterns Are Interesting – Pattern Evaluation Methods.

Unit IV **(15 Hours)**

Classification: Basic Concepts and Advanced Methods: Basic Concepts-Decision Tree Induction-Bayes Classification Methods-Rule-Based Classification Bayesian Belief Networks-Classification by Backpropagation-Support Vector Machines-Classification Using Frequent Patterns

Unit V **(15 Hours)**

Cluster Analysis: Basic Concepts and Methods: Cluster Analysis-Partitioning Methods-Hierarchical Methods

Text Book:

Jiawei Han, Micheline Kamber and Jian Pei, 2012, Data Mining – Concepts and Techniques, 3rd Edition, Elsevier, USA.

Unit	Chapter/Section
I	1(1.1-1.6)
II	2 (2.1-2.3) 3 (3.1-3.4)
III	6 (6.1-6.3)
IV	8 (8.1-8.4) 9 (9.1-9.4)
V	10(10.1-10.3)

References:

1. Ian H. Witten, Eibe Frank and Mark A. Hall, Data Mining: Practical Machine Learning Tools and Techniques (Second Edition), Morgan Kaufmann, 2011.
2. Margaret H Dunham, Data Mining Introductory and Advanced topics, Pearson Education, NJ 07458.
3. D. Hand, H. Mannila and P. Smyth, 2001, Principles of Data Mining, MIT Press. Publishers, USA.

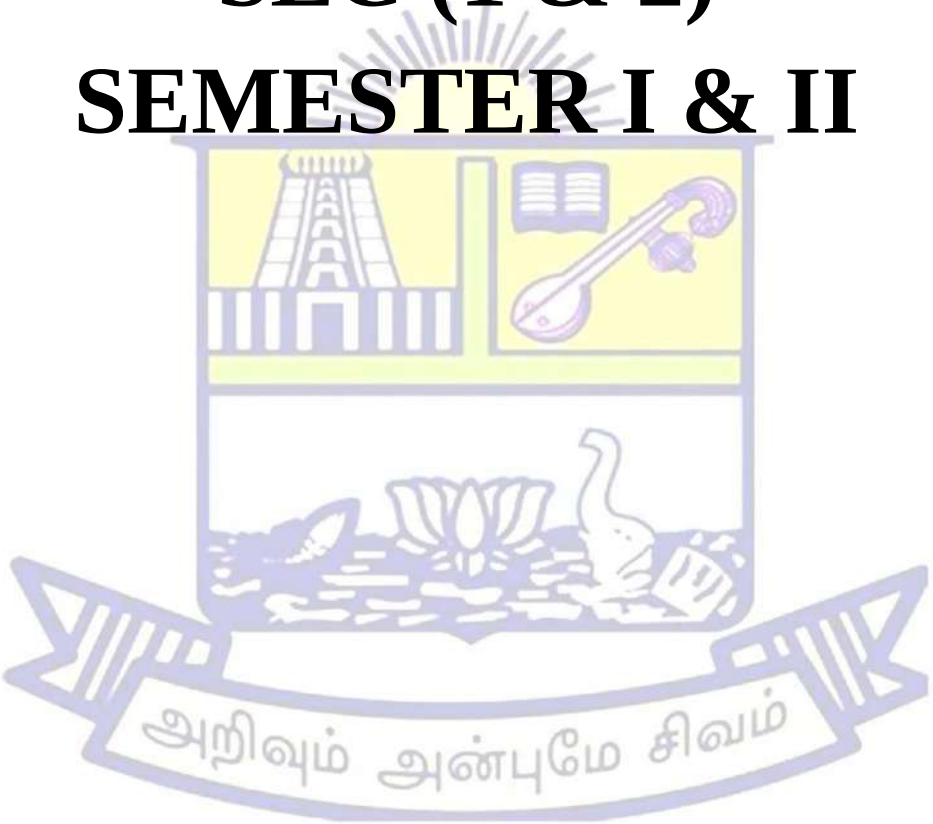
Web Resources:

1. https://www.geeksforgeeks.org/data-mining/
2. https://data-flair.training/blogs/data-mining-tutorials-home/
3. https://youtube.com/playlist?list=PLLspfyoOYoQcI6Nno3gPkq0h5YSe81hsc

Course Designers:

1. Mrs. S. Shanavas Parvin
2. Mr. K. V. Janarthanan

SKILL ENHANCEMENT COURSES
SEC (1 & 2)
SEMESTER I & II



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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
PMA23SL11A	Differential Equations using SCILAB	**SEC 1**	--	--	**3**	**2**

L - Lecture T - Tutorial P – Practicals

Year	Semester	Int.Marks	Ext.Marks	Total
First	First	**25**	**75**	**100**

Preamble:

The course deals with problem solving techniques using the free and open source computational software Scilab. It is designed to develop skills in solving Problems in Ordinary Differential Equations such as Solution techniques for first order linear ordinary differential equations with constant coefficients , Solution of homogeneous linear equations of any order with constant coefficients . It also deals with some of the Numerical solution techniques like Euler's method, Modified Euler's method , Runge- Kutta methods etc using Scilab.

Prerequisite:

Fundamental knowledge in any computer programming language.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Develop Scilab programs to solve first order ODEs	95	90
CO2	Recall the procedure to obtain the general solution to the non – homogeneous second order linear ODE and develop Scilab programs.	90	85
CO3	Solve system of linear homogenous ODEs solution using matrices and Build programs	90	85
CO4	Solve ODEs using Euler's method , Modified Euler's method , Runge - Kutta method	90	85
CO5	Analyze solutions of Boundary value problems	85	80

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	M	S
CO2	S	S	M	S	M
CO3	M	M	S	M	M
CO4	S	M	M	M	S
CO5	S	M	S	S	M

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	M	S	S	M	M
CO2	S	S	S	M	S	S	S
CO3	S	M	S	S	S	S	S
CO4	S	M	M	S	S	S	S
CO5	S	M	M	S	S	M	M

Bloom's Taxonomy:

	CA		End of Semester
	First	Second	
Knowledge – K1	15%	15%	20%
Understand – K2	15%	15%	20%
Apply – K3	30%	30%	20%
Analyze –K4	20%	20%	20%
Evaluate- K5	20%	20%	20%

List of Practicals:

1. Solution techniques for first order , linear ODEs with constant coefficients
2. Solution of homogeneous linear equations of any order with constant coefficients
3. Obtain the general solution to the non-homogeneous, second order, linear ODE.
4. System of linear homogeneous ODEs – solution using Matrices.
5. Solution of ODE using Euler's method.
6. Solution of ODE using Modified Euler's method
7. First order differential equation using Runge- Kutta method
8. Second order differential equation using Runge- Kutta method.
9. Simultaneous differential equation using Runge- Kutta method
10. Adams Predictor Corrector method
11. Solution to Boundary value problems

References:

1. Rajan Goyal, Mansi Dhingra, 2019, Programming in SCILAB,Narosa Publishing house Pvt Ltd, New Delhi
2. Earl A Coddington, 2012, An Introduction to Ordinary Differential Equations , PHI Learning Private Limited, New Delhi
3. M.K.Jain , S.R.K. Iyengar, R.K. Jain, 2018, Numerical Methods for Scientific and Engineering Computation, Sixth Edition, New Age International Publishers, New Delhi
4. B.S.Grewal, 2015, Numerical Methods in Engineering and Science with Programs in C, C++ & MATLAB, Khanna Publishers.
5. T.Veerarajan, T. Ramachandran,2006, Numerical Methods with programs in C , Second Edition,Tata McGraw – Hill Publishing Company Limited, New Delhi.

Web Resources:

1.Scilab Tutorials for Computational Science, Graeme Chandler and Stephen Roberts
2.Scilab, A Hands on Introduction , Satish Annigeri
3. Notes on Scilab , Gary Bunting

Course Designers:

1. Dr. B. Arivazhagan
2. Mrs. V. Kanchana Devi

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(For those who joined M.Sc. Mathematics on or after June 2023)

CourseCode	Course Title	Category	L	T	P	Credits
PMA23SL11B	Lab in C++	SEC 1	-	-	3	2

L - Lecture T - Tutorial P - Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	25	75	50

Preamble:

The course provides practical knowledge to find solution for analytical problems using C++ language.

Prerequisite:

Knowledge in C language.

Course Outcomes:

On the completion of the course the student will be able to

	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Illustrate Programming principles	85	80
CO2	Develop skills to solve mathematical problems	90	85
CO3	Calculate statistics of given data sets	80	75
CO4	Design simple projects	85	80
CO5	Construct programs using strings and functions	75	70

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	M	S	S
CO2	M	S	M	M	S
CO3	M	S	S	M	S
CO4	S	M	S	M	M
CO5	S	M	M	S	M

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	M	M	M	S	M
CO2	S	M	S	S	S	M	S
CO3	M	S	M	M	S	M	M
CO4	S	M	S	M	M	M	M
CO5	S	M	M	S	M	S	M

List of Practicals:

1. Check Whether Number is Even or Odd
2. Find All Roots of a Quadratic Equation
3. Check Whether a character is Vowel or Consonant.
4. Calculate Sum of Natural Numbers
5. Check Leap Year
6. Find Factorial
7. Display Fibonacci Series
8. Find GCD and LCM
9. Calculate Power of a Number
10. Find ASCII Value of a Character
11. Check Whether a Number is Palindrome or Not
12. Display Factors of a Number
13. Check Whether a Number can be Express as Sum of Two Prime Numbers
14. Convert Binary Number to Decimal and vice-versa
15. Calculate Average of Numbers Using Arrays
16. Calculate Standard Deviation
17. Find Transpose of a Matrix
18. Concatenate Two Strings
19. Find the Length of a String
20. Find Largest Element of an Array

References:

1. E. Balagurusamy, 2019, Object - Oriented Programming with C++, 7th Edition, The McGraw–Hill Company Ltd, New Delhi.
2. Steve Oualline, 2002, Practical C++ Programming, 2nd Edition, O'Reilly Media Inc, United States of America.
3. Richard Grimes, 2017, Beginning C++ Programming, Packt Publishing Ltd, UK.

Web Resourcess:

1. https://www.programiz.com/cpp-programming/examples
2. https://www.geeksforgeeks.org/c-plus-plus/
3. https://oceanai.mit.edu/ivpman/pdfs/lab_cpp_01_intro.pdf

Course Designers:

1. Mr. M. Madhavan
2. Dr. S. Vijaya

THIAGARAJAR COLLEGE, MADURAI – 9.

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
PMA23SL11C	**Lab in JAVA Programming**	**SEC 1**	**-**	**-**	**3**	**2**

L - Lecture T - Tutorial P–Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	15	35	50

Preamble:

Programming in Java is a fundamental task to find solution to problems such as displays the number of characters, lines and words in a text, add and multiply the two given matrices and rank of students of a class using interfaces etc.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Illustrate Programming principles	85	80
CO2	Code, debug and execute Java programs to solve the given problems	80	75
CO3	Implement multi-threading and exception-handling	80	70
CO4	Implement functionality using String	80	75
CO5	Construct programs using switch case and array statement	80	75

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	S	L	M
CO2	M	S	**S**	M	M
CO3	**S**	L	M	M	L
CO4	M	**S**	S	L	M
CO5	S	S	**S**	M	M

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	L	M	M	L	L
CO2	S	S	**L**	S	S	S	L
CO3	M	L	M	M	L	S	S
CO4	M	**S**	S	S	M	L	S
CO5	L	L	**S**	M	M	M	M

Bloom's Taxonomy:

	CA		End of Semester
	First	Second	
Knowledge – K1	15%	15%	20%
Understand – K2	15%	15%	20%
Apply – K3	30%	30%	20%
Analyze –K4	20%	20%	20%
Evaluate- K5	20%	20%	20%

List of Practicals:

1. Write a Java program that prompts the user for an integer and then prints out all the prime numbers up to that integer?
2. Write a Java program that displays the number of characters, lines and words in a text?
3. Write a Java program to solve the quadratic equation using switch case statement.
4. Write a Java program to add two given matrices.
5. Write a Java program to multiply two given matrices.
6. Write a Java program to find the transpose of a given matrix.
7. Write a Java program to find the inverse of the square matrix.
8. Write a Java program to find sum, max, min and average of any array of elements using inheritance.
9. Write a Java program to do String Manipulation using Character Array and perform the following string operations: a) String length b) Concatenating two strings.
10. Write a Java program to find the percentage of marks, rank of students of a class using interfaces.
11. Write a Java program in java so that thread to find the divisors and child thread to check prime.
12. Write a Java program in java to handle exceptions.
13. Write a Java program to accept a text and change its size and font. Include bold italic options. Use
    frames and controls.
14. Write a Java program to draw bar charts.
15. Write a Java program to calculate the area under the curve.

References:

1. Herbert Schildt, 2010, The Complete Reference, 7the Edition, Tata McGraw Hill, New Delhi.
2. Gary Cornell, 2008, Core Java 2 Volume I – Fundamentals, 8th Edition, Pearson Education, NeW Delhi.
3. Brian Overland and Michael Morrison, 2001, Java 2 Programming Reference, 1st Edition.
4. Patrick Naughton, 1997, The Java Handbook, Tata McGraw-Hill, New Delhi.

Course Designers:

1. Dr. R. Angeline Chella Rajathi
2. Ms. P. Vanmathy

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(For those who joined M.Sc. Mathematics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
PMA23SL21A	**Lab in Mathematical Python**	**SEC 2**	**-**	**-**	**3**	**2**

L - Lecture T - Tutorial P–Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	100

Preamble:

This course aims to equip you with the practical skills and knowledge needed to apply mathematical concepts using Python programming. Get ready to dive into a hands-on learning experience

Prerequisite:

A strong foundation in mathematics, including calculus, linear algebra, and basic numerical methods. Additionally, students should have basic programming skills and familiarity with Python programming language.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Apply mathematical concepts to develop Python programs for solving numerical problems.	90	85
CO2	Analyze mathematical problems and design Python programs to solve them.	80	75
CO3	Use Python functions, loops, and control structures to implement mathematical algorithms	85	80
CO4	Evaluate and interpret the results obtained from Python programs in the context of the given mathematical problems.	85	80
CO5	Implement various mathematical algorithms using Python libraries for linear algebra, numerical methods, and analysis.	75	70

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	L	M	L	M
CO2	S	S	M	M	M
CO3	M	M	S	M	S
CO4	M	S	M	M	S
CO5	L	M	S	S	M

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M	M	M	M	M	L
CO2	M	L	S	M	S	M	M
CO3	M	M	S	M	M	S	L
CO4	M	M	S	S	S	L	M
CO5	M	L	M	M	M	M	S

Bloom's Taxonomy:

	CA		End of Semester
	First	Second	
Knowledge – K1	15%	15%	20%
Understand – K2	15%	15%	20%
Apply – K3	30%	30%	20%
Analyze –K4	20%	20%	20%
Evaluate- K5	20%	20%	20%

List of Programs

1. Program to find the area of a rectangle
2. Program to convert temperature from Celsius to Fahrenheit
3. Program to calculate compound interest
4. Program to calculate the roots of a quadratic equation
5. Program to calculate the volume of a sphere
6. Program to calculate the factorial of a number
7. Program to calculate the greatest common divisor (GCD) of two numbers
8. Program to solve a system of linear equations using Gaussian elimination
9. Program to approximate the value of pi using the Monte Carlo method
10. Program to calculate the n-th Fibonacci number
11. A program for Primality checking of given integer, and print primes up to given integer.
12. A program to obtain marks of students in five subjects and calculate total marks, percentage. Assign grades according to the following criteria:
    Grade A: Percentage >=80
    Grade B: Percentage >=70 and <80
    Grade C: Percentage >=60 and <70
    Grade D: Percentage >=40 and <60
    Grade E: Percentage<40.

13. A program to count the number of even and odd numbers from an array of N numbers.
14. A program to find mean, median, mode for the given set of numbers in a list.
15. Program to calculate the determinant of a matrix
16. Program to solve a system of linear equations using Cramer's rule
17. Program to perform matrix multiplication
18. Program to find the roots of a polynomial equation using the Newton-Raphson method
19. Program to calculate the eigenvalues and eigenvectors of a matrix
20. Program to calculate the dot and cross product of two vectors and length of a vector

References:

1. Allen B. Downey, 2019, Think Python, 2nd Edition, Shroff Publishers and Distributors Pvt. Ltd. India Sixth Reprint.
2. R. Thareja, 2017, Python Programming: Using Problem Solving Approach, Oxford University Press.
3. H. P. Langtangen, 2016, A Primer on Scientific Programming with Python, Springer-Verlag, Berlin.
4. K.V. Namboothiri, March 2013, Python for Mathematics Students, Version2.1.
5. McKinney. W, 2017, Python for data analysis: Data wrangling with Pandas, NumPy, and IPython. O'Reilly Media, Inc.
6. Johansson, 2018, R. Numerical Python: A practical techniques approach for industry. Apress.

Course Designers:

1. Dr. R. Lakshmanan
2. Mrs. B. Ambika

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Course Code	Course Title	Category	L	T	P	Credits
PMA23SL121B	Numerical Analysis using SCI LAB	SEC 2	-	-	3	2

L - Lecture T - Tutorial P–Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	100

Preamble:

The course is designed to develop skills in solving numerical analysis problems using SCI Lab.

Prerequisite:

Fundamental knowledge in C- Programming and ability to solve algebraic and transcendental equations.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Develop SCI programs to solve transcendental and algebraic equationsusing Bisection Method, Regula-Falsi method, Newton Raphson method and Secant method.	85	80
CO2	Recall the procedure to solve system of algebraic equations and develop SCI programs.	85	80
CO3	Evaluate definite integrals using Trapezoidal method and analyze these results with exact solutions	90	85
CO4	Determine the definite integrals using Simpson's method	75	75
CO5	Solve and compare the solutions of given first order ordinary differential equations with exact solutions using SCI programs	85	80

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	M	L	M	S
CO2	S	S	M	L	S
CO3	M	M	S	S	L
CO4	M	L	S	S	S
CO5	S	S	M	S	L

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**M**	**M**	**S**	**L**	**S**
CO2	**S**	**S**	**M**	**M**	**S**	**S**	**S**
CO3	**M**	**L**	**S**	**S**	**S**	**S**	**S**
CO4	**M**	**M**	**L**	**S**	**S**	**S**	**S**
CO5	**S**	**S**	**S**	**S**	**M**	**M**	**L**

Bloom's Taxonomy:

	CA		End of Semester
	First	**Second**	
Knowledge – K1	15%	15%	20%
Understand – K2	15%	15%	20%
Apply – K3	30%	30%	20%
Analyze –K4	20%	20%	20%
Evaluate- K5	20%	20%	20%

List of Practicals:

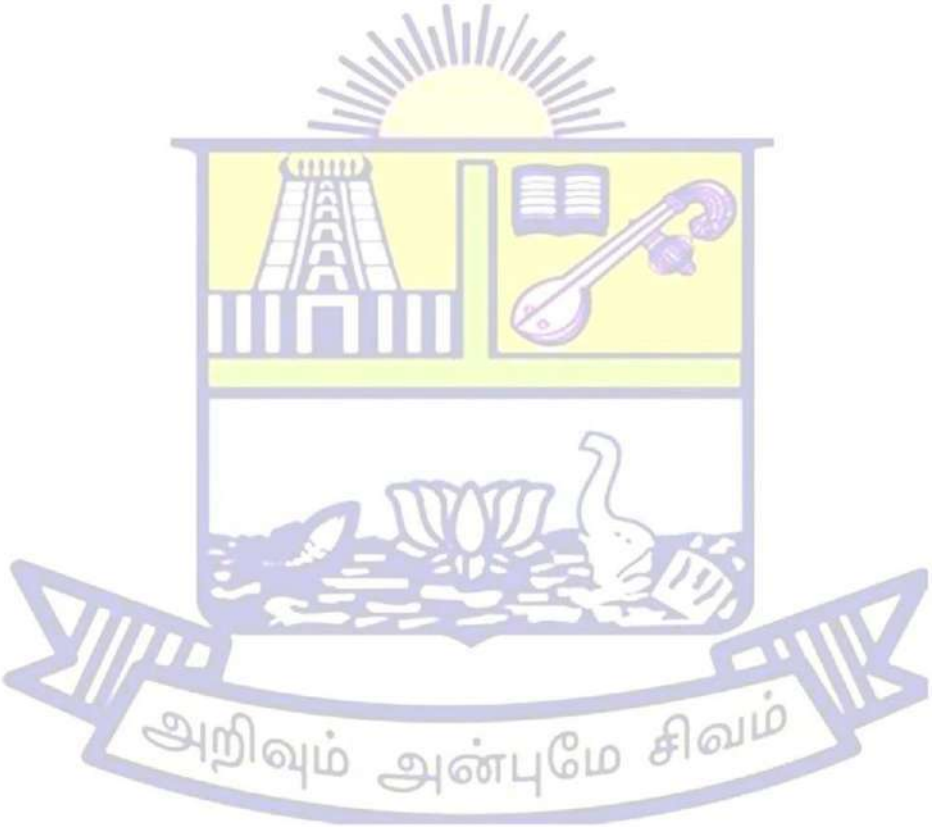
1. Solving transcendental and algebraic equations using Bisection method.
2. Solving transcendental and algebraic equations using Regula- Falsi method.
3. Solving transcendental and algebraic equations using Newton-Raphson method.
4. Solving transcendental and algebraic equation using Secant method.
5. Solving system of linear algebraic equations using Gauss-Seidel method.
6. Solving system of linear algebraic equations using Gauss-Elimination method.
7. Solving system of linear algebraic equations using Gauss-Jordan method.
8. Solving system of linear algebraic equations using Jacobi method.
9. Solving Interpolation using Lagrangian method.
10. Solving Interpolation using Newton's divided difference formula.
11. Solving Interpolation using Newton's forward difference formula.
12. Evaluating the integral of f(x) between the limits a to b using Trapezoidal rule .
13. Evaluating the integral of f(x) between the limits a to b using Simpons rule.
14. Solving first order initial value problem using Taylor method.
15. Solving first order initial value problem using Runge- Kutta method.

References:

1. S. Pal, 2009, Scilab Textbook Companion for Numerical Methods: Principles, Analysis, andAlgorithms, Oxford University Press.
2. M. K. Jain, S. R. K. Iyengar And R. K. Jain 2007, Scilab Textbook Companion for Numerical Methods For Scientific And Engineering Computation , New Age International (P) Limited.

Course Designers:

1. Mrs. K. Ponmari
2. Dr. P. Krishnaveni



ABILITY ENHANCEMENT COMPULSORY COURSES

AECC

SEMESTER I & II

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Course Code	Course Title	Category	L	T	P	Credits
PMA23AT11	Basic Soft Skills	AECC	2	-	-	2

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	25	75	100

Preamble:

To help learners develop their basic soft skills and develop their personality together with their technical skills.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Know about various aspectsof Basic soft skills and learnways to develop personality	85	75
CO2	Provide insight into much needed technical and non-technical qualities in career planning.	80	75
CO3	Learn about Leadership, team building, decision making	85	75
CO4	Understand the importance and type of communication in personal environment.	80	75
CO5	Understand various issues in personal and learn to overcome them	80	75

Mapping of COs with PSOs:

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	L	M	M	M
CO2	S	S	M	S	L
CO3	M	M	M	L	S
CO4	M	L	M	M	S
CO5	S	M	L	M	S

Mapping of COs with POs:

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	S	L	S	S
CO2	L	S	S	M	L	M
CO3	S	M	L	M	M	L
CO4	L	M	S	S	M	M
CO5	S	L	M	M	M	S

Bloom's Taxonomy:

	CA		End of Semester
	First	Second	
Knowledge – K1	15%	15%	20%
Understand – K2	15%	15%	20%
Apply – K3	30%	30%	20%
Analyze –K4	20%	20%	20%
Evaluate- K5	20%	20%	20%

Contents:

Unit – I **(6 Hours)**

Personality Development: Knowing Yourself, Positive Thinking, Johari's Window, Communication Skills, Non-verbal Communication, Physical Fitness

Unit II **(6 Hours)**

Emotional Intelligence: Meaning and Definition, Need for Emotional Intelligence,Intelligence Quotient versus Emotional Intelligence Quotient, Components of Emotional Intelligence, Competencies of Emotional Intelligence, Skills to DevelopEmotional Intelligence

Unit III **(6 Hours)**

Etiquette and Mannerism: Introduction, Professional Etiquette, TechnologyEtiquette

Unit IV **(6 Hours)**

Communication Today: Significance of Communication, GSC's 3M Model of Communication, Vitality of the Communication Process, Virtues of Listening,

Unit V **(6 Hours)**

Communication Today: Fundamentals of Good Listening, Nature of Non-Verbal Communication, Need forIntercultural Communication, Communicating Digital World

Text Book:

Gajendra S. Chauhan, 2015, Soft Skills: an Integrated Approach to Maximise Personality, Wiley, India

References:

1. Barun K. Mitra, 2016, Personality Development and Soft Skills, SecondEdition, Oxford Press, India.
2. Shalini Kalia, Shailja Agrawal, 2015, Business Communication, Wiley, India.
3. Sherfield , 2011, Cornerstone: Developing Soft Skills, Fourth Edition, Pearson, India.
4. M. S. Rao, 2010, Soft Skills - Enhancing Employability, I. K. International Publishing and Private Ltd.

Web Resources:

1. https://www.goskills.com/Soft-Skills
2. https://learndigital.withgoogle.com/digitalgarage/course/soft-skills-training
3. https://www.sessionlab.com/blog/online-training-resources/

Course Designers:

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Course Code	Course Title	Category	L	T	P	Credits
PMA23AT21	**Academic Soft Skills**	**AECC**	**2**	**-**	**-**	**2**

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	25	75	100

Preamble:

To help learners develop their academic soft skills and develop their personality together with their technical skills. Developing academic skills to harnesshidden strengths, capabilities and knowledgeequip them to excel in real work environment and corporate life.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Know about various aspectsof Academic soft skills and learnways to develop personality	90	85
CO2	Provide insight into much needed technical and non-technical qualities in career planning.	80	75
CO3	Learn about Leadership, team building, decision making and Employment Communication	85	75
CO4	Understand the importance and type of communication in personal and professional environment.	80	75
CO5	Understand various issues in personal and profession communication and learn to overcome them	80	75

Mapping of COs with PSOs:

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**M**	**M**	**L**	**S**
CO2	**L**	**M**	**S**	**M**	**L**
CO3	**S**	**M**	**L**	**M**	**M**
CO4	**L**	**M**	**S**	**S**	**M**
CO5	**S**	**L**	**M**	**M**	**M**

Mapping of COs with POs:

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	M	S	L	S	S
CO2	L	S	S	M	L	M
CO3	S	M	L	M	M	L
CO4	L	M	S	S	M	M
CO5	S	L	M	M	M	S

Bloom's Taxonomy:

	CA		End of Semester
	First	Second	
Knowledge – K1	15%	15%	20%
Understand – K2	15%	15%	20%
Apply – K3	30%	30%	20%
Analyze –K4	20%	20%	20%
Evaluate- K5	20%	20%	20%

Contents:

Unit I **(6 Hours)**

Employment Communication: Introduction, Resume, Curriculum Vitae, Scannable Resume, Developing an Impressive Resume, Formats of Resume, Job Application orCover Letter

Unit II **(6 Hours)**

Professional Presentation: Nature of Oral Presentation, Planning a Presentation, Preparing the Presentation, Delivering the Presentation

Unit III **(6 Hours)**

Job Interviews: Introduction, Importance of Resume, Definition of Interview, Background Information, Types of Interviews, Preparatory Steps for Job Interviews

Unit IV **(6 Hours)**

Interview Skill Tips, Changes in the Interview Process, FAQ During Interviews

Unit V **(6 Hours)**

Group Discussion: Introduction, Ambience/Seating Arrangement for Group Discussion, Importance of Group Discussions, Difference between Group Discussion, Panel Discussion and Debate, Traits, Types of Group Discussions, topic basedand Case based Group Discussion, Individual Traits

Text Book:

Gajendra S. Chauhan, 2015, Soft Skills: an Integrated Approach to Maximise Personality, Wiley,India

References:

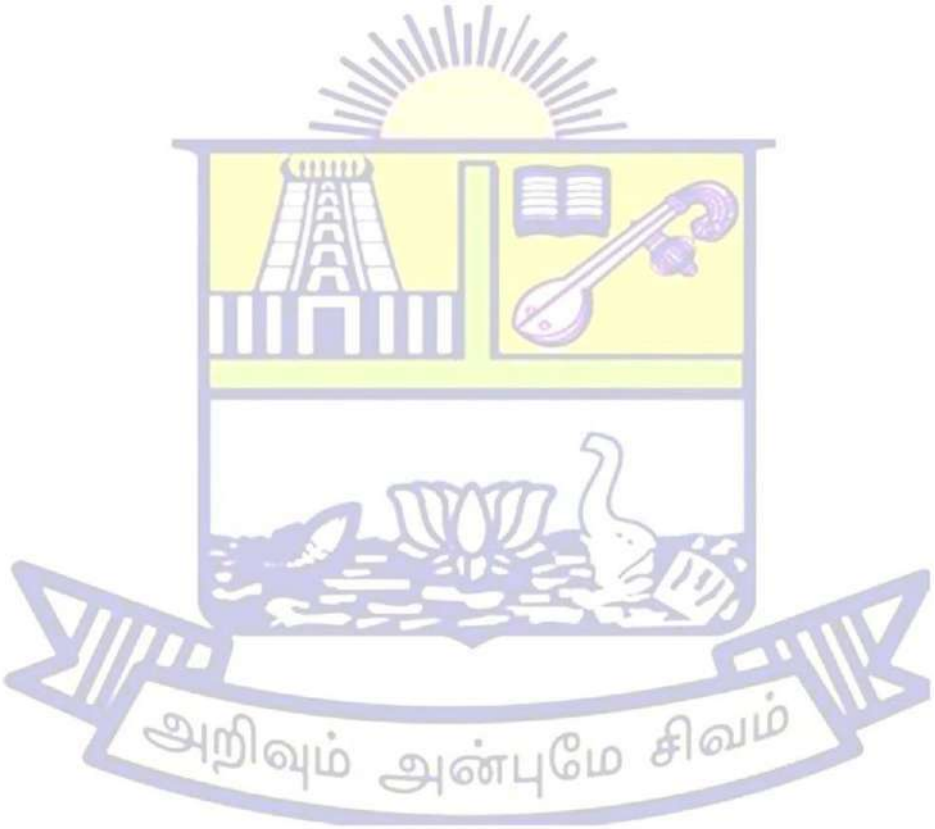
1. Barun K. Mitra, 2016, Personality Development and Soft Skills, Second edition, Oxford Press, India.
2. Shalini Kalia, Shailja Agrawal, 2015, Business Communication, Wiley, India.
3. Sherfield , 2011, Cornerstone: Developing Soft Skills, Fourth Edition, Pearson, India.
4. M. S. Rao, 2010, Soft Skills - Enhancing Employability, I. K. International Publishing and Private Ltd.

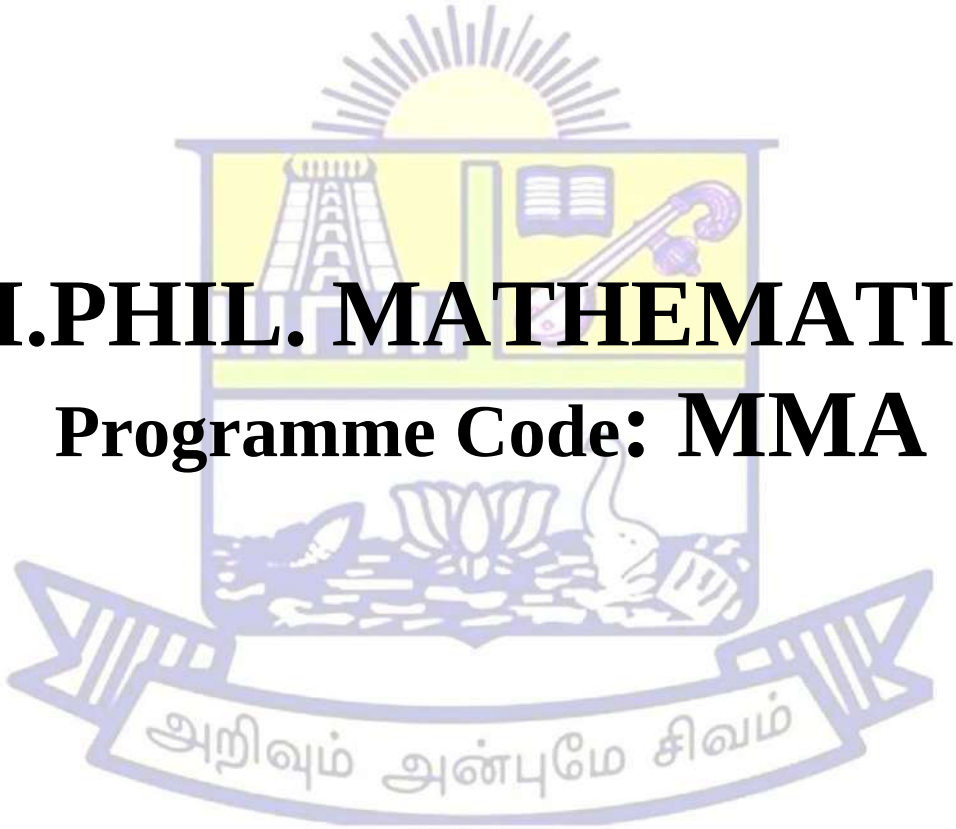
Web Resources:

1. https://www.educationcorner.com/teaching-soft-skills-guide.html
2. https://www.skcet.ac.in/Soft_Skills_Development.html
3. https://www.sessionlab.com/blog/online-training-resources/

Course Designers:

1. Mrs. S. Shanavas Parvin
2. Mr. G. Gowtham





M.PHIL. MATHEMATICS

Programme Code: MMA

Programme Outcome - PO (Aligned with Graduate Attributes)- Master of Philosophy (M.Phil.)

Knowledge and Critical thinking

Acquire, analyse, evaluate and interpret data using appropriate techniques. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Problem Solving

Critically evaluate information and ideas from multiple perspectives. Employ conceptual, analytical, quantitative and technical skills in solving the problems and are adept with a range of technologies

Complementary Skills

Recognize the need for information, effectively search for, retrieve, evaluate and apply that information gathered in support of scientific investigation or scholarly debate.

Communication Efficiency

Communicate and disseminate clearly and convincingly the research findings effectively in the academic community and to stakeholders of their discipline in written and or oral form. Elaborate on the ideas, findings and contributions in their field of interest to expert and non-expert audiences.

Environment, Ethical and Social Relevance

Apply ethical principles for societal development on environment context. Demonstrate the knowledge of and need for sustainable development.

Life-Long Learning

Recognize the need, and have the ability, to engage in continuous reflective learning in the context of technological advancement.

Team Work

Work effectively in teams, both collaboratively and independently to meet a shared goal with people whose disciplinary and cultural backgrounds differ from their own. Engage in intellectual exchange of ideas with researchers of other disciplines to address important research issues

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(For those who joined M.Phil. Mathematics on or after June 2023)

Programme Educational Objectives (PEO) for M.Phil. Mathematics

The objectives of this programme is

PEO 1	To develop practical skills & scientific methods to formulate hypothesis, design theoretical or / and computational model and perform scientific simulations to solve and explain observed phenomena.
PEO 2	To substantiate professional growth that keeps on discovering new avenues in emerging fields of pure and applied mathematics.
PEO 3	To motivate people toward research with sound theoretical and practical knowledge of mathematics.
PEO 4	To prepare students to learn the concrete ideas of mathematics, to analyze problems critically, and to develop problem-solving skills.
PEO 5	To encourage students to become effective independent learners.

Programme Specific Outcomes for M.Phil. Mathematics

On the successful completion of M. Phil. Mathematics, the students will be able to

PSO 1	Develop the process of designing a research study from its inception to its report.
PSO 2	Inculcate research level thinking in the field of pure and applied mathematics.
PSO 3	Assimilate complex mathematical ideas and arguments using wide and updated knowledge in the new areas of various branches of Mathematics
PSO 4	Culminate abstract mathematical thinking
PSO 5	Perform independent judgments in various fields of Mathematics at research-level.

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(For those who joined M.Phil. Mathematics on or after June 2023)

M. Phil. MATHEMATICS

COURSE STRUCTURE (w.e.f. 2023 – 2024 batch onwards)

Semester – I

Code No	Subject	Contact Hrs / Week	Credits	Total No of Hrs Allotted	Max Marks CA	Max Marks SE	Total
MMA23CT11	Research Methodology	6	6	90	100	100	200
MMA23CT12	Advanced Algebra and Analysis	6	6	90	100	100	200
MMA23ET11	Elective (In depth study)	-	6	90	100	100	200

Semester – II

Code No	Subject	Contact Hrs / Week	Credits	Total No of Hrs Allotted	Max Marks CA	Max Marks SE	Total
MMA23CT21	Dissertation	6	6	90	100	100	200

Elective papers: (One paper is to be chosen in Semester I)

A). Stochastic Differential Equations and its Applications

B) Magic Labelings of Graphs

C) Transform Theory on Function Spaces

D) Theory of Domination in Graphs

E) Algorithmic Graph Theory

F) Delay Differential Equations and its Applications

Total Credits – 24

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

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Course Code	Course Title	Category	L	T	P	Credit
MMA23CT11	**Research Methodology**	**Core**	**6**	**-**	**-**	**6**

L - Lecture T - Tutorial P–Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	100	100	200

Preamble

The course deals with the basic concepts and terminologies of research and train the students in methods, techniques, tools and methodologies.

Prerequisite

Fundamental knowledge in different types of research..

Course Outcomes

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Develop abstract mathematical thinking	75	75
CO2	Design research ideas on own	75	75
CO3	List and Explain Tertiary level in Thesis	75	75
CO4	Analyze the problems and solutions in research	75	75
CO5	Write a complete thesis on research findings	75	75

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
-	**L**	**S**	**L**	**M**	**L**
CO2	**S**	**L**	**L**	**L**	**L**
CO3	**L**	**M**	**L**	**S**	**L**
CO4	**L**	**L**	**S**	**M**	**L**
CO5	**L**	**L**	**S**	**L**	**M**

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**S**	**M**	**L**	**M**	**M**
CO2	**S**	**S**	**M**	**S**	**M**	**L**	**M**
CO3	**S**	**S**	**S**	**M**	**L**	**L**	**M**
CO4	**S**	**S**	**S**	**M**	**L**	**L**	**S**
CO5	**S**	**S**	**S**	**M**	**L**	**M**	**S**

Bloom's Taxonomy:

	CA		End of Semester Marks(%)
	I Internal Marks(%)	II Internal Marks(%)	
Knowledge – K1	20	20	40
Understand – K2	20	20	40
Apply – K3	20	20	40
Analyze –K4	20	20	40
Evaluate- K5	20	20	20
Create – K6	20	20	20

Contents:

Unit I **(18 hours)**

Introduction: Meaning of Research – Objectives of Research – Motivation in Research – Types of Research – Research Approaches – Significance of Research – Research Methods versus Methodology – Research and Scientific Method – Importance of Knowing How Research is done – Research Process – Criteria of Good Research – Problems Encountered by Researchers in India.

Unit II **(18 hours)**

Defining the Research Problem: What is a Research Problem? – Selecting the Problem – Necessity of Defining the Problem – Technique Involved in Defining a Problem.

Research Design : Meaning of Research Design- Need for Research Design – Features of a Good Design- Important concepts Relating to Research Design – Different Research Designs – Basic Principles of Experimental Designs.

Unit III **(18 hours)**

Assignment and Theses at the Tertiary level : Writing at the Tertiary Level- Planning the Assignment – Planning the Thesis – Scholarly Writing: A Case Study – Computer Tools for Writing and Publishing - The Computer as an Information Tool.

Unit IV **(18 hours)**

Writing the Assignment or Thesis: Common Features of Editorial Style - The General Format – Page and Chapter Format – The Use of Quotations – Footnotes.

Unit V **(18 hours)**

Writing the Assignment or Thesis: Tables and Figures – Referencing – Appendices – Editing and Evaluating the Final Product.

Text Books:

1. Kothari. C.R., 2010, Research Methodology, Methods and Techniques (Second Revised Edition) New Age International Publishers, New Age International Publishers.
2. Jonathan Anderson, Millicent Poole, 2017, Assignment and Thesis Writing, 4th Edition, Wiley India.

Unit	Book	Chapter
I	1	1
II	1	2,3
III	2	1-6
IV	2	7-11
V	2	12-15

References:

1. Panneerselvam. R., 2007, Research Methodology, Prentice Hall of India, New Delhi.
2. Gurumani N.,2016, Scientific Thesis Writing and Paper Presentation, MJP Publishers, Chennai.
3. Yogesh Kumar Singh, 2006, Fundamentals of Research Methodology and Statistics, New Age International (P) Ltd.
4. Ranjith Kumar, 2011, Research Methodology a Step-by-Step Guide for Beginners, 3rd Edition, Sage Publication Ltd.
5. Geoffery Marczyk, David DeMatteo, David Festinger, 2005, Essentials of Research Design and Methodology, John Wiley & Sons.

Course Designers:

1. Dr. B. Arivazhagan
2. Mrs. B. Ambika

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

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Course Code	Course Title	Category	L	T	P	Credits
MMA23CT12	**Advanced Algebra and Analysis**	**Core**	**6**	**-**	**-**	**6**

L - Lecture T - Tutorial P - Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	100	100	200

Preamble:

The course enhances advancements in theory of Modules, Measure and Banach algebra,

Prerequisite:

Sound knowledge in Algebra, real and complex analysis, topology, measure theory and functional analysis.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	List and Explain fundamentals of abstract algebra	75	75
CO2	Analyze Modules, submodules, quotient modules and local properties of fractions	75	75
CO3	Recall and identify regular and singular elements in a Banach Algebra	75	75
CO4	Find the spectral radius and Develop Gelfand mappings on commutative Banach algebra	75	75
CO5	Recall and Illustrate integration as a Linear functional corresponding to finite positive Borel	75	75

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**L**	**S**	**L**	**M**	**L**
CO2	**L**	**L**	**S**	**L**	**L**
CO3	**L**	**S**	**M**	**L**	**L**
CO4	**L**	**L**	**S**	**M**	**L**
CO5	**S**	**M**	**L**	**L**	**M**

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	M	L	L	M
CO2	S	S	M	S	M	L	M
CO3	S	S	S	M	L	L	M
CO4	S	S	S	M	L	L	S
CO5	S	S	S	M	L	M	S

Bloom's Taxonomy:

	CA		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge – K1	20	20	40
Understand – K2	20	20	40
Apply – K3	20	20	40
Analyze –K4	20	20	40
Evaluate- K5	20	20	20
Create – K6	20	20	20

Contents:

Unit I **(18 hours)**

Modules: Modules and module homomorphisms - Submodules and quotient modules - Operations and submodules – Direct sum and product – Finitely generated modules – Exact sequences – Tensor product of modules –Restriction and extension of scalars – Exactness properties of the tensor product – Algebras – Tensor product of algebras

Unit II **(18 hours)**

Rings and Modules of fractions: Local properties – Extended and contracted ideals in rings of fractions

Unit III **(18 hours)**

Banach Algebras: Definition and examples – Regular and singular elements – Topological divisors of zero – The spectrum – The formula for the spectral radius – The radial and semi-simplicity.

Unit IV **(18 hours)**

The Gelfand mapping – Application of the formula r(x) = lim ||xn || 1/n - Involution in Banach algebras- The Gelfand Neumark theorem – Ideals in and the Banach-Stone theorem.

Unit V **(18 hours)**

Positive Borel Measures: The Riesz representation theorem- Regularity Properties of Borel Measures-Lebesgue measure- Continuity properties of measurable functions.

Text Books:

1. Atiyah. M.F. and I.G. GeMacdonald, 1969, Introduction to Commutative Algebra , Addison – Wesley Publishing Company, Great Britain.
2. G.F. Simmons, 2012, Introduction to Topology and Modern Analysis - Tata McGraw – Hill edition, Eighteenth Reprint, New Delhi.
3. Walter Rudin, 2010, Real and Complex analysis - Tata McGraw – Hill 3rd Edition, Ninth Reprint, New Delhi.

Unit	Book	Chapter / Sections
I	1	2
II	1	3
III	2	12 (Full)
IV	2	13 (Full), 14(section 74)
V	3	2(Full)

References:

1. Balmohan Vishnu Limaye, 2012, Functional Analysis - 2nd Edition, New Age International, Chennai.
2. Kosaku Yoshida, 2007- Functional Analysis, Springer Verlag, 200, New Delhi.
3. Erwin Kreyszig, 2007, Introductory Functional Analysis with Applications, John Wiley & Sons, Third Print, New Jersey.
4. Thomas W. Hungerford, 2008, Algebra, Springer Verlag International edition, New York.
5. Serge Lang, 2010, Algebra, Revised Third Edition, Springer International edition, New Haven, Connecticut.

Course Designers:

1. Dr. G. Prabakaran
2. Dr. R. Angeline Chella Rajathi

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

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Course Code	Course Title	Category	L	T	P	Credits
MMA23ET11A	**Stochastic Differential Equations and its Applications**	**Elective**	**6**	**-**	**-**	**6**

L - Lecture T - Tutorial P - Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	100	100	200

Preamble:

The course provides an introduction to stochastic differential equations that discusses the fundamental concepts and properties of stochastic differential equations and presents strategies for their stochastic perturbation.

Prerequisite:

Strong knowledge in multivariate calculus, probability and statistics and ordinary differential equations

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Explain the Ito Stochastic integral	75	75
CO2	Discuss the theory of existence and uniqueness of the solutions to Stochastic differential equations	75	75
CO3	Define stability properties of Stochastically	75	75
CO4	Develop Stochastic simulations in their respective	75	75
CO5	Analyze the epidemic models with stochastic	75	75

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**M**	**L**	**L**	**M**
CO2	**L**	**L**	**S**	**L**	**L**
CO3	**L**	**L**	**S**	**M**	**L**
CO4	**S**	**L**	**L**	**L**	**L**
CO5	**L**	**S**	**L**	**L**	**M**

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**S**	**M**	**L**	**L**	**M**
CO2	**S**	**S**	**M**	**S**	**M**	**M**	**M**
CO3	**S**	**S**	**S**	**M**	**L**	**L**	**S**
CO4	**S**	**S**	**S**	**M**	**M**	**M**	**S**
CO5	**S**	**S**	**S**	**M**	**L**	**M**	**S**

Bloom's Taxonomy:

	CA		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge – K1	20	20	40
Understand – K2	20	20	40
Apply – K3	20	20	40
Analyze –K4	20	20	40
Evaluate- K5	20	20	20
Create – K6	20	20	20

Contents:

Unit I

Brownian Motions and Stochastic Integrals: Introduction – Basic Notations of probability theory – Stochastic processes - Brownian motions- Stochastic integrals – Ito's formula – Moment inequalities – Gronwall-type inequalities.

Unit II

Stochastic Differential Equations: Introduction - Stochastic differential equations – Existence and uniqueness of solutions - L^p - estimates – Almost surely asymptotic estimates.

Unit III

Stability of Stochastic Differential Equations: Introduction – Stability in probability – Almost sure exponential stability – Moment exponential stability – Stochastic stabilization and destabilization.

Unit IV

Stochastic Delay Population Systems: Introduction – Noise independent of population sizes - Noise dependent of population sizes: Part I - Noise dependent of population sizes: Part II – Stochastic delay Lotka-Volterra food chain.

Unit V

The Behavior of an SIR Epidemic Model with Stochastic Perturbation.

Text Book:

Xuerong Mao, 2007, Stochastic Differential Equations and Applications, Horwood Publishing Limited, United Kingdom, Second Edition.

Research Article for Unit V:

Chunyan Ji, Daqing Jiang and Ningzhong Shi, The Behavior of an SIR Epidemic Model with Stochastic Perturbation, Stochastic Analysis and Applications, 30: 755 -773, 2012.

Unit	Chapter/section
I	1(1.1 – 1.8)
II	2(2.1 – 2.5)
III	4(4.1 – 4.5)
IV	11(11.1 – 11.5)
V	Research Article

References:

1. Bernt Oksendal, Reprint 2011, Stochastic Differential Equations, Springer, 6th Edition, New York.
2. Avner Friedman, 2004, Stochastic Differential Equations and Applications, Dover Publications, New York.

Course Designers:

1. Dr. M. Senthilkumaran
2. Mrs. K. Ponmari

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Course Code	Course Title	Category	L	T	P	Credits
MMA23ET11B	**Magic Labelings of Graphs**	**Elective**	**6**	**-**	**-**	**6**

L - Lecture T - Tutorial P - Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	100	100	200

Preamble:

The course deals with edge-magic total labelings, vertex-magic total labelings and super edge-magic graceful labelings and their applications.

Prerequisite:

Strong knowledge in graph theory and fundamentals of Labeling in Graphs

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Relate the magic square concepts with the applications of magic labeling.	75	75
CO2	Illustrate edge-magic and super edge-magic total	75	75
CO3	Demonstrate the necessary conditions for vertex magic total labeling and its related labelings.	75	75
CO4	Recall the forbidden configurations for totally magic labelings and determine the totally magic	75	75
CO5	Develop research skills by analyzing the properties of super edge-magic graceful graphs.	75	75

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**L**	**L**	**L**	**L**	**S**
CO2	**L**	**S**	**L**	**M**	**L**
CO3	**L**	**L**	**S**	**M**	**L**
CO4	**S**	**L**	**L**	**S**	**L**
CO5	**S**	**M**	**L**	**M**	**S**

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	M	S	S	S
CO2	S	L	M	S	M	L	M
CO3	S	S	S	L	S	S	S
CO4	S	L	L	L	S	L	S
CO5	S	S	S	S	S	S	S

Bloom's Taxonomy:

	CA		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge – K1	20	20	40
Understand – K2	20	20	40
Apply – K3	20	20	40
Analyze –K4	20	20	40
Evaluate- K5	20	20	20
Create – K6	20	20	20

Contents:

Unit I

Preliminaries: Magic – Magic square – Latin square – Magic rectangles – Labelings – Magic labelings – Some applications of Magic labelings.

Unit II

Edge-Magic Total Labelings: Basic ideas – Definitions – Some elementary counting – Duality – Cycles – Small cycles – Generalizations of cycles – Complete bipartite graphs – Small cases – Stars – Trees – Super Edge-Magic Total Labelings.

Unit III

Vertex-Magic Total Labelings: Basic Ideas – Definitions – Basic counting – Regular graphs – Cycles and Paths – Graphs with vertices of degree one – The complete graphs-Super Vertex-Magic Total Labelings– E-Super Vertex-Magic Total Labelings – V-Super Vertex-Magic Total Labelings.

Unit IV

Totally Magic Labelings: Basic Ideas – Definitions – Examples – Isolates and stars – Forbidden configurations – Totally magic injections - The totally magic equation matrix.

Unit V

Super edge-magic graceful graphs

Text Book:

Alison M. Marr, W.D. Wallis, 2013, Magic Graphs, Second Edition, Springer Science+Business Media, New York.

Research Article for Unit V:

G. Marimuthu and M. Balakrishnan, Super edge magic graceful graphs, Information Sciences, Elsevier, Volume 287, 140 - 151, 2014.

Unit	Chapter / Sections
I	1 (1.1, 1.4, 1.5, 1.6)
II	2 (2.1, 2.4, 2.5, 2.7, 2.9)
III	3 (3.1, 3.2, 3.3, 3.7, 3.8, 3.10)
IV	4 (4.1, 4.2, 4.3, 4.6, 4.7)
V	Research Article

References:

1. Jeyanthi. P., 2012, Studies in Graph Theory – Magic labeling and related concepts, LAP Lambert Academic Publishing, Germany.
2. Susana C. López and Francesc A. Muntaner-Batle, 2019, Graceful, Harmonious and Magic TypeLabelings - Relations and Techniques, Springer, New York.

Web Resources:

1. https://mat.upc.edu/en/people/susana.clara.lopez/publications/openprob.pdf
2. www.jatit.org/volumes/Vol66No1/6Vol66No1.pdf
3. https://pdfs.semanticscholar.org/49d2/655916a7abafa302564c6da4bdf1717e5de0.pdf

Course Designers:

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

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Course Code	Course Title	Category	L	T	P	Credits
MMA23ET11C	**Transform Theory on Function Spaces**	**Elective**	**-**	**-**	**-**	**6**

L - Lecture T - Tutorial P - Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	100	100	200

Preamble:

The course highlights the transform analysis on function spaces such as L^p, Holomorphic functions and Banach algebras.

Prerequisite:

Sound knowledge in real, complex and functional analysis.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Define and analyze Fourier Transform on L^p	75	75
CO2	Demonstrate and develop Fourier Transform on L^1	75	75
CO3	Find, illustrate and compare the relationship between L^p space and continuous function	75	75
CO4	Recall and extend the Gelfand Theory of	75	75
CO5	Identify and Classify Maximal ideal space of Bounded Holomorphic functions.	75	75

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	L	S	M	L
CO2	S	L	M	S	L
CO3	S	M	L	L	S
CO4	L	L	S	M	L
CO5	S	M	L	L	S

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	M	S	M	L
CO2	S	S	M	S	M	L	M
CO3	S	S	S	L	L	M	L
CO4	S	S	S	S	L	L	M
CO5	S	S	S	S	M	M	M

Bloom's Taxonomy:

	CA		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge – K1	20	20	40
Understand – K2	20	20	40
Apply – K3	20	20	40
Analyze –K4	20	20	40
Evaluate- K5	20	20	20
Create – K6	20	20	20

Contents:

Unit I

Convex functions and inequalities - The L^pSpaces – Approximation by continuous functions.

Unit II

Fourier transforms: Formal properties – The inversion theorem – The Plancherel theorem – The Banach Algebra $L^1(R)$.

Unit III

Fourier transforms on L^p (R).

Unit IV

Ideals and homomophism – Homomorphisms and quotient algebras - Gelfand transforms .

Unit V

On Maximal Ideal space of Bounded Holomorphic functions.

Text Books:

1. Walter Rudin, 2010, Real and Complex analysis - Tata McGraw – Hill 3rd Edition, Ninth Reprint, New Delhi
2. Walter Rudin, 2006, Functional Analysis, Tata McGraw-Hill, II edition, New Delhi.

Research Articles

1.Devendra Kumar and Dimple Singh, Fourier Transform in L^p (R) Spaces, $p \geq 1$ Gen. Math. Notes, Vol. 3, No. 1, March 2011, pp.14-25 ISSN 2219-7184.

2. Hermann Render , The Maximal Ideal Space Of H∞(D) With Respect To The Hadamard Product, Proceedings Of The American Mathematical Society Volume 127, Number 5, Pages 1409–1411 S 0002-9939(99)04697-3 Article electronically published on January 29, 1999.

Unit	Book	Chapter / Sections
I	1	3(full)
II	1	9(full)
III	3	Research Article
IV	2	11.1-11.13
V	4	Research Article

References:

1. Balmohan Vishnu Limaye, 2012, Functional Analysis - 2nd Edition, New Age International, Chennai.
2. Kosaku Yoshida, 2008, Functional Analysis Springer Verlag, New Delhi.
3. Erwin Kreyszig, 2007, Introductory Functional Analysis with Applications, John Wiley & Sons, Third Print. New Jersey.
4. Simmons. G.F., 2012, Introduction to Topology and Modern Analysis, Tata McGraw – Hill edition, Eighteenth Reprint, New Delhi.

Web Resources:

1. Devendra Kumar and Dimple Singh, Fourier Transform in L^p (R) Spaces, $p \geq 1$ Gen. Math. Notes, Vol. 3, No. 1, March 2011, pp.14-25 ISSN 2219-7184.
2. Hermann Render , The Maximal Ideal Space Of H∞(D) With Respect To The Hadamard Product, Proceedings Of The American Mathematical Society Volume 127, Number 5, Pages 1409–1411 S 0002-9939(99)04697-3 Article electronically published on January 29, 1999.

Course Designers:

1. Dr. R. Angeline Chella Rajathi
2. Dr. G. Prabakaran

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Course Code	Course Title	Category	L	T	P	Credits
MMA23ET11D	**Theory of Domination in Graphs**	**Elective**	**6**	**-**	**-**	**6**

L - Lecture T - Tutorial P – Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	100	100	200

Preamble:

The course deals with the concepts of covering and independence with domination, various types of domination parameters and domination polynomial.

Prerequisite:

Sound knowledge in connectedness and independence in graphs and some ideas about real polynomials.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Find and illustrate the relation among domination, independence and covering	75	75
CO2	Define and develop new domination parameters	75	75
CO3	Build advanced ideas in domination	75	75
CO4	Identify and classify the properties of domination	75	75
CO5	Determine polynomials for various domination	75	75

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**L**	**L**	**L**	**S**	**L**
CO2	**S**	**M**	**L**	**L**	**M**
CO3	**S**	**L**	**M**	**M**	**L**
CO4	**L**	**S**	**M**	**L**	**L**
CO5	**L**	**L**	**S**	**L**	**M**

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**S**	**M**	**S**	**S**	**S**
CO2	**S**	**L**	**M**	**S**	**M**	**L**	**M**
CO3	**S**	**S**	**S**	**L**	**S**	**S**	**S**
CO4	**S**	**S**	**L**	**L**	**S**	**L**	**S**
CO5	**S**	**S**	**S**	**S**	**M**	**S**	**S**

Bloom's Taxonomy:

	CA		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge – K1	20	20	40
Understand – K2	20	20	40
Apply – K3	20	20	40
Analyze –K4	20	20	40
Evaluate- K5	20	20	20
Create – K6	20	20	20

Contents:

Unit I

Independence and coverings – Domination in graphs

Unit II

Total dominating sets – Connected dominating sets.

Unit III

Nordhaus - Gaddum type results – Domatic number

Unit IV

Domination Polynomial of a Graph – Introduction – Coefficients of domination polynomial – Domination polynomial of corona of a graph

Unit V

Connected Domination Polynomial of a Graph – Introduction – Characterization of graphs using connected polynomials –Connected domination polynomial of some standard graphs

Text Book:

1. Gary Chartrand, Linda Lesniak and Ping Zhang, 2016, Graphs and Digraphs, Sixth Edition, CRC Press, Boca Raton Florida.
2. Haynes. T.W., Hedetniemiand. S.T. and Peter J. Slater, 1998. Fundamentals of domination in Graphs, Marcel Dekker Inc, New York.

Research Articles:

1. SaeidAlikhani and Yee-hock Peng, Introduction to Domination Polynomial of a graph, Ars Combinatoria, **(**Canada), Vol. 114 (2014) pp. 257-266.
2. Dhananjaya Murthy B. V., Deepak G. and N. D. Soner, Further results in connected domination Polynomial of a graph, American journal of mathematical science and applications, 2(1) January-June 2014, ISSN: 2321-497x, 41-46

Unit	Book/ Sections
I	1(12.3,12.4)
II	2 (6.3,6.4)
III	2 (9.1,9.2)
IV	Research Article -1
V	Research Article – 2

References:

1. Kulli. V.R., 2010, Theory of domination in graphs, Vishwa International Publications, Gulbarga
2. Martin Baca and Mirka Miller, 2008, Super Edge-Antimagic Graphs-A Wealth of Problems and Some Solutions, Brown Walker Press, USA

Course Designers:

1. Dr. K. Kayathri
2. Dr. G. Prabakaran

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Phil. Mathematics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
MMA23ET11E	**Algorithmic Graph Theory**	**Elective**	**-**	**-**	**-**	**6**

L – Lecture T – Tutorial P – Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	100	100	200

Preamble:

The course deals with basic principles of algorithm designing techniques, graph theoretical algorithms and the theory of NP completeness

Prerequisite:

Sound knowledge in fundamental concepts of Graph theory and computer programming skills

Course Outcomes:

On the completion of the course the student will be able to

#	Course outcomes	Expected Proficiency (%)	Expected Attainment (%)
CO1	Recall some basic programming principles and algorithm design techniques	75	75
CO2	Illustrate some basic graph theoretical algorithms and 79nalyse some common graph theory	75	75
CO3	Develop minimal spanning tree algorithms and 79nalyse the algorithms	75	75
CO4	Explain the theory of NP – completeness	75	75
CO5	Design some new Graph coloring algorithms and 79nalyse the complexity.	75	75

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**S**	**L**	**L**	**L**
CO2	**L**	**S**	**L**	**L**	**L**
CO3	**L**	**L**	**L**	**M**	**S**
CO4	**L**	**L**	**L**	**S**	**M**
CO5	**L**	**L**	**S**	**L**	**M**

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**S**	**M**	**S**	**S**	**S**
CO2	**S**	**L**	**M**	**S**	**M**	**L**	**M**
CO3	**S**	**S**	**S**	**L**	**M**	**S**	**M**
CO4	**S**	**S**	**L**	**L**	**M**	**L**	**M**
CO5	**S**	**S**	**S**	**M**	**M**	**S**	**S**

Bloom's Taxonomy:

	CA		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge – K1	20	20	40
Understand – K2	20	20	40
Apply – K3	20	20	40
Analyze –K4	20	20	40
Evaluate- K5	20	20	20
Create – K6	20	20	20

Contents:

Unit I **(18 hours)**

Introduction: The Role of Algorithms in Computing – Getting Started – Growth of Functions

Unit II **(18 hours)**

Elementary Graph Algorithms: Representation of graphs – Breadth –first search – Depth – first search – Topological sort – Strongly connected components

Unit III **(18 hours)**

Minimum spanning Trees: Growing a minimum spanning tree – The algorithms of Kruskal and Prim

Unit IV **(18 hours)**

NP – Completeness: Polynomial time – Polynomial – time verification – NP –completeness and reducibility – NP –completeness proofs – NP –complete problems

Unit V

Research Papers

1. "**Solving the graph coloring problem via hybrid genetic algorithms**", Journal of king Saud University – Engineering Sciences (2015) 27,114-118
2. "**A novel scheme for graph coloring**", Sciverse Science Direct, Procedia Technology 4 (2012) 261 – 266.

Text Book:

Thomas H.Corman, Charles E.Leiserson, Ronald L.Rivest and Clifford Stein, 2010, Introduction to Algorithms, Third Edition, PHI Learning Private Limited, New Delhi.

Unit	Chapters/Sections
I	Chapter I : Sections 1 -3
II	Chapter VI :Section 22
III	Chapter VI : Sections 23
IV	Chapter VII :Section 34
V	Journal

References:

1.Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, 2010, Fundamentals of Computer Algorithms, Galgotial Publications Pvt. Ltd, New Delhi

2. Udit Agarwal, 2014, Algorithms Design and Analysis, Dhanpat Rai & Co (Pvt.) Ltd, New Delhi.

3. Lee. R.C.T., Tseng.S.S., Chang. R.C. and Tsai. Y.Y., 2013, Introduction to Design and Analysis of Algorithms A Strategic Approach, McGraw Hill Education (India) Private Limited, New Delhi

4. William Kocky and Donald L.Kreher, 2005, “Graphs, Algorithms,, and Optimization, CRC Press.

Course Designers:

1. Dr. B. Arivazhagan
2. Dr. D. Pandiaraja

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Phil. Mathematics on or after June 2023)

Course Code	Course Title	Category	L	T	P	Credits
MMA23ET11G	**Delay Differential Equations and its Applications**	**Elective**	**6**	**-**	**-**	**6**

L - Lecture T - Tutorial P - Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	100	100	200

Preamble:

This course provides an introduction to delay differential equations(DDEs) that discusses the fundamental concepts and properties of DDEs and present stability properties of HIV model.

Prerequisite:

Sound knowledge in ordinary differential equations and fundamental concepts in dynamical systems.

Course Outcomes:

On the successful completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Recall the basic concepts of delay differential	75	75
CO2	Explain the stability concepts in various problems	75	75
CO3	Construct the Liapunov functions for delay	75	75
CO4	Analyze and Find Hopf bifurcation for delay	75	75
CO5	Explain stability and Hopf bifurcation in a delayed	75	75

Mapping of COs with PSOs:

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**L**	**L**	**S**	**L**	**L**
CO2	**L**	**L**	**L**	**S**	**L**
CO3	**S**	**L**	**L**	**L**	**M**
CO4	**L**	**S**	**L**	**M**	**L**
CO5	**S**	**L**	**L**	**L**	**M**

Mapping of COs with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**S**	**M**	**S**	**S**	**S**
CO2	**S**	**L**	**M**	**S**	**M**	**L**	**S**
CO3	**S**	**S**	**S**	**L**	**M**	**S**	**M**
CO4	**S**	**S**	**L**	**L**	**M**	**L**	**M**
CO5	**S**	**S**	**S**	**M**	**M**	**S**	**S**

Bloom's Taxonomy:

	CA		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge – K1	20	20	40
Understand – K2	20	20	40
Apply – K3	20	20	40
Analyze –K4	20	20	40
Evaluate- K5	20	20	20
Create – K6	20	20	20

Contents:

Unit I

Introduction: Examples of Delay Differential Equations - Some Terminology - Solving Delay Equations Using a Computer - Delayed Negative Feedback: A Warm-Up: Preliminaries - The Simplest Delay Equation - Oscillation of Solutions - Solutions Backward in Time.

Unit II

Existence of Solutions: The Method of Steps for Discrete Delay Equations -Positivity of Solutions - A More General Existence Result - Continuation of Solutions - Remarks on Backward Continuation - Stability Definitions - Linear Systems and Linearization: Autonomous Linear Systems - Laplace Transform and Variation of Constants Formula - The Characteristic Equation - Small Delays Are Harmless - The Scalar Equation $x'(t) = Ax(t)+Bx(t-r)$ - Principle of Linearized Stability - Absolute Stability.

Unit III

Semi dynamical Systems and Delay Equations: The Dynamical Systems Viewpoint - Semiflows and Omega Limit Sets – Semi Dynamical Systems Induced by Delay Equations - Monotone Dynamics - Delayed Logistic Equation - Delayed Microbial Growth Model - Liapunov Functions - Logistic Equation with Instantaneous and Delayed Density Dependence.

Unit IV

Hopf Bifurcation: A Canonical Example - Hopf Bifurcation Theorem - Delayed Negative Feedback - Computation of the Hopf Bifurcation - Series Expansion of Hopf Solution - The Logistic Equation - A Second-Order Delayed Feedback System - Delayed Feedback Dominates Instantaneous Feedback - Instantaneous Feedback Dominates Delayed Feedback - Stabilizing the Straight-Up Steady State of the Pendulum - Gene Regulation by End-Product Repression - A Poincar´e-Bendixson Theorem for Delay Equations.

Unit V

Stability and Hopf bifurcation in a delayed model for HIV infection of $CD4^+$ T cells.

Text Book:

Hal Smith, 2010. Delay Differential Equations with Applications to the Life Sciences, Springer.

Research Article for Unit V:

Liming Cai, Xuezhi Li, Stability and Hopf bifurcation in a delayed model for HIV infection of $CD4^+$ T cells, Chaos, Solitons and Fractals, 42 (2009), 1-11.

Unit	Chapter/section
I	Chapters 1, 2
II	Chapters 3, 4
III	Chapters 5
IV	Chapters 6
V	Research Article

References:

1. Thomas Erneux, 2009, Applied Delay Differential Equations, Springer.
2. Yang Kuang, 1993, Delay Differential Equations with Applications in Population Dynamics, Academic press.
3. Gobalsamy. K., 2013, Stability and Oscillation of Delay Differential equations of Population Dynamics, Springer.

Course Designers:

1. Dr. M. Senthilkumaran
2. Dr. D. Pandiaraja

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

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Course Code	Course Title	Category	L	T	P	Credits
MMA23CT21	**Dissertation**	**Core**	**-**	**-**	**-**	**6**

L - Lecture T - Tutorial P–Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	100	100	200

The course aims to develop core skills in Pure and Applied Mathematics and allow students to specialize in industrial modelling or numerical analysis, in preparation for study towards a Ph.D. or a career using mathematics within industry. An important element is the course regarding transferable skills which will link with academics and employers to deliver important skills for a successful transition to a research career or the industrial workplace.

The students will choose the topic which will reflect careful study and a clear thinking. Students are free to choose any subject.

Students are expected to produce dissertation with a minimum 40 pages.

VALUE ADDED COURSES

DIPLOMA
IN
MATHEMATICAL SOFTWARES

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2023)

Course Code	Course Title	Category
PMA23DOPL11	**Essentials and Usages of Mathematica**	**Diploma**

L-Lecture T-Tutorial P–Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	First			100

Preamble:

Wolfram Mathematica is a technical computing solution that provides businesses of all sizes with tools for image processing, data visualization and theoretic experiments. This course provides an introduction to Mathematica and deals with symbolic computation, manipulating matrices, plotting functions and handling various types of data.

Prerequisite:

Knowledge in Fundamental computer programming concepts and some mathematical principles

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Recall fundamental Mathematica commands	80	70
CO2	Solving some problems in Linear algebra, Graph theory, Differential Equations, Number theory, Operations Research and Discrete Mathematics	85	75
CO3	Illustrate programs using Mathematica and some real life problems	80	70
CO4	Develop simple projects using Mathematica	85	70
CO5	Apply different techniques in Mathematica to solve various problems	80	75

Mapping of COs with PSOs:

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**M**	**M**	**S**	**M**	**M**
CO2	**S**	**S**	**M**	**S**	**M**
CO3	**M**	**M**	**M**	**S**	**S**
CO4	**S**	**M**	**M**	**S**	**M**
CO5	**S**	**M**	**M**	**S**	**M**

Mapping of COs with POs:

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M	S	M	M	S	L
CO2	S	M	S	M	M	S	S
CO3	S	M	S	S	M	S	S
CO4	M	S	S	M	M	M	M
CO5	M	S	S	M	M	M	M

Contents: **30 Hours**

Core Language

Language Overview – Expressions – Rules & Patterns – Procedural Programming – Parallel Programming – Package Development – Syntax – Units – Lists – Variables & Functions – Functional Programming – Sting Manipulation – External Operations – Tuning & debugging.

Mathematics and Algorithm

Mathematical functions – Formula manipulation – Matrices & Linear Algebra – calculus – Polynomial Algebra – Graphs & Networks – Logic & Boolean Algebra – Control Systems – Mathematical Data – Number & Precision – Equation Solving – Optimization – Probability & Statistics – Discrete Math – Number Theory – Computational Systems – Finance.

Visualization and graphics

Data visualization – Charting – Statistical visualization – Gauges – Drawing & interactivity – computational Geometry – Sound &Sonification – Function visualization – Dynamic visualization – Financial visualization – Options & Styling – Symbolic Graphics language – Importing & Exporting

Data manipulation

Importing & Exporting – Numerical Data – Image Processing – Text Processing – Files – Date & time – Arrays.

References:

1. Martha L. Abell, James P. Braselton, 2009, Mathematica by Example, 4th Edition, Academic Press, USA.
2. Michael Trott, 2004, The Mathematica Guide Book for Programming, Springer, USA
3. Stephen Wolfram, 2003, The Mathematica Book, 5th Edition, Wolfram Media, USA
4. John Gray, 2014, Mastering Mathematica- Programming Methods and Applications, Academic Press.
5. Wolfram Mathematica 9 Documentation – Original.

Course Designers:

1. Dr. B. Arivazhagan
2. Mr. M. Madhavan

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2023)

Course Code	Course Title	Category
PMA23DOPL21	**R- Environment for Applied Mathematics**	**Diploma**

L-Lecture T-Tutorial P–Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second			100

Preamble:

R is a programming language and free software environment for statistical computing and graphics supported by the R Foundation for statistical computing. This course deals with descriptive statistics such as mean, median, mode, standard deviation and standard error with visualization of data. Also it discusses the methods solving ordinary, partial and stochastic differential equations using different packages.

Prerequisite:

Knowledge in Fundamental computer programming language and some mathematical and statistical concepts.

Course Outcomes:

On the completion of the course the student will be able to

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Recall the data types in R	85	75
CO2	Solving some problems in Ordinary, Partial and Statistics	85	75
CO3	Demonstrate statistical approach of some real life problems using R	80	70
CO4	Construct simple projects using R	85	70
CO5	Apply different techniques in R Software to visualize various data.	85	70

Mapping of COs with PSOs:

#	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**M**	**S**	**M**	**S**
CO2	**S**	**S**	**S**	**M**	**M**
CO3	**M**	**S**	**S**	**S**	**S**
CO4	**S**	**M**	**S**	**S**	**M**
CO5	**S**	**M**	**S**	**S**	**M**

Mapping of COs with POs:

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	M	S	S	M	S	M
CO2	S	M	S	M	S	M	S
CO3	S	M	S	M	M	S	S
CO4	M	S	S	M	S	M	M
CO5	M	S	S	M	S	M	M

Contents: 30 Hours

Introduction to R Software and Data Handling

Software Overview – Basics and R as a Calculator – Calculations with Data vectors – Build-in Commands and Missing Data handling – Operations with Matrices – Variables and Types of Data- List- Data frames and factors.

Control flow statements in R

If statement – If else statement- switch - loops- while loops- for loop – Loop Control statements R- functions.

Descriptive Statistics

Absolute frequency – Relative Frequency – Frequency distribution function – Cumulative Distribution Functions. Arithmetic Mean – Median – Quartiles – Mode – Geometric Mean and Harmonic Mean – Range, Inter quartile range and Quartile Deviation – Absolute Deviation and Absolute Mean Deviation – Mean Squared Error, Variance and Standard deviation.

Visualization and Plots

Bar Diagrams – Subdivided Bar Plots and Pie Diagrams – 3D Pie Diagram and Histogram – Kernel Density and Steam-Leaf Plots.

Solving Differential Equations using desolve Package

A simple ODE: chaos in the atmosphere – Model specification – Model applications - Solver for Initial Value Problems of Ordinary Differential equations in R – Runge-Kutta methods and Euler- Solving PDEs using deSolve – Examples.

References:

1. Arsalane Chouaib Guidoum[cre, aut], Kamal Boukhetala[aut], 2020, Simulation of Diffusion Process Packages, R version(>=3.0.0)
2. Karline Soetaert, Thomas Petzoldt, Woodrow Setzer. R., 2010, Package deSolve: Solving Initial Value Differential Equations in R.
3. Michael J. Crawley, 2015, Statistics – An Introduction using R, Second Edition, John & Wiley Sons, Ltd, UK
4. Peter Dalgaard, 2008, Introductory Statistics with R, Second Edition, Springer.
5. R Documentation- Version (3.6.2 and above)
6. Stefano M. Lacus, 2008, Simulation and Interference for Stochastic Differential Equations with R Examples, Springer

Course Designers:

1. Mr. M. Madhavan
2. Dr. R. Lakshmanan