Thiagarajar College

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

Thirty Ninth Academic Council Meeting

Department of Mathematics

Dr. Rm. Murugappan
Dean – Curriculum Development

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with "A" Grade by NAAC)
Curriculum Structure for

B.A. Tamil, English & Economics

B.Sc., Maths, Physics, Chemistry, Botany, Biotechnology, Zoology, Microbiology and Psychology

(For those who joined in 2020 and after)

Category	Course	No. of Courses / Paper	Credit Distribution	Hrs/ Week	Total Credits
Part I	Tamil	4	3	12+12	12
Part II	English	4	3	12+12	12
		Sub Total		**48**	**24**
Part III	Core			72 +12	74
	Elect–Core	2	5	10	10
	Elect–Generic	2+2	5	24	20
		Sub Total		**118**	**104**
Part IV	**AECC** I & II Sem	I Sem EVS II Sem VE	2 + 1	2 I & II Sem	03
	NME III & IV Sem	2	2	2 III & IV Sem	04
	SEC V & VI Sem	2	2	2 V & VI Sem	04
		Sub Total		**06**	**11**
	Total				**139**
Part V	**NCC (Army &Navy)/ PE/ NSS / Rotaract/ Quality/WSC Circle/ Library/ SSL/ Nature Club/Value Education/ YRC**				**1**
	Grand Total				**140**

AECC – Ability Enhancement Compulsory Course
SEC – Skill Enhancement Course
NME – Non Major Elective

For Choice Based Credit System (CBCS)

- For NME every department offers two papers (one in each at III & IV Semester)
- For SEC every department offers two papers for each course (in Sem V &VI)
- For Major elective there may be an option for choice.

Semester	Courses
I	**EVS**
II	**VE**
III	**NME**
IV	**NME**
V	**SEC**
VI	**SEC**

B.Sc., Mathematics

Programme Code - UMA

(Aided & SF)

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

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.

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.,

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

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.

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.

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.

THIAGARAJAR COLLEGE, MADURAI – 9.

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

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 educate and form the youth as liberated lifelong learners who are sensitive to gender and ecology, empowered to respond to global challenges.
- To make the students creative and research oriented
- 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.

THIAGARAJAR COLLEGE, MADURAI – 9
(An Autonomous Institution Affiliated to Madurai Kamaraj University)
(Re – Accredited with 'A' Grade by NAAC)
POST GRADUATE 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.

.

THIAGARAJAR COLLEGE, MADURAI – 9.

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined **B.Sc. Mathematics** on or after June 2020)

COURSE STRUCTURE (w.e.f. 2020 batch onwards)

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	U20P111	இக்கால இலக்கியம்	6	3	90	25	75	100
Part II - English	U20EN11	English for Communication I	6	3	90	25	75	100
Core 1	UMA20C11	Calculus	5	4	75	25	75	100
Core 2	UCO20C11M	Financial Accounting	5	5	75	25	75	100
Allied(C)	UCH20GE11M	General Chemistry - I	4	4	60	25	75	100
Allied (C) - Lab	UCH20GL21M	Ancillary Chemistry Lab	2	-	30	-	-	-
AECC I	U20ES11	Environmental Studies	2	2	30	15	35	50
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	U20P121	பக்தி இலக்கியமும் சிற்றிலக்கியமும்	6	3	90	25	75	100
Part II - English	U20EN21	English for Communication II	6	3	90	25	75	100
Core 3	UMA20C21	Algebra and Trigonometry	5	4	75	25	75	100
Core 4	UCO20C21M	Cost and Management Accounting	5	5	75	25	75	100
Allied (C)	UCH20GE21M	General Chemistry - II	4	4	60	25	75	100
Allied (C) - Lab	UCH20GL21M	Ancillary Chemistry Lab	2	2	30	40	60	100
AECC II	U20VE21	Value Education	2	1	30	15	35	50
TOTAL			**30**	**22**				

Semester – III

Course	Code No.	Subject	Contact Hours / Week	Credits	Total No. of Hours Allotted	Max. Marks CA	Max. Marks SE	Total
Part I -Tamil	U20P131	Tamil	6	3	90	25	75	100
Part II - English	U20EN31	English for Communication III	6	3	90	25	75	100
Core 5	UMA20C31	Differential Equations and Laplace Transforms	5	5	75	25	75	100
Core 6	UMA20C32	Analytical Geometry of 3D and Vector Calculus	5	4	75	25	75	100
Allied (P)	UPH20GE31M	Physics -I	4	4	60	25	75	100
Allied (P) - Lab	UPH20GL41M	Allied Physics Practical	2	-	30	-	-	-
Non Major Elective NME	UMA20NE31	Mathematical Aptitude for Competitive Examinations	2	2	30	15	35	50
TOTAL			**30**	**21**				

Semester – IV

Course	Code No.	Subject	Contact Hours / Week	Credits	Total No. of Hours Allotted	Max. Marks CA	Max. Marks SE	Total
Part I Tamil	U20P141	Tamil	6	3	90	25	75	100
Part II English	U20EN41	English for Communication IV	6	3	90	25	75	100
Core 7	UMA20C41	Algebraic Structures	6	5	60	25	75	100
Core 8	UMA20C42	Sequences and Series	4	4	60	25	75	100
Allied (P)	UPH20GE41M	Basic Electronics	4	4	60	25	75	100
Allied (P) - Lab	UPH20GL41M	Allied Physics Practical	2	2	30	40	60	100
NME	UMA20NE41	Mathematical Logic	2	2	30	15	35	50
TOTAL			**30**	**23**				

Semester – V

Course	Code No.	Subject	Contact Hours / Week	Credits	Total No. of Hours Allotted	Max. Marks CA	Max. Marks SE	Total
Core 9	UMA20C51	Linear Algebra	6	5	90	25	75	100
Core 10	UMA20C52	Real Analysis	6	5	90	25	75	100
Core 11	UMA20C53	Linear Programming Problems	6	5	60	25	75	100
Core 12	UMA20C54	Programming in C	5	4	75	25	75	100
Core Elective 1	UMA20CE51	Options Given	5	5	75	25	75	100
SEC 1	UMA20SE51	Options Given	2	2	30	15	35	50
TOTAL			**30**	**26**				

Self Study Paper* 05 Credits (extra)

Semester – VI

Course	Code No.	Subject	Contact Hours / Week	Credits	Total No. of Hours Allotted	Max. Marks CA	Max. Marks SE	Total
Core 13	UMA20C61	Complex Analysis	6	5	90	25	75	100
Core 14	UMA20C62	Probability and Statistics	6	5	90	25	75	100
Core 15	UMA20C63	Resource Management Techniques	6	5	90	25	75	100
Core 16	UMA20C64	Numerical Methods	5	4	75	25	75	100
Core Elective 2	UMA20CE61	Options Given	5	5	75	25	75	100
SEC 2	UMA20SE61	Options Given	2	2	30	15	35	50
Part V		**NCC / NSS / Physical Education**	-	1	-	100	-	100
TOTAL			**30**	**27**				
TOTAL CREDITS FOR SEMESTERS I to VI				**140**				

SEC (2 Hours / week)

1) Programming in C – Lab
2) Numerical Methods – Lab
3) Theory of Numbers
4) Theory of Lattices
5) Statistical Test of Significance

Non Major Elective papers (NME) (2 Hours /week)

1) Mathematical Aptitude for Competitive Examinations (NME)
2) Mathematical Logic (NME)

Core Electives for Semester V

1) Mechanics
2) Combinatorics
3) Cryptography

Core Electives for Semester VI

1) Discrete Mathematics
2) Fundamentals of Computer Algorithms
3) Fuzzy sets

Self Study paper: Soft Skills

A) Consolidation of contact hours and credits: UG

Semester	Contact Hrs/ Week	Credits
I	30 hrs	21
II	30 hrs	22
III	30 hrs	21
IV	30 hrs	23
V	30 hrs	26
VI	30 hrs	26
Part – V	-	01
Total	**180 hrs**	**140**
V	Additional credit (Self study paper)	5

B) Curriculum Credits: Part wise

		No of papers	Credits per paper	Total credits
Part I	**Tamil**	**4**	**3**	**12**
Part II	**English**	**4**	**3**	**12**
Part III	**Core Theory**	**6+10**	**4/5**	**74**
	Core Elective	**2**	**5**	**10**
	Generic Elective Theory	**4**	**4**	**16**
	Generic Elective Lab	**2**	**2**	**4**
Part IV	**AECC**	**2**	**1/2**	**3**
	NME	**2**	**2**	**4**
	SEC	**2**	**2**	**4**
Part V (NSS/NCC/Physical Education)				**1**
Grand total				**140**

THIAGARAJAR COLLEGE, MADURAI – 9.

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined B.Sc. Mathematics on or after June 2020)

Programme Code : UMA

Course Code	Course Title	Category	L	T	P	Credit
UMA20C11	**Calculus**	**Core**	**4**	**1**	**-**	**4**

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 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	Knowledge Level
CO1	Recall the basic concepts of differentiation, partial differentiation and integration.	K1
CO2	Develop problem solving skills using derivatives and partial derivatives.	K2
CO3	Classify the nature of double points of a curve and determine asymptotes for the curve.	K3
CO4	Solve problems in double and triple integrals using transformation of one coordinate system to another.	K3
CO5	Analyze the properties of Beta and Gamma functions.	K3

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Blooms 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)**

Successive differentiation: Leibnitz formula for the n^{th} derivative of a product – Partial differentiation: Successive partial derivatives – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

Unit II **(15 Hours)**

Envelopes, Curvature of plane curves: Envelopes – Curvature.

Unit III **(12 Hours)**

Linear Asymptotes – Singular points.

Unit IV **(20 Hours)**

Reduction formulae – Integrals of the form $\int e^{ax}\cos bx\, dx$, a & b are constants – Bernoulli's formulae

Multiple integrals: Definition of the double integral – Evaluation of the double integral – Triple integrals - Change of variables.

Unit V **(13 Hours)**

Improper integrals: Beta and Gamma functions.

Text Books:

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

Unit	Book	Chapter/Section
I	1	III 2.1, 2.2., VIII 1 (1.1 – 1.7), 4,5.
II	1	X (Full)
III	1	XI (Full), XII (Full)
IV	2	I 13 (13. 1 – 13.10), 14, 15.1 V(1, 2, 3, 4), VI
V	2	VII (Full)

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.
5. Shanti Narayan, 2002, Differential Calculus, 14th Edition, S. Chand and Company Ltd.

Course Designers:

1. Mrs. R. Latha
2. Dr. D. Saravanakumar

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with 'A' Grade by NAAC)
ENVIRONMENTAL STUDIES

Course Code	Course Title	Category	L	T	P	Credit
U20ES11	Environmental Studies	AECC1	2	-	-	2

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

Preamble

Students acquire knowledge on the basic concepts, components and importance of environment.

Course Outcomes

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

	Course outcomes	Knowledge Level
CO1	Define the structure and functions of ecosystem	K1
CO2	Explain the benefits of biodiversity conservation	K2
CO3	Summarise the sources, effects and control measures of various types of Pollutants	K1
CO4	Perceive the environment legislations in India for sustainable development.	K3

K1: Knowledge K2: Understand K3: Apply

Mapping of Course Outcomes with Programme Specific Outcomes

	PO1	PSSO2	PSO3	PSO4	PSO5
CO1	L	L	M	L	M
CO2	-	M	M	-	M
CO3	-	L	M	L	L
CO4	-	-	L	L	L

Mapping of Course Outcomes with Programme Outcomes

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

Blooms taxonomy: Assessment Pattern

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

Course Title: Environmental Studies

Unit I

Definition and Scope of Environmental Studies – Ecology and Ecosystem – Structure of an Ecosystem – Food chains, food webs and ecological pyramids – Causes of Biodiversity Loss – Benefit and Conservation of Biodiversity

Unit II

Environmental problems and Management: Causes, effects and Control measures of : Air Pollution – Water Pollution – Noise Pollution – Nuclear Hazards. Solid waste management and Waste Disposal methods. Climate change and Global Warming causes and Measures. Waste and Plastics. Urban environmental problems and measures. Environmental Legislations in India. Sustainable development and Inclusive growth.

Text Book

1. Kanagasabai, C.S. 2005.Environmental Studies. Rasee publishers. Madurai.

Reference Books

1. Yogendra, N. and Srivastava, N. 1998. Environmental Pollution, Ashish Publishing House. New Delhi.

Sapru R.K.2001. Environment Management in India, Vol. I & Vol. II Ashish publishers house, New Delhi.

THIAGARAJAR COLLEGE, MADURAI – 9.

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POSTGRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined B.Sc. Mathematics on or after June 2020)

Programme Code : UMA

Course Code	Course Title	Category	L	T	P	Credit
UMA20C21	**Algebra and Trigonometry**	**Core**	**4**	**1**	**-**	**4**

L - Lecture T - Tutorial P–Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	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.

Course Outcomes

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

#	Course Outcome	Knowledge Level
CO1	Find the sum of the series by applying Binomial, Exponential and Logarithmic Series	K1
CO2	Find the sum of the powers of the roots of equations using Newton's method	K2
CO3	Apply transformations of equations and solve the equations	K3
CO4	Recall expressions for trigonometric functions	K3
CO5	Relate circular trigonometric functions and hyperbolic functions	K3

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Blooms 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)**

Relations between the roots and coefficients of equations - Symmetric function of the roots– Sum of the powers of the roots of an equation – Newton's theorem on the sum of powers of the roots**.**

Unit III **(15 Hours)**

Transformations of equations – Roots with signs changed – Roots multiplied by a given number - To increase or decrease the roots of a given equation by a given quantity – Removal of Terms – Descarte's Rule of signs - Horner's Method.

Unit IV **(15 Hours)**

Applications of De Moivre's theorem: Expression for $\sin n\theta$, $\cos n\theta$ and $\tan n\theta$ – Expression for $\sin^n \theta$ and $\cos^n \theta$ – Expansion of sin θ, cos θ, tan θ in powers of θ.

Unit V **(15 Hours)**

Hyperbolic functions– Inverse Hyperbolic functions– Logarithm of a complex number.

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. Arumugam. S. and Thangapandi Isaac. A., 2012, Trigonometry, New Gamma Publishing House, Palayamkottai.

Unit	Book	Chapter/Section
I	1	3 (5, 10) 4 (2, 3, 5, 6,7)
II	1	6 (11, 12, 13, 14)
III	1	6 (15.1, 15.2. 17, 19, 24, 30)
IV	2	1
V	2	2 & 3

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.

Course Designers:

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

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with 'A' Grade by NAAC)
VALUE EDUCATION

Course Code	Course Title	Category	L	T	P	Credit
U20VE21	Value Education	AECC2	2	-	-	1

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

Preamble

Students acquire knowledge on the basic concepts, components and importance of environment.

Course Outcomes

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

	Course outcomes	Knowledge Level
CO1	Define the values, Self assessment and values needed for self development	**K1**
CO2	Explain about the good character and good relationships	**K2**
CO3	Summarise the types of thoughts, developing thought pattern, external influences on thoughts	**K1**
CO4	Find out the causes of Illusions, Symptoms and stages of stress	**K3**

K1: Knowledge K2: Understand K3: Apply

Mapping of Course Outcomes with Programme Specific Outcomes

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

Mapping of Course Outcome with Programme Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5	PO6
CO1	**L**	**-**	**M**	**-**	**-**	**-**
CO2	**-**	**L**	**M**	**L**	**-**	**L**
CO3	**M-**	**M**	**S**	**-**	**-**	**-**
CO4		**-**	**M**	**L**	**-**	**M**

Blooms taxonomy: Assessment Pattern

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

Course Title: Value Education

Unit I

Self Development – Introduction - Definition and Types of Values – Self Assessment – Values needed for self development - Values needed for family life –Principles of happy living

Character development- Good character – Good relationships - Legendary people of highest character – The quest for character –Developing character -The key to good character.

Unit II:

Positive Thinking and Self Esteem - Types of thoughts - Areas of thinking - Developing thought pattern - External influences on Thoughts - Methods to keep outlook positive – Meaning of Self Esteem – Self empowerment.

Stress free living – Illusions and causes - Symptoms and stages of stress – Self confidence**–** Role models and leadership qualities – Critical thinking - Communication skills – Happy and successful life.

Reference:

Study material / Course material

1. Values for Excellence in Life Compiled by then Curriculum Development Cell Thiagarajar College, Madurai, in collaboration with the Education wing, Brahma Kumaris, Madurai.

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. 2020 June

Major	Year	Sem	Code	Title of the Paper	Cont Hrs/W	Credit
Physics	I	I	**UMA20GE11P**	**Allied Mathematics - I for Physics**	6	5
		II	**UMA20GE21P**	**Allied Mathematics - II for Physics**	6	5
Chemistry	II	III	**UMA20GE31C**	**Allied Mathematics - I for Chemistry**	6	5
	II	IV	**UMA20GE41C**	**Allied Mathematics - II for Chemistry**	6	5
Computer Science/Computer Application /Information Technology	I	I	**UMA20GE11I**	**Mathematical Foundation for Computer Science**	5	5
		II	**UMA20GE21I**	**Probability and Statistics**	5	5
	II	III	**UMA20GE31I**	**Computational Methods**	5	5
		IV	**UMA20GE41I**	**Operations Research**	5	5
Commerce		I	**UMA20GE11K**	**Business Mathematics**	5	5
		II	**UMA20GE21K**	**Business Statistics**	5	5

Scheme of Examination

Mark Statements:	**Internal (CA)**	**External (Sum)**
Theory:	25	75
Practical:	40	60

Minimum Marks required

	Internal (CA)	**External (Sum)**	**CA + SUM**
Theory	Nil	27 / 75	40%
Practical	Nil	21 / 60	40%

THIAGARAJAR COLLEGE, MADURAI – 9.

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined B.Sc. Physics on or after June 2020)

Programme Code : UMA

Course Code	Course Title	Category	L	T	P	Credit
UMA20GE11P	**Allied Mathematics - I for Physics**	**Generic Elective**	**5**	**1**	**-**	**5**

L - Lecture T - Tutorial P–Practical

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	Knowledge Level
CO1	Find the nature of the roots of an equation	K1
CO2	Solve higher degree equations using various methods	K2
CO3	Define and Explain the concept of curvature and evolute	K3
CO4	List the difference operators and apply interpolation techniques to real life problems	K3
CO5	Demonstrate the pattern of the series and estimate sums of infinite series.	K3

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Blooms 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 **(18 Hours)**

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

Unit II **(18 Hours)**

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

Unit III **(18 Hours)**

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

Unit IV **(18 Hours)**

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

Unit V **(18 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	1(1.3 & 1.4)

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. Mr. M. Madhavan
2. Dr. K. Saravanakumar

THIAGARAJAR COLLEGE, MADURAI – 9.

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined B.Sc. Physics on or after June 2020)

Course Code	Course Title	Category	L	T	P	Credit
UMA20GE21P	**Allied Mathematics - II for Physics**	**Generic Elective**	**5**	**1**	**-**	**5**

L - Lecture T - Tutorial P–Practical

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	Knowledge Level
CO1	Classify the integrals and apply the appropriate techniques on integration	K2
CO2	Solve ordinary differential equations using various methods	K3
CO3	Formulate partial differential equations and solve them	K3
CO4	Find the Laplace transform of various functions and solve linear differential equations	K1
CO5	Construct Fourier series of a given periodic function by evaluating Fourier coefficients	K3

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Blooms 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 **(18 Hours)**

Integration: Reduction formulae - Bernoulli's formula.

Unit II **(18 Hours)**

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

Unit III **(18 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 **(18 Hours)**

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

Unit V **(18 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:

Mr. M. Madhavan , Dr. K. Saravanakumar

THIAGARAJAR COLLEGE, MADURAI – 9.

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined B.Sc. Computer Science / B.C.A. / B.Sc. (I.T.) on or after June 2020)

Programme Code : UMA

Course Code	Course Title	Category	L	T	P	Credit
UMA20GE11I	**Mathematical Foundation for Computer Science**	**Generic Elective**	**5**	**-**	**-**	**5**

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, logic, basic principles of Boolean Algebra and Graph theory.

Course Outcomes

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

#	Course Outcome	Knowledge Level
CO1	Relate set theoretical concepts and analyze simple algorithms	K1
CO2	Recall basic matrix operations and solve problems using matrix theory	K1
CO3	Construct and classify logical sentence in terms of logical connectives and predicates	K2
CO4	Formulate and interpret Boolean logic principles	K3
CO5	Find matrices related to graphs and apply graph theoretical ideas in problem solving	K3

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Blooms 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)**

Relations and Functions :Cartesian Product of Two sets – Relations – Representations of a Relation – Operations on Relations – Equivalence Relations – Closures and Warshall's Algorithm – Partitions and Equivalence Classes. Functions and operators – One – to – one, Onto functions – Special Types of Functions – Invertible Functions – Composition of Functions.(Proofs of the Theorems are not included – Problems only)

Unit II **(15 Hours)**

Matrix Algebra : Introduction - Matrix operations – Inverse of a Square Matrix – Elementary operations and Rank of a Matrix – Simultaneous Linear Equations – Inverse by Partitioning - Eigen values and Eigen vectors.

Unit III **(15 Hours)**

Logic :Introduction – TF-statements – Connectives – Atomic and compound statements – Well Formed (Statement) Formulae – Truth table of a Formula – Tautology – Tautological Implications and Equivalence of Formulae – Replacement Process – Functionally complete sets of connectives and Duality law – Normal Forms – Principal Normal Forms

Unit IV **(15 Hours)**

Lattices and Boolean Algebra : Lattices – Some properties of Lattices – New Lattices – Modular and Distributive Lattices.

Unit V **(15 Hours)**

Graph Theory : Basic concepts – Matrix Representation of Graphs

Note : Proof of the Theorems are not included

Text Book:

Venkataraman. M.K., Sridharan. N. and Chandrasekaran. N. 2009, Discrete Mathematics, The National Publishing Company, Chennai.

Unit	Chapter/Section
I	II(1 – 7) III(1 – 5)
II	VI(1 – 7)
III	IX(1 – 12)
IV	X(1- 4)
V	XI(1 and 2)

References:

1. Seymour Lipschutz and Marc Lars Lipson, 2002, Discrete Mathematics, Tata McGraw Hill Publishing Company Ltd. New Delhi.
2. Trembley. J.P. and Manohar. R. 2001, Discrete Mathematical Structures with Applications to Compute Science, Tata McGraw –Hill Publishing Company Ltd, New Delhi.

Course Designers:

1. Dr. R. Angeline Chella Rajathi
2. Mr. K.V. Janarthanan

THIAGARAJAR COLLEGE, MADURAI – 9.

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined B.Sc. Computer Science / B.C.A. / B.Sc. (I.T.) on or after June 2020)

Programme Code : UMA

Course Code	Course Title	Category	L	T	P	Credit
UMA20GE21I	**Probability and Statistics**	**Generic Elective**	**5**	**-**	**-**	**5**

L - Lecture T - Tutorial P – 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	Knowledge Level
CO1	Improve data handling skills and summarize statistical computations	K2
CO2	Determine the relationship between quantitative variables and extend regression analysis	K2
CO3	Recall and apply a comprehensive set of Probability ideas	K1
CO4	Find, interpret and analyze the measure of central tendencies, Moment Generating function and Characteristic function of random variables	,K3
CO5	Relate, Analyze and Demonstrate the knowledge of using various distributions for statistical analysis	K3

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Blooms 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)**

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

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. Mr. K.V. Janarthanan

THIAGARAJAR COLLEGE, MADURAI – 9.

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined B.Com. on or after June 2020)

Programme Code : UMA

Course Code	Course Title	Category	L	T	P	Credit
UMA20GE11K	**Business Mathematics**	**Core**	**5**	**-**	**-**	**5**

L - Lecture T - Tutorial P–Practical

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

Preamble

The course provides introduction to basic mathematical skills needed to understand, analyze and solve mathematical problems encountered in business and finance.

Course Outcomes

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

#	Course Outcome	Knowledge Level
CO1	Explain various mathematical applications	K2
CO2	Solve Problems related to their Business	K3
CO3	Recall the concept of set theory	K1
CO4	Develop critical thinking modeling and problem solving skills in a	K3
CO5	Define basic terms in the areas of financial mathematics	K1

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Blooms 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)**

Simple Interest and Compound Interest: Calculating simple interest – finding out missing items – calculating compound interest – finding out missing items – difference between simple interest and compound interest.

Unit II **(15 Hours)**

Commercial Arithmetic: Discount on Bills – logarithms – calculation of log values and anti-log values – ratio – proportions and Percentages – Annuities – Simple problems.

Unit III **(15 Hours)**

Sets: Basic concepts: Set Operation – Union of set – Intersection of sets – Difference of sets – Venn Diagram – Laws of Sets.

Unit IV **(15 Hours)**

Matrices: Basic concepts – Addition and subtraction of matrices – Multiplication of two matrices – Inverse of a matrix – Solving equation through matrices – Rank of a matrix.

Unit V **(15 Hours)**

Permutations and Combinations

Text Book:

Vittal P.R., Business Mathematics, Revised Edition 2014, Margham Publications, Chennai.

Unit	Chapter/section
I	17, 18
II	2, 6, 11, 19
III	1(Pages 1-36)
IV	14
V	8

References:

1. Sundaresan V. and Jayaseelan S.D., 2004, An Introduction to Business Mathematics, Revised Edition, Sultan Chand & Sons, New Delhi.
2. Nag N.K., 2014, Business Mathematics, Revised Edition, Kalyani Publishers, New Delhi.
3. Aggarwal R.S., 2016, Quantitative Aptitude for Competitive Examinations, Revised Edition, S. Chand & Company Ltd., New Delhi.

Course Designers:

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

THIAGARAJAR COLLEGE, MADURAI – 9.

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined B.Com. on or after June 2020)

Programme Code : UMA

Course Code	Course Title	Category	L	T	P	Credit
UMA20GE21K	**Business Statistics**	**Core**	**5**	**-**	**-**	**5**

L - Lecture T - Tutorial P–Practical

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

Preamble

In this course emphasis is placed on the applications of measures of central tendency, measures of dispersion, correlation and regression, index numbers and Analysis of time series.

Course Outcomes

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

#	Course Outcome	Knowledge Level)
CO1	Collect, process, analyze and present the statistical data	K3
CO2	Apply various statistical tools	K3
CO3	Find the measures of central tendency, correlation, regression and index numbers	K1
CO4	Interpret statistical analysis tools	K2
CO5	Choose a statistical method for solving practical problems	K3

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Blooms 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)**

Classification and Tabulation: Classification, Tabulation and Presentation of data – Diagrams – Bar diagram, Frequency polygon, Histogram and Ogive. Measures of Central Tendency (Averages) – Meaning – Characteristics of a typical average – Computation of Mean, Median, Mode, Geometric Mean, Harmonic Mean and Weighted Arithmetic Mean.

Unit II **(15 Hours)**

Dispersion: Dispersion – Meaning – Properties of a good measure of dispersion – Absolute Vs relative measure of dispersion – Computation of Range, Quartile Deviation, Mean Deviation, Standard Deviation and Co-efficient of Variation. Skewness – Meaning – Variation Vs Skewness – Measures of Skewness – Karl Person's and Bowley's Co-efficient of Skewness.

Unit III **(15 Hours)**

Correlation : Definition – Types of Correlation – Methods of Studying Correlation – Spearman's Rank Correlation Co-efficient. Regression: Definition – Correlation Vs Regression – Regression lines and Regression Equations – Regression co-efficients – Computation of correlation co-efficient from regression co-efficients.

Unit IV **(15 Hours)**

Index Numbers: Definition – Characteristics of Index numbers – Uses – Types of Index numbers – Construction of Price Index numbers – Unweighted Index numbers – Weighted Index numbers – Time reversal test and Factor reversal test of Index number.

Unit V **(15 Hours)**

Analysis of Time Series: Introduction – Uses – Components of time series – Measurement of trend – graphical method, semi-average method, moving average and method of least square.

Text Book:

Pillai, R.S.N. and Bagavathi, 2016(Eighth Edition), Statistics (Theory and Practice), S. Chand & Company Ltd., New Delhi.

Unit	Chapter/section
I	6, 9
II	10, 11
III	12, 13
IV	14
V	15

References:

1. Gupta S.P. and Gupta M.P. 2012, Business Statistics, S. Chand & Company Ltd., NewDelhi.
2. Sharma J.K., 2014, Fundamentals of Business Statistics, Pearson Education, India.

Course Designers:

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

M.Sc. Mathematics

Programme Code : PMA

(Aided & SF)

THIAGARAJAR COLLEGE, MADURAI – 9.
(Re-Accredited with 'A' Grade by NAAC)
Curriculum Structure for PG

Semester	Category	No. of Courses	Credit Distribution
I	Core	---	18
	Elective	1	5
II	Core	---	18
	Elective	1	5
III	Core	---	18
	Elective	1	5
IV	Core	---	18
	Project	1	3
Total Credits			90

For Choice Based Credit System (CBCS)

- **Choices should be offered for Elective Courses**
- **Total Credits for Core Courses 72**

Total Credits for Elective Courses 18 (3 Electives + 1 Project)

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

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.

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;

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;

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.

Problem solving

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

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.

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.

THIAGARAJAR COLLEGE, MADURAI – 9.

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2020)

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

THIAGARAJAR COLLEGE, MADURAI – 9.

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2020)

M.Sc. Mathematics

COURSE STRUCTURE (w.e.f. 2020 batch onwards)

Semester – I

Course	Code No.	Subject	Contact Hours / Week	Credits	Total Number of Hours Allotted	Max. Marks		Total
						CA	SE	
Core 1	PMA20C11	Groups and Rings	6	5	90	25	75	100
Core 2	PMA20C12	Real Analysis	6	5	90	25	75	100
Core 3	PMA20C13	Ordinary Differential Equations	6	4	90	25	75	100
Core 4	PMA20C14	Applied Numerical Analysis	4	3	60	25	75	100
Elective 1	PMA20CE11	Options Given	5	5	60	25	75	100
Core Lab	PMA20CL14	Applied Numerical Analysis – Lab	2	1	45	40	60	100
Flip Class		Flip Class	1	-	15	-	-	-
		TOTAL	**30**	**23**				

Semester – II

Course	Code No.	Subject	Contact Hours / Week	Credits	Total Number of Hours Allotted	Max. Marks		Total
						CA	SE	
Core 5	PMA20C21	Theory of Fields	6	5	90	25	75	100
Core 6	PMA20C22	Complex Analysis	6	5	90	25	75	100
Core 7	PMA20C23	Topology	6	4	90	25	75	100
Core 8	PMA20C24	Partial Differential Equations	6	4	90	25	75	100
Elective 2	PMA20CE21	Options Given	6	5	90	25	75	100
		TOTAL	**30**	**23**				

Semester – III

Course	Code No.	Subject	Contact Hours / Week	Credits	Total Number of Hours Allotted	Max. Marks		Total
						CA	SE	
Core 9	PMA20C31	Linear Algebra	6	5	90	25	75	100
Core 10	PMA20C32	Classical Mechanics	6	5	90	25	75	100
Core 11	PMA20C33	Measure and	6	4	90	25	75	100
Core 12	PMA20C34	Differential Geometry	6	4	90	25	75	100
Elective 3	PMA20CE31	Options given	6	5	90	25	75	100
		TOTAL	**30**	**23**				

Semester – IV

Course	Code No.	Subject	Contact Hours / Week	Credits	Total Number of Hours Allotted	Max. Marks		Total
						CA	SE	
Core 13	PMA20C41	Mathematical	6	5	90	25	75	100
Core 14	PMA20C42	Functional Analysis	6	5	90	25	75	100
Core 14	PMA20C43	Optimization	6	4	90	25	75	100
Core 16	PMA20C44	Fluid Dynamics	6	4	90	25	75	100
Project	PMA20PJ41	Project	6	3	90	40	60	100
		TOTAL	**30**	**21**				

A) Consolidation of Contact Hours and Credits

Semester	Contact Hours/ Week	Credits
I	30	23
II	30	23
III	30	23
IV	30	21
Total	120	90

B) Curriculum Credits

Core	72 Credits
Elective	15 Credits
Project	3 Credits
Total	**90 Credits**

Major Electives I to be chosen from the following

1) Number Theory
2) Combinatorics

Major Electives II to be chosen from the following

1) Graph Theory
2) Fuzzy Sets and Fuzzy Logic

Major Elective III to be chosen from the following

1) Calculus of Variations and Integral Equations
2) Stochastic Processes

THIAGARAJAR COLLEGE, MADURAI – 9

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2020)

Programme Code : PMA

Course Code	Course Title	Category	L	T	P	Credit
PMA20C11	**Groups and Rings**	**Core**	**5**	**1**	**-**	**5**

L – Lecture T – Tutorial P – Practical

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

Preamble

The course demonstrates the method of counting the number of Sylow subgroups, solvability of groups and the structure theorem for finite abelian groups. The chain conditions in rings are elaborately discussed.

Prerequisite

Basic knowledge in abstract algebra.

Course Outcomes

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

#	Course Outcome	Knowledge Level
CO1	Find the number of subgroups in a group	K1
CO2	Demonstrate and analyze the concepts of solvability of group	K2
CO3	Examine advanced ideas in the algebraic structures	K3
CO4	Solve the irreducibility of polynomials	K4
CO5	Explain chain conditions in Rings	K5

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Blooms taxonomy

	CA		End of Semester (Marks)
	First(Marks)	Second(Marks)	
Knowledge – K1	15% (9)	15% (9)	20% (30)
Understand – K2	15% (9)	15% (9)	20% (30)
Apply – K3	30% (18)	30% (18)	20% (30)
Analyze –K4	20% (12)	20% (12)	20% (30))
Evaluate- K5	20% (12)	20% (12)	20% (30)
Total Marks	**60**	**60**	**150**

Contents

Unit - I **(18 Hours)**

A counting principle – Normal subgroups and Quotient groups – Homomorphisms – Automorphisms Cayley's theorem – Permutation groups.

Unit - II **(18 Hours)**

Another counting principle – Sylow's theorem – Direct products – Finite Abelian groups.

Unit - III **(18 Hours)**

Euclidean Ring – A particular Euclidean Ring – Polynomial Rings - Polynomials over the Rational field – Polynomial Rings over commutative Rings

Unit - IV **(18 Hours)**

Generators of a subgroup and derived subgroups – Normal series – Solvable groups – Jordan-Holder theorem

Unit - V **(18 Hours)**

Noetherian Rings – Artinian Rings – Examples and counter-examples.

TextBooks:

1. Herstein. I.N., 2014, Topics in Algebra, Wiley Student Edition, India.
2. Surjeet Singh and Qazi Zameeruddin, 2015, Modern Algebra, Vikas Publishing House Pvt. Ltd, New Delhi.

Unit	Book	Chapter/Section
I	1	2(2.5 – 2.10)
II	1	2(2.11 – 2.14)
III	1	3 (3.7 – 3.11)
IV	2	5
V	2	15

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. K. Kayathri
2. Dr. G. Prabakaran

THIAGARAJAR COLLEGE, MADURAI – 9.

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2020)

Programme Code : PMA

Course Code	Course Title	Category		L	T	P	Credit
PMA20C12	**Real Analysis**	**Core**		**5**	**1**	**-**	**5**

L-Lecture T-Tutorial P–Practical

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

Preamble

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

Prerequisite

Basic knowledge in multivariate calculus, metric spaces and linear algebra. Furthermore they need to be familiar with methods of proofs and basic set theoretic concepts.

Course Outcomes

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

#	Course Outcome	Knowledge Level
CO1	Recall and apply the concepts of continuity, discontinuity, compactness and connectedness in metric spaces.	K1
CO2	Demonstrate the differentiation of functions of real variables.	K2
CO3	Evaluate the integral of functions of a real variable in the sense of Riemann Stieltjes.	K5
CO4	Identify and Classify the sequence of functions which are point wise convergence and uniform convergence.	K3
CO5	Analyze the structure of the exponential and logarithmic functions, the trigonometric functions, the gamma and beta functions.	K4

Mapping of COs with PSOs

	PSO1	PS	PSO3	PS	PSO5
CO1	**S**	-	-	-	-
CO2	-	-	-	**S**	-
CO3	-	-	**S**	**M**	-
CO4	**S**	-	-	-	-
CO5	-	**M**	-	-	**S**

Mapping of COs with POs

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

Blooms taxonomy

	CA		End of Semester (Marks)
	First(Marks)	Second(Marks)	
Knowledge – K1	15% (9)	15% (9)	20% (30)
Understand – K2	15% (9)	15% (9)	20% (30)
Apply – K3	30% (18)	30% (18)	20% (30)
Analyze –K4	20% (12)	20% (12)	20% (30))
***Evaluate*-** **K5**	20% (12)	20% (12)	20% (30)
Total Marks	**60**	**60**	**150**

Contents

Unit I **(18 Hours)**

Continuity : Limits of functions – Continuous Functions – Continuity and Compactness – Continuity and Connectedness – Discontinuities – Monotonic Functions – Infinite Limits and Limits at Infinity

Unit II **(18 Hours)**

Differentiation : The Derivative of a Real Function – Mean Value Theorems – The Continuity of Derivatives – L'Hospital's Rule – Derivatives of Higher Order –Taylor's Theorem–Differentiation of vector –valued functions.

Unit III **(18 Hours)**

The Riemann – Stieltjes Integral : Definition and Existence of the Integral – Properties of the Integral – Integration and Differentiation – Integration of Vector - Valued Functions – Rectifiable Curves**.**

Unit IV **(18 Hours)**

Sequences and Series of Functions : Discussion of Main Problem – Uniform Convergence – Uniform Convergence and Continuity – Uniform Convergence and Integration – Uniform Convergence and Differentiation.

Unit V **(18 Hours)**

Equicontinuous Families of Functions – The Stone – Weierstrass Theorem – Some Special Functions: Power Series – The Exponential and Logarithmic Functions – The

Trigonometric functions The Algebraic Completeness of the Complex Field – The Gamma Function.

Text Book:

Walter Rudin, 2017, Principles of Mathematical Analysis, Third Edition McGraw - Hill Education (India) Pvt. Ltd., New Delhi.

Unit	Chapter/Page
I	4 (Full)
II	5 (Full)
III	6 (Full)
IV	7 (Pages 143 – 154)
V	7 (Pages 155 – 161), 8 (Pages 172 – 185 and 192 -195)

References:

1. Karunakaran. V, 2012, Real Analysis, Pearson, Chennai.
2. Stephen Abbott, 2010, Understanding Analysis, Springer Verlag, NewYork.
3. Tom M. Apostol, 1969, Mathematical Analysis, A Modern Approach to Advanced Calculus, Addison-Wesley Publishing Company, United States.

Course Designers:

1. Mrs. R. Latha
2. Dr. D. Saravana Kumar

THIAGARAJAR COLLEGE, MADURAI – 9.

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2020)

Programme Code : PMA

Course Code	Course Title	Category	L	T	P	Credit
PMA20C13	**Ordinary Differential Equations**	**Core**	**4**	**2**	**-**	**4**

L-Lecture T-Tutorial P–Practical

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

Preamble

The course provides mathematical methods to solve higher order differential equations and understand the concept of power series solution, special functions, existence and uniqueness of solutions of ordinary differential equations and investigate their stability by Liapunov's direct method.

Prerequisite

Knowledge in algebra, calculus and ability to solve linear differential equations with constant coefficients.

Course Outcomes

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

#	Course Outcome	Knowledge Level
CO1	Apply the methods of undetermined coefficients and variation of parameters to solve linear equations with constant coefficients	K4
CO2	Demonstrate the concepts of power series solutions and special functions	K2
CO3	Define Legendre polynomials and establish their special properties	K1
CO4	Analyze the existence and uniqueness of solutions of ordinary differential equations	K3
CO5	Explain Nonlinear differential equations and their stability by Liapunov's Direct Method	K5

Mapping of COs with PSOs

	PS	PSO2	PSO3	PSO4	PS
CO1	-	S	M	-	-
CO2	S	-	-	-	-
CO3	S	S	-	**M**	-
CO4	-	-	-	S	M
CO5	**S**	-	M	M	-

Mapping of COs with POs

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

Blooms taxonomy

	CA		End of Semester (Marks)
	First(Marks)	Second(Marks)	
Knowledge – K1	15% (9)	15% (9)	20% (30)
Understand – K2	15% (9)	15% (9)	20% (30)
Apply – K3	30% (18)	30% (18)	20% (30)
Analyze –K4	20% (12)	20% (12)	20% (30))
Evaluate- K5	20% (12)	20% (12)	20% (30)
Total Marks	**60**	**60**	**150**

Contents

Unit I **(18 Hours)**

Second Order Linear Equations: Introduction – The General Solution of the Homogeneous Equation – The use of a known solution to find another – The Homogeneous Equation with constant co-efficients – The method of undetermined co-efficients – The method of variation of Parameters.

Unit II **(18 Hours)**

Power Series solutions and Special functions: Introduction – A Review of Power series- Series solutions of First Order Equations – Second Order Linear Equations (Ordinary Points) – Regular Singular Points - Regular Singular Points (Continued) – Gauss's Hypergeometric Equation – The point at infinity.

Unit III **(18 Hours)**

Some Special Functions of Mathematical Physics: Legendre Polynomials – Properties of Legendre Polynomials – Bessel Functions (The Gamma Function) – Properties of Bessel functions.

Unit IV **(18 Hours)**

Systems of First Order Equations: General Remarks on systems – Linear systems – Homogeneous Linear systems with constant co-efficients – The Existence and Uniqueness of solutions: The method of Successive Approximations – Picard's Theorem.

Unit V **(18 Hours)**

Nonlinear Equations: Autonomous Systems (The Phase Plane and its phenomena) – Types of Critical Points (Stability) – Critical Points and stability of Linear Systems – Stability by Liapunov's Direct Method – Simple Critical Points of Nonlinear Systems.

Text Book:

George F. Simmons, 34th Reprint 2018, Differential Equations with Applications and Historical Notes, McGraw-Hill Education (India) Private Limited, Second Edition, Chennai.

Unit	Chapter/Section
I	3(14 - 19)
II	5(26 - 32)
III	8(44 – 47)
IV	10(54 - 56), 13(68,69)
V	11(58 - 62)

References:

1. Earl A. Coddington, 2010, An Introduction to Ordinary Differential Equations PHI Learning Private Limited, New Delhi.
2. Somasundaram. D., Ordinary Differential Equations : A First Course, 2001, Narosa Publishing House, New Delhi.
3. Deo. S.G., V. Lakshmikantham and V. Raghavendra, 2010, Text Book of Ordinary Differential Equations, Tata McGraw Hill Education Private Limited, New Delhi.

Course Designers:

1. Dr. M. Senthilkumaran
2. Mrs. K. Ponmari

Thiagarajar College (Autonomous):: Madurai – 625 009
(An Autonomous Institution Affiliated to Madurai Kamaraj University)
Re- Accredited with "A" Grade by NAAC
PG and Research Department of Mathematics
(For those joined M.Sc. Mathematics course on or after June 2020)
Programme Code : PMA

Course Code	Course Title	Category	L	T	P	Credit
PMA20C14	**Applied Numerical Analysis**	**Core-4**	**4**			**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 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	Knowledge Level
CO1	Solve transcendental and polynomial equations and system of linear algebraic equations	K3
CO2	Explain Lagrange and Newton's interpolation procedure	K2
CO3	Make use of numerical techniques to find the derivative at a point and evaluate definite integrals	K5
CO4	Demonstrate and match Mathematical preliminaries to solve ordinary differential equations	K4
CO5	Illustrate the numerical solutions of initial value problems	K1

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge K1	15%(9)	15%(9)	20%(30)
Understand – K2	15%(9)	15%(9)	20%(30)
Apply-K3	30%(18)	30%(18)	20%(30)
Analyze-K4	20%(12)	20%(12)	20%(30)
Evaluate –K5	20%(12)	20%(12)	20%(30)
Total Marks	60	60	150

Contents

Unit I **(12 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 **(12 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 **(12 Hours)**

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

Unit IV **(12 Hours)**

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

Unit V **(12 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, 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, Third Edition, 2009, Elementary Numerical Analysis : An Algorithmic Approach, Tata McGraw- Hill Edition, New Delhi

Course Designers:

1. Dr. M. Senthilkumaran
2. Dr. B. Arivazhagan

Thiagarajar College (Autonomous):: Madurai – 625 009
(An Autonomous Institution Affiliated to Madurai Kamaraj University)
Re- Accredited with "A" Grade by NAAC
PG and Research Department of Mathematics
(For those joined M.Sc. Mathematics course on or after June 2020)
Programme Code : PMA

Course Code	Course Title	Category	L	T	P	Credit
PMA20CL14	**Applied Numerical Analysis – Lab**	**Core-**	**-**	**-**	**3**	**1**

L - Lecture T - Tutorial P–Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	**40**	**60**	**100**

Preamble

The course is designed to develop skills in solving numerical analysis problems using C programming.

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	Knowledge Level
CO1	Develop C programs to solve transcendental and algebraic equations using Bisection Method, Regula – falsi method, Secant method and Newton Raphson method	K3
CO2	Recall the procedure to solve system of algebraic equations and develop C programs.	K1
CO3	Evaluate definite integrals using Trapezoidal and Simpson's methods and analyze these results with exact solutions	K4
CO4	Solve and compare the solutions of given first order ordinary differential equations with exact solutions using C programs	K2

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Lab in Applied Numerical Analysis

1. Solving transcendental and algebraic equations using Bisection method and Regula falsi method
2. Solving transcendental and algebraic equations using Secant method and Newton-Raphson method.
3. Solving system of linear algebraic equations using Gauss elimination method
4. Interpolation using Lagrange method.
5. Interpolation using Newton -Gregory formula.
6. Evaluating the integral of f(x) between the limits a to b using Trapezoidal rule of integration.
7. Evaluating the integral of f(x) between the limits a to b using Simpson's rule of integration.
8. Solving first order initial value problem using Euler's method.
9. Solving first order initial value problem using Runge- Kutta method.
10. Solving first order initial value problem using Milne's method.

References

1. Jain, M.K., Iyengar. S.R.K. and Jain. R.K., 2018, Numerical Methods for Scientific and Engineering Computation, Sixth Edition, New Age International Publishers, New Delhi
2. Grewal. B.S., 2015, Numerical Methods in Engineering and Science with Programs in C, C++ & MATLAB, Khanna Publishers
3. Veerarajan. T. and Ramachandran. T., 2006, Numerical Methods with programs in C, Second Edition, Tata McGraw – Hill Publishing Company Limited, New Delhi

Course Designers

1. Dr. B. Arivazhagan
2. Dr. P. Krishna Veni

THIAGARAJAR COLLEGE, MADURAI – 9

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2020)

Programme Code : PMA

Course Code	Course Title	Category	L	T	P	Credit
PMA20CE11(A)	**Number Theory**	**Elective**	**4**		**-**	**5**

L – Lecture T – Tutorial P – Practical

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

Preamble

The course deals with the concepts of numbers such as Divisibility, Congruences, Quadratic residues and some arithmetic functions.

Prerequisite

Basic knowledge in classical algebra and theory of numbers

Course Outcomes

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

#	Course Outcome	Knowledge Level
CO1	Demonstrate and apply division algorithm in integers and define factorization using primes	K1
CO2	Classify and Solve the Chinese Reminder problem using congruences	K2
CO3	Determine Quadratic residues	K5
CO4	Define and illustrate arithmetic functions and also analyze their properties	K4
CO5	Recall prime factorization and solve special types of Diophantine equations	K3

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Blooms taxonomy

	CA		End of Semester (Marks)
	First(Marks)	Second(Marks)	
Knowledge – K1	15% (9)	15% (9)	20% (30)
Understand – K2	15% (9)	15% (9)	20% (30)
Apply – K3	30% (18)	30% (18)	20% (30)
Analyze –K4	20% (12)	20% (12)	20% (30))
Evaluate- K5	20% (12)	20% (12)	20% (30)
Total Marks	**60**	**60**	**150**

Contents

Unit I **(12 Hours)**

Divisibility : Introduction – Divisibility - Primes

Unit II **(12 Hours)**

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

Unit III **(12 Hours)**

Quadratic reciprocity : Quadratic residues – Quadratic reciprocity – The Jacobian symbol

Unit IV **(12 Hours)**

Some functions of Number Theory : Greatest integer function – Arithmetic functions – The Mobius inversion formula.

Unit V **(12 Hours)**

Diophantine equations : The equation ax + by = c – Simultaneous linear equations – Pythagorean triangles

Text Book:

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

Unit	Chapter/Section
I	1.1 – 1.3
II	2.1 – 2.3
III	3.1 – 5.3
IV	4.1 – 5.3
V	5.1 – 5.3

Reference Books :

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.

Course Designers:

1. Dr. G. Prabakaran
2. Dr. R. Angeline Chella Rajathi

THIAGARAJAR COLLEGE, MADURAI – 9.

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2020)

Programme Code : PMA

Course Code	Course Title	Category	L	T	P	Credit
PMA20CE11(B)	**Combinatorics**	**Elective**	**4**	**-**	**-**	**5**

L - Lecture T - Tutorial P–Practical

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

Preamble

The course deals with enumeration problems using generating functions and recurrence relations

Prerequisite

Basic counting methods and linear recurrence relations

Course Outcomes

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

#	Course Outcome	Knowledge Level
CO1	Classify the concepts of arrangements and selections.	K4
CO2	Determine the recurrence relations and solve with generating functions	K5
CO3	Recall Polya's formula and solve enumeration problems	K1
CO4	Demonstrate inclusion-exclusion Principle.	K2
CO5	Analyze the concepts of cycle index	K4

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Blooms taxonomy

	CA		End of Semester (Marks)
	First(Marks)	Second(Marks)	
Knowledge– K1	15% (9)	15% (9)	15% (20)
Understand – K2	15% (9)	15% (9)	15% (20)
Apply – K3	30% (18)	30% (18)	30% (40)
Analyze –K4	20% (12)	20% (12)	20% (25)
Evaluate- K5	20% (12)	20% (12)	20% (25)
Total Marks	**60**	**60**	**130**

Contents :

Unit I **(12 Hours)**

General counting methods for arrangements and selections: Two basic counting principles – Simple arrangements and selections – Arrangements and selections with repetitions – Distributions.

Unit II **(14 Hours)**

Generating functions**:** Generating function models – Calculating Coefficients of Generating Functions – Partitions – Exponential Generating functions – A Summation Method.

Unit III **(12 Hours)**

Recurrence Relations: Recurrence Relation Models – Divide-and-Conquer Relations – Solution of Linear Recurrence Relations – Solution of Inhomogeneous Recurrence Relations.

Unit IV **(10 Hours)**

Inclusion-Exclusion: Counting with Venn diagrams – Inclusion-Exclusion Formula – Restricted Positions and Rook Polynomials.

Unit V **(12 Hours)**

Polya's Enumeration Formula: Equivalence and Symmetry Groups – Burnside's Theorem – The Cycle Index – Polya's Formula.

Text Book:

Alan Tucker, 2012, Applied Combinatorics, VI Edition, John Wiley & Sons, Inc., New Jersey.

Unit	Chapter/Sections
I	5(5.1 – 5.4)
II	6(6.1 – 6.5)
III	7(7.1 – 7.4)
IV	8(8.1 – 8.3)
V	9(9.1 – 9.4)

References:

1. Richard A. Brualdi, 2010. Introductory Combinatorics, 5th Edition, Pearson Education Inc, Asia Limited and China Machine Press.
2. V. Krishnamurthy, 2000. Combinatorics – Theory and Applications, East-West Press, New Delhi.
3. Peter J. Cameron, 1995. Combinatorics: Topics, Techniques, Algorithms, 1st Edition, Cambridge University Press, United Kingdom.
4. C.L. Liu, 1968. Introduction to Combinatorial Mathematics, McGraw Hill, New York.

Course Designers:

1. Dr. K. Kayathri
2. Dr. G. Prabakaran

THIAGARAJAR COLLEGE, MADURAI – 9

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2020)

Programme Code : PMA

Course Code	Course Title	Category	L	T	P	Credit
PMA20C21	**Theory of Fields**	**Core**	**5**	**1**	**-**	**5**

L – Lecture T – Tutorial P – Practical

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

Preamble

The Course deals with methods of finding roots of a polynomial over a field in its extension. The constructible real numbers are discussed. The four-square theorem is proved using the properties of finite fields.

Prerequisite

The course requires knowledge in Fields and Number theory.

Course Outcomes

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

#	Course Outcome	Knowledge Level)
CO1	Recall and construct extensions of a given field	K1
CO2	Find the degree of the splitting field of a polynomial	K2
CO3	Demonstrate the constructability of algebraic numbers	K3
CO4	List and identify the extensions such as finite, algebraic, simple and normal	K4
CO5	Explain the properties of finite fields	K5

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Blooms taxonomy

	CA		End of Semester (Marks)
	First(Marks)	Second(Marks)	
Knowledge – K1	15% (9)	15% (9)	20% (30)
Understand – K2	15% (9)	15% (9)	20% (30)
Apply – K3	30% (18)	30% (18)	20% (30)
Analyze –K4	20% (12)	20% (12)	20% (30))
Evaluate- K5	20% (12)	20% (12)	20% (30)
Total Marks	**60**	**60**	**150**

Contents

Unit - I **(20 Hours)**

Extension Fields – The Transcendence of e – Roots of polynomials

Unit - II **(16 Hours)**

Construction with straight edge and compass – More about roots

Unit – III **(20 Hours)**

The elements of Galois theory – Solvability by radicals

Unit – IV **(16 Hours)**

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

Unit – V **(18 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	5.1, 5.2, 5.3
II	5.4, 5.5
III	5.6, 5.7
IV	7.1, 7.2
V	7.3, 7.4

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
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. K. Kayathri
2. Dr. G. Prabakaran

THIAGARAJAR COLLEGE, MADURAI – 9.

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2020)

Programme Code : PMA

Course Code	Course Title	Category	L	T	P	Credit
PMA20C22	**Complex Analysis**	**Core**	**5**	**1**	**-**	**5**

L-Lecture T-Tutorial P–Practical

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

Preamble

The course covers complex functions, complex integration, Elliptic functions, series and product development.

Prerequisite

Basic knowledge in complex numbers and calculus.

Course Outcomes

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

#	Course Outcome	Knowledge Level
CO1	Recall and Analyze the concepts in complex analysis	K1
CO2	Define and Evaluate complex integration	K5
CO3	Determine and Analyze the calculus of residues	K4
CO4	Develop series of complex function and extend its product using Jensen's and Poisson formula	K3
CO5	Classify elliptic functions and analyze their properties	K2

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Blooms taxonomy

	CA		End of Semester (Marks)
	First(Marks)	Second(Marks)	
Knowledge – K1	15% (9)	15% (9)	20% (30)
Understand – K2	15% (9)	15% (9)	20% (30)
Apply – K3	30% (18)	30% (18)	20% (30)
Analyze –K4	20% (12)	20% (12)	20% (30))
Evaluate- K5	20% (12)	20% (12)	20% (30)
Total Marks	**60**	**60**	**150**

Contents

Unit I **(18 Hours)**

Complex Functions: Introduction to the concept of analytic functions – Limits and Continuity – Analytic functions – Polynomials – Rational functions. Elementary theory of Power series – Sequences, Series, Uniform Convergence, Power Series, Abel's Limit theorem – The Exponential and Trigonometric Functions : The Exponential, the Trigonometric Functions – The Periodicity – The Logarithm.

Unit II **(18 Hours)**

Complex Integration: Fundamental Theorems – Line Integrals, Rectifiable arcs – Line Integrals as Functions of arcs – Cauchy's theorem for a rectangle – Cauchy's theorem in a disk – Cauchy's Integral formula – Index of a point – Integral Formula – Higher derivatives – Local Properties of Analytical Functions – Removable singularities – Taylor's theorem – Zeros and poles – The Local mapping – The Maximum Principle.

Unit III **(18 Hours)**

Complex Integration: Calculus of Residues- Residue theorem, Argument Principle, Evaluation of definite Integrals. Harmonic Functions- Definition and Basic properties, the Mean- value Property, Poisson's Formula.

Unit IV **(18 Hours)**

Series and Product Development : Power Series Expansions: Weierstrass's Theorem – The Taylor Series – The Laurent Series – Partial Fractions and Factorization: Partial Fractions – Infinite Products – Canonical Products – The Gamma Function – Entire functions : Jensen's Formula – Hadamard's theorem.

Unit V **(18 Hours)**

Elliptic functions: Doubly Periodic Functions – The Period Module – Unimodular Transformations – The Canonical basis – General Properties of Elliptic Functions – Weierstrass Theory – Weierstrass P-function – The functions ζ (z) and σ(z)– The Differential Equation.

Text Book:

Ahlfors, V., 2013, Complex Analysis, Third Edition, McGraw-Hill Education (India).

Unit	Chapter/Section
I	2
II	4 (1, 2 and3)
III	4 (5.1, 5.2, 5.3, 6.1, 6.2, 6.3)
IV	5 (1.1, 1.2, 1.3 , 2.1, 2.2, 2.3, 2.4, 3.1,3.2)
V	7(2.1, 2.2, 2.3, 2.4, 3.1, 3.2 , 3.3)

References

1. Roopkumar. R., 2015, Complex analysis, Dorling Kinderley Pvt. Ltd., New Delhi.
2. Ponnusamy. S., 2013, Foundation of Complex Analysis, Narosa Publishing House. New Delhi.
3. Karunakaran, V., 2006, Complex Analysis, Narosa Publishing House Pvt. Ltd. Second Edition, New Delhi.
4. Serge Lang, 1999, Complex Analysis, 3rd edition, Springer.

Course Designers:

1. Mrs. R. Latha
2. Dr. D. Saravana Kumar

THIAGARAJAR COLLEGE, MADURAI – 9.

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2020)

Programme Code : PMA

Course Code	Course Title	Category	L	T	P	Credit
PMA20C23	**Topology**	**Core**	**5**	**1**	**-**	**5**

L - Lecture T - Tutorial P–Practical

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

Preamble

The course emphasizes an introduction to theory of topological spaces and also focus on selected types of topological spaces.

Prerequisite

Knowledge in basic concepts of Real and Complex analysis.

Course Outcomes

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

#	Course Outcome	Knowledge Level
CO1	Recall and construct various topologies on sets and compare them	K1
CO2	Define basis and make use of bases to generate topology and justify connectedness in topological spaces	K3
CO3	Classify and analyze the nature of compact topological spaces in particular on Real line	K2
CO4	Define and Categorize separation axioms on different topological spaces	K4
CO5	Interpret and extend the metrizable concepts of Topological spaces	K5

Mapping of Cos with PSOs

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

Mapping of Cos with POs

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

Blooms taxonomy

	CA		End of Semester (Marks)
	First(Marks)	Second(Marks)	
Knowledge– K1	15% (9)	15% (9)	15% (20)
Understand – K2	15% (9)	15% (9)	15% (20)
Apply – K3	30% (18)	30% (18)	30% (40)
Analyze –K4	20% (12)	20% (12)	20% (25)
Evaluate- K5	20% (12)	20% (12)	20% (25)
Total Marks	**60**	**60**	**130**

Contents

Unit I **(22 Hours)**

Topological Spaces – Basis for a topology – The order topology – The product topology on X x Y – The subspace topology – Closed sets and limit points – Continuous functions – The product topology – The metric topology.

Unit II **(17 Hours)**

Connected Spaces – Connected Subspaces of the Real line – Components and local connectedness.

Unit III **(17 Hours)**

Compact Spaces – Compact Subspaces of the Real line – Limit point compactness.

Unit IV **(17 Hours)**

The Countability axioms – The Separation axioms – Normal spaces – The Urysohn lemma.

Unit V **(17 Hours)**

The Urysohn Metrization theorem – The Tietze extension theorem – The Tychonoff theorem.

Text Book :

James R. Munkres, 2016, Topology**,** PHI Learning Private limited, Second Edition, New Delhi.

Unit	Chapter/Section
I	2(12 – 20)
II	3(23 – 25)
III	3(26 – 28)
IV	4(30 – 33)
V	4(34, 35), 5(37)

References :

1. George F. Simmons, 2012, Introduction to Topology and Modern Analysis, Eighteenth Reprint, Tata McGraw-Hill Education Private Limited, New Delhi.
2. Chandrasekhara Rao. K.,Topology, 2012, Narosa Publishing House, New Delhi.
3. Chatterjee. D., 2007, Topology General & Algebraic, New Age International. Chennai.
4. Deshpande. J.V., 1998, Introduction to Topology, Tata McGraw-Hill. New Delhi.

Course Designers :

1. Dr. R. Angeline Chella Rajathi
2. Mr. K.V. Janarthanan

THIAGARAJAR COLLEGE, MADURAI – 9.

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2020)

Programme Code : PMA

Course Code	Course Title	Category	L	T	P	Credit
PMA20C24	**Partial Differential Equations**	**Core**	**5**	**1**	**-**	**5**

L - Lecture T - Tutorial P - Practical

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

Preamble

The course deals with methods of solving first order partial differential equations 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	Knowledge Level
CO1	Match the physical situations with real world problems to construct mathematical models using partial differential equations	K1
CO2	Explain and Solve different kinds of partial differential equations	K2,
CO3	Classify second order partial differential equations	K4
CO4	Apply Variable separation method to solve Laplace's and diffusion equations	K3
CO5	Select the most appropriate method to solve the particular partial differential equations	K5

Mapping of Cos with PSOs

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

Mapping of Cos with POs

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

Blooms taxonomy

	CA		End of Semester (Marks)
	First(Marks)	Second(Marks)	
Knowledge– K1	15% (9)	15% (9)	15% (20)
Understand – K2	15% (9)	15% (9)	15% (20)
Apply – K3	30% (18)	30% (18)	30% (40)
Analyze –K4	20% (12)	20% (12)	20% (25)
Evaluate- K5	20% (12)	20% (12)	20% (25)
Total Marks	**60**	**60**	**130**

Contents

Unit I **(18 Hours)**

Partial Differential Equations of the First Order: Linear Equations of the First Order – Integral Surfaces Passing through a Given Curve - Surfaces Orthogonal to a Given System of Surfaces- Non-linear Partial Differential Equations of the First Order – Cauchy's Method of Characteristics - Compatible Systems of First Order Equations – Charpit's Method – Special types of First order Equations.

Unit II **(18 Hours)**

Partial Differential Equations of the Second Order: The Origin of Second Order Equations –Second Order Equations in Physics - Linear Partial Differential Equations with Constant Coefficients – Equations with Variable Coefficients – Characteristic Curves of Second Order Equations.

Unit III **(18 Hours)**

Laplace's Equation: The Occurrence of Laplace's Equations in Physics – Elementary Solutions of Laplace's Equation – Families of Equipotential Surfaces - Boundary Value Problems – Separation of Variables.

Unit IV **(18 Hours)**

The Wave Equation: The Occurrence of the Wave Equation in Physics – Elementary Solutions of the One-dimensional Wave Equation – Vibrating Membranes: Application of the Calculus of Variations - Three dimensional Problems.

Unit V **(18 Hours)**

The Diffusion Equation: The Occurrence of the Diffusion Equation in Physics – The Resolution of Boundary Value Problems for the Diffusion Equation – Elementary Solutions of the Diffusion Equation – Separation of Variables.

Text Book :

Sneddon. I. N, 1957, Elements of Partial Differential Equations, McGraw-Hill, NewDelhi.

Unit	Chapter/ Section
I	2 (4 – 11)
II	3 (1-2, 4 – 6)
III	4 (1 – 5)
IV	5 (1-2, 4, 5)
V	6 (1 – 4)

References

1. Sankara Rao. K., 2016, Introduction to Partial Differential Equations, PHI Learning Private Limited, New Delhi.
2. AslakTveito & Ragnar Winther, 2010, Introduction to Partial Differential Equations: A Computational Approach, Springer – Verleg.
3. Bhamra. K.S., 2010, Partial Differential Equations: An Introductory Treatment with Applications, PHI Learning Private Limited, New Delhi.

Course Designers

1. Dr. M. Senthilkumaran
2. Mr. M. Madhavan

THIAGARAJAR COLLEGE, MADURAI – 9.

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POSTGRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2020)

Programme Code : PMA

Course Code	Course Title	Category	L	T	P	Credit
PMA20C21(A)	Graph Theory	Core	5	1	-	5

L - Lecture T - Tutorial P - Practical

Year	Semester	Int. Marks	Ext. Marks	Total
First	Second	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	Knowledge Level)
CO1	Relate connectivity concepts in the theory of Network Flow problems	K1
CO2	Analyze and Apply coloring concepts in Storage problem and Scheduling Problem	K3
CO3	Applyspanning tree properties and algorithms in Connector Problem and Shortest-path problem that involve designing railroad networks and	K5
CO4	Explain matching concepts in job assignment problems	K4
CO5	Understand domination conceptsand develop mathematical models of real life problems	K2

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Blooms taxonomy

	CA		End of Semester (Marks)
	First Internal (Marks)	Second Internal(Marks)	
Knowledge– K1	15% (9)	15% (9)	15% (20)
Understand – K2	15% (9)	15% (9)	15% (20)
Apply – K3	30% (18)	30% (18)	30% (40)
Analyze –K4	20% (12)	20% (12)	20% (25)
Evaluate- K5	20% (12)	20% (12)	20% (25)
Total Marks	**60**	**60**	**130**

Contents

Unit I **(18 Hours)**

Connectivity: Introduction – Vertex Cuts and Edges Cuts – Connectivity and Edge Connectivity – Blocks – Cyclical Edge Connectivity of a Graph – Menger's Theorem.

Unit II **(18 Hours)**

Trees: Counting the Number of Spanning Trees – Cayley's Formula –Helly Property – Applications.

Unit III **(18 Hours)**

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

Unit IV **(18 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 **(18 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, First South Asian Edition, Springer Science+ Business Media, New York

Unit	Chapter/ Sections
I	3(3.1-3.6)
II	4(4.4-4.7)
III	5(5.1-5.6)
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.

Course Designers:

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

THIAGARAJAR COLLEGE, MADURAI – 9

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2020)

Programme Code : PMA

Course Code	Course Title	Category	L	T	P	Credit
PMA20E21(B)	**Fuzzy Sets and Fuzzy Logic**	**Elective**	**5**	**1**	**-**	**5**

L – Lecture T – Tutorial P – Practical

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

Preamble

This course introduces the concept of uncertainty and fuzziness and deals with 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	Knowledge Leve)
CO1	Define and illustrate the concept of fuzzy sets and crisp sets	K1
CO2	Analyze the axioms and build operations on fuzzy sets	K3
CO3	Apply rules of inference and infer from various types of fuzzy propositions	K2
CO4	Develop fuzzy controllers for real life problems and implement it in appropriate hardware	K4
CO5	Apply and assess multistage decision making in dynamic systems	K5

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Blooms taxonomy

	CA		End of Semester (Marks)
	First(Marks)	Second(Marks)	
Knowledge – K1	15% (9)	15% (9)	20% (30)
Understand – K2	15% (9)	15% (9)	20% (30)
Apply – K3	30% (18)	30% (18)	20% (30)
Analyze –K4	20% (12)	20% (12)	20% (30))
Evaluate- K5	20% (12)	20% (12)	20% (30)
Total Marks	**60**	**60**	**150**

Contents

Unit I **(16 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 principal for Fuzzy sets

Unit II **(20 Hours)**

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

Unit III **(18 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 **(18 Hours)**

Fuzzy Systems – General discussion – Fuzzy Controllers: an overview – an example – Fuzzy systems and Neural Networks – Fuzzy Neural Networks – Fuzzy Automata – Fuzzy Dynamic systems

Unit V **(18 Hours)**

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

Text Book:

George J. Klir and Bo Yuan. 2012. Fuzzy Sets and Fuzzy Logic Theory and Applications, Prentice-Hall of India

Unit	Chapter/Section
I	1.1 – 1.4, 2.1 – 2.3
II	3.1 – 3.5, 4.1 – 4.4
III	8.3 – 8.8
IV	12.1 – 12.7
V	15.1 – 15.7

Reference Books :

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

Course Designers:

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

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

THIAGARAJAR COLLEGE, MADURAI – 9.

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Phil. Mathematics on or after June 2020)

Programme Code : MMA

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.

THIAGARAJAR COLLEGE, MADURAI – 9.

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Phil. Mathematics on or after June 2020)

M. Phil. MATHEMATICS
COURSE STRUCTURE (w.e.f. 2020 – 2021 batch onwards)

Semester – I

Code No	Subject	Contact Hrs / Week	Credits	Total No of Hrs Allotted	Max Marks CA	Max Marks SE	Total
MMA20C11	Research Methodology and Module Theory	6	6	90	100	100	200
MMA20C12	Advanced Analysis	6	6	90	100	100	200
MMA20CE11	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
MMA20PJ21	Dissertation	6	6	90	100	100	200

Elective papers: (One paper is to be chosen in Semester I)

1. Stochastic Differential Equations and Applications
2. Magic Labelings of Graphs
3. Transform Theory on Function Spaces
4. Theory of Domination in Graphs
5. Algorithmic Graph Theory
6. Delay Differential Equations and Applications

Question paper pattern:

5 Internal choice questions 5 x 20 = 100 Marks

Total Credits – 24

THIAGARAJAR COLLEGE, MADURAI – 9.

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Phil. Mathematics on or after June 2020)

Programme Code : MMA

Course Code	Course Title	Category	L	T	P	Credit
MMA20C11	**Research Methodology and Module Theory**	**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 research methodology, theory of modules and document preparation system using LATEX.

Prerequisite

Fundamental knowledge in commutative algebra and computer programming.

Course Outcomes

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

#	Course Outcome	Knowledge Leve)
CO1	Develop abstract mathematical thinking	K3
CO2	Design mathematical documents using LATEX software	K5
CO3	List and Explain fundamentals of abstract algebra	K1
CO4	Analyze Modules, submodules, quotient modules and local properties of fractions	K4
CO5	Explain Noetherian and Artin Rings in research level	K2

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Blooms 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)**

Research Methodology: 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 – What is a Research Problem? – Selecting the Problem – Necessity of Defining the problem – Techniques Involved in Defining a Problem – Meaning of Research Design – Need for Research Design – Features of a Good Design – Import Concepts Relating to Research Design – Different Research Designs – Basic Principles of Experimental Designs.

Unit II **(18 Hours)**

LATEX:The Basics – The Document – Bibliography – Bibliographic Databases – Table of contents, Index and Glossary – Displayed Text – Rows and Columns – Typesetting Mathematics.

Unit III **(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 IV **(18 Hours)**

Rings and Modules of fractions: Local properties – Extended and contracted ideals in rings of fractions

Unit V **(18 Hours)**

Chain conditions - Noetherian rings – Primary Decomposition in Noetherian rings – Artin rings.

Text Books :

1. Kothari. C.R., 2010, Research Methodology, Methods and Techniques (Second Revised Edition) New Age International Publishers, New Age International Publishers.
2. LATEX Tutorials, 2003, A Primer - Indian TEX Users Group.
3. Atiyah. M.F. and I.G. GeMacdonald, 1969, Introduction to Commutative Algebra , Addison – Wesley Publishing Company, Great Britain.

Unit	Book	Chapter
I	1	1,2,3
II	2	I-VIII
III	3	2
IV	3	3
V	3	6,7,8

References:

1. Panneerselvam. R., 2007, Research Methodology, Prentice Hall of India.
2. Thomas W. Hungerford, 2008, Algebra, Springer Verlag International edition, New York.
3. Serge Lang, 2010, Algebra, Revised Third Edition, Springer International edition, New Haven, Connecticut.

Web Resources:

1. http://edutechwiki.unige.ch/en/Research_methodology_resources
2. https://www.maths.tcd.ie/~dwilkins/LaTeXPrimer/GSWLaTeX.pdf
3. www.math.iitb.ac.in/~srg/Lecnotes/AfsPuneLecNotes.pdf
4. https://nptel.ac.in/courses/111106098/

Course Designers:

1. Dr. K. Kayathri
2. Dr. B. Arivazhagan

THIAGARAJAR COLLEGE, MADURAI – 9.

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Phil. Mathematics on or after June 2020)

Programme Code : MMA

Course Code	Course Title	Category	L	T	P	Credit
MMA20C12	**Advanced 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 measures, Banach algebra, topology and vector spaces.

Prerequisite

Strong knowledge in 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	Knowledge Level
CO1	Recall and identify regular and singular elements in a Banach Algebra	K1
CO2	Find the spectral radius and Develop Gelfand mappings on commutative Banach algebra	K3
CO3	Recall and Illustrate integration as a Linear functional corresponding to finite positive Borel measure	K2
CO4	Classify and analyze various properties of topological vector spaces	K4
CO5	Define and apply Seminorms and Prove various properties on function spaces	K5

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Blooms 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)**

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 II **(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 III **(18 Hours)**

Positive Borel Measures: The Riesz representation theorem- Regularity Properties of Borel Measures-Lebesgue measure- Continuity properties of measurable functions.

Unit IV **(18 Hours)**

Toplogical vector spaces – Separation properties – Linear mappings – Finite Dimensional spaces- Metrization- Boundedness and continuity- Bounded linear transformations.

Unit V **(18 Hours)**

Seminorms and local convexity - Quotient spaces - Seminorms and quotient spaces – The spaces L^p with $(0 < p < 1)$.

Text Books:

1. G.F. Simmons, 2012, Introduction to Topology and Modern Analysis - Tata McGraw – Hill edition, Eighteenth Reprint, New Delhi.
2. Walter Rudin, 2010, Real and Complex analysis - Tata McGraw – Hill 3rd Edition, Ninth Reprint, New Delhi.
3. Walter Rudin, 2006, Functional Analysis, Tata McGraw-Hill, II edition, New Delhi.

Unit	Book	Chapter / Sections
I	1	12 (Full)
II	1	13 (Full), 14(section 74)
III	2	2(Full)
IV	3	1.1-1.32
V	3	1.33-1.47

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.

Course Designers:

1. Dr. G. Prabakaran
2. Dr. R. Angeline Chella Rajathi

THIAGARAJAR COLLEGE, MADURAI – 9.

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Phil. Mathematics on or after June 2020)

Course Code	Course Title	Category	L	T	P	Credit
MMA20CE11(A)	**Stochastic Differential Equations and Applications**	**Elective**	**-**	**-**	**-**	**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	Knowledge Level
CO1	Explain the Ito Stochastic integral	K2
CO2	Discuss the theory of existence and uniqueness of the solutions to Stochastic differential equations	K5
CO3	Define stability properties of Stochastically differential equation	K1
CO4	Develop Stochastic simulations in their respective field of interest	K3
CO5	Analyze the epidemic models with stochastic perturbations	K4

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Blooms 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 – 1.8
II	2.1 – 2.5
III	4.1 – 4.5
IV	11.1 – 11.5
V	Research Article

References:

1. BerntOksendal, 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

THIAGARAJAR COLLEGE, MADURAI – 9.

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Phil. Mathematics on or after June 2020)

Programme Code : MMA

Course Code	Course Title	Category	L	T	P	Credit
MMA20CE11(B)	**Magic Labelings of Graphs**	**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 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	Knowledge Level)
CO1	Relate the magic square concepts with the applications of magic labeling.	K1
CO2	Illustrate edge-magic and super edge-magic total labeling concepts.	K2
CO3	Demonstrate the necessary conditions for vertex magic total labeling and its related labelings.	K4
CO4	Recall the forbidden configurations for totally magic labelings and determine the totally magic graphs.	K5
CO5	Develop research skills by analyzing the properties of super edge-magic graceful graphs.	K4

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Blooms 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:

1. Dr. K. Kayathri
2. Dr. G. Prabakaran

THIAGARAJAR COLLEGE, MADURAI – 9.

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Phil. Mathematics on or after June 2020)

Programme Code : MMA

Course Code	Course Title	Category	L	T	P	Credit
MMA20CE11(C)	**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	Knowledge Level
CO1	Define and analyze Fourier Transform on L^p space	K1
CO2	Demonstrate and develop Fourier Transform on L^1 space	K2
CO3	Find, illustrate and compare the relationship between L^p space and continuous function	K5
CO4	Recall and extend the Gelfand Theory of Commutative Banach algebras	K3
CO5	Identify and Classify Maximal ideal space of Bounded Holomorphic functions.	K4

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Blooms 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^p Spaces – Approximation by continuous functions.

Unit II

Fourier transforms: Formal properties – The inversion theorem – The Plancherel theorem – The Banach Algebra $L^1(R)$.

Unit III

ourier 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 Article

3. 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.
4. 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. G. Prabakaran
2. Dr. R. Angeline Chella Rajathi

THIAGARAJAR COLLEGE, MADURAI – 9.

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Phil. Mathematics on or after June 2020)

Programme Code : MMA

Course Code	Course Title	Category	L	T	P	Credit
MMA20CE11(D)	**Theory of Domination in Graphs**	**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 the concepts of covering and independence with domination, various types of domination parameters and domination polynomial.

Prerequisites

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	Knowledge Level
CO1	Find and illustrate the relation among domination, independence and covering	K1
CO2	Define and develop new domination parameters	K3
CO3	Build advanced ideas in domination	K2
CO4	Identify and classify the properties of domination through polynomials	K4
CO5	Determine polynomials for various domination parameters	K5

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Blooms 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 Books:

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:

Dr. K. Kayathri , Dr. G. Prabakaran

THIAGARAJAR COLLEGE, MADURAI – 9.

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Phil. Mathematics on or after June 2020)

Programme Code : MMA

Course Code	Course Title	Category	L	T	P	Credit
MMA20CE11(E)	**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	Knowledge Level
CO1	Recall some basic programming principles and algorithm design techniques	K1
CO2	Illustrate some basic graph theoretical algorithms and analyze some common graph theory algorithms.	K2
CO3	Develop minimal spanning tree algorithms and analyze the algorithms	K3
CO4	Explain the theory of NP – completeness	K4
CO5	Design some new Graph coloring algorithms and analyze the complexity.	K5

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Blooms 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: The Role of Algorithms in Computing – Getting Started – Growth of Functions

Unit II

Elementary Graph Algorithms: Representation of graphs – Breadth –first search – Depth – first search – Topological sort – Strongly connected components

Unit III

Minimum spanning Trees: Growing a minimum spanning tree – The algorithms of Kruskal and Prim

Unit IV

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.

Units I – IV - Text Book

Unit	Chapter/Section
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 Designer:

1. Dr. D. Pandiaraja
2. Dr. B. Arivazhagan

THIAGARAJAR COLLEGE, MADURAI – 9.

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Phil. Mathematics on or after June 2020)

Programme Code : MMA

Course Code	Course Title	Category	L	T	P	Credit
MMA20CE11(F)	Delay Differential Equations and Applications	Elective	-	-	-	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	Knowledge Level
CO1	Recall the basic concepts of delay differential equation	K1
CO2	Explain the stability concepts in various problems	K2
CO3	Construct the Liapunov functions for delay differential equations	K3
CO4	Analyze and Find Hopf bifurcation for delay differential equation	K4
CO5	Explain stability and Hopf bifurcation in a delayed model for HIV	K5

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Blooms 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. D. Pandiaraja
2. Dr. M. Senthilkumaran

THIAGARAJAR COLLEGE, MADURAI – 9.

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with "A" Grade by NAAC

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Phil. Mathematics on or after June 2020)

Programme Code : MMA

Course Code	Course Title	Category	L	T	P	Credit
MMA20PJ21	**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 modeling 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.