Thiagarajar College

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

Thirty Eighth Academic Council Meeting

Department of Mathematics

Dr. Rm. Murugappan
Dean – Curriculum Development

B.Sc., MATHEMATICS

Programme Code : UMA

THIAGARAJAR COLLEGE, MADURAI – 9.

(Re-Accredited with 'A' Grade by NAAC)

Curriculum structure for

B.Sc., CS, IT & BCA BBA & B.Com

(For those who joined in 2019 and after)

Catergory	Course	No.of Courses /paper	Credit Distribution	Hrs/ Week	Total Credits
Part I	Tamil	2	3	-	06
Part II	English	2	3	-	06
		Sub Total			**12**
Part III	Core	-	-	-	84
	Elective –Main	2	5	-	10
	Elective – Generic	2+2	5	-	20
		Sub Total			**114**
Part IV	**AECC** I &II Sem	I sem EVS II Sem .Prof.Skill Development	2	4	04
	NME III & V Sem Horizontal Migration **SEC** IV & VI Sem Vertical Migration	2 2	2	8	08
	Value Education V Sem	1	1	2	**01**
		Sub Total		**14**	**13**
	Total				**139**
Part V	**NCC (Army &Navy)/ PE/ NSS / Rotaract/ Quality Circle/ Library/ SSL/ Nature Club/Value Education/ YRC/WSC**				**01**
	Grand Total				**140**
	Self-Study Paper (Optional)- -V Sem			**05**	**145**

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 &V semester)
- For SEC every department offer three papers for each course (Sem IV & VI)
- For Major elective there may be an option for choice.

THIAGARAJAR COLLEGE, MADURAI – 9.

(Re-Accredited with 'A' Grade by NAAC)

Curriculum structure for

BA Tamil, English & Economics

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

(For those who joined in 2019 and after)

Catergory	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	72
	Elect –Main	2	5	10	10
	Elect – Generic	2+2	5	24	20
		Sub Total		**118**	**102**
Part IV	**AECC** I &II Sem	I sem EVS II Sem .Prof.Skill Development	2	4	04
	NME III & V Sem Horizontal Migration **SEC** IV & VI Sem Vertical Migration	2 2	2	8	08
	Value Education V Sem	1	1	2	**1**
		Sub Total		**14**	**13**
	Total				**139**
Part V	**NCC (Army &Navy)/ PE/ NSS / Rotaract/ Quality/WSC Circle/ Library/ SSL/ Nature Club/Value Education/ YRC**				**1**
	Grand Total				**140**
	Self-Study Paper (Optional)- -V Sem			**05**	**145**

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 &V semester)
- For SEC every department offer three papers for each course (Sem IV & VI)
- For Major elective there may be an option for choice.

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 to equip/prepare the students

PEO 1	Provide students with a thorough knowledge of fundamental mathematical facts, and solve problems which can be analyzed mathematically.
PEO 2	Provide high quality and relevant education in the field of Mathematics
PEO 3	Provide grounding in a coherent body of knowledge, a board coverage of related academic skills, personal development and social skills.
PEO 4	Develop confidence to appear for SSC (CGL), IBPS, RRB and Civil services exam and will occupy higher posts in administrative level.
PEO 5	Expose them to various contemporary issues which will enable them 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 2019)

B.Sc. Mathematics

COURSE STRUCTURE (w. e. f. 2019 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	U19TM11	Tamil	6	3	90	25	75	100
Part II - English	U19EN12	English	6	3	90	25	75	100
Core 1	UMA19C11	Calculus	5	4	75	25	75	100
Core 2	UCO19C12M	Financial Accounting	5	5	75	25	75	100
Allied(C)-1	UCH19GE11M	General Chemistry - I	4	4	60	25	75	100
Allied (C) - 1 Lab	UCH19GL21M	Ancillary Chemistry Lab	2	-	30	-	-	-
AECC	U19ES11	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	U19TM21	Tamil	6	3	90	25	75	100
Part II - English	U19EN22	English	6	3	90	25	75	100

Core 3	UMA19C21	Algebra and Trigonometry	5	4	75	25	75	100
Core 4	UCO19C22M	Cost and Management Accounting	5	5	75	25	75	100
Allied (C) - 1	UCH19GE21M	General Chemistry - II	4	4	60	25	75	100
Allied (C) - 1 Lab	UCH19GL21M	Ancillary Chemistry Lab	2	2	30	40	60	100
AECC	UMA19AE21	Quantitative Aptitude	2	2	30	15	35	50
TOTAL			**30**	**23**				

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	U19TM31	Tamil	6	3	90	25	75	100
Part II - English	U19EN32	English	6	3	90	25	75	100
Core 5	UMA19C31	Differential Equations and Laplace Transform	5	5	75	25	75	100
Core 6	UMA19C32	Analytical Geometry of 3D and Vector calculus	5	4	75	25	75	100
Allied (P) - 2	UPH19GE31M	Physics - I	4	4	60	25	75	100
Allied (P) - 2 Lab	UPH19GL41M	Allied Physics Practical	2	-	30	-	-	-
Non Major Elective	UMA19NE31	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	U19TM41	Tamil	6	3	90	25	75	100
Part II English	U19EN42	English	6	3	90	25	75	100
Core 7	UMA19C41	Sequences and Series	4	4	60	25	75	100
Core 8	UMA19C42	C Programming	4	4	60	25	75	100
Core Lab 1	UMA19CL41	C Programming Lab	2	1	30	15	35	50
Allied (P)-2	UPH19GE41M	Basic Electronics	4	4	60	25	75	100
Allied (P)-2 Lab	UPH19GL41M	Allied Physics Practical	2	2	30	40	60	100
SEC	UMA19SE41	Skill Enhanced Course	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	UMA19C51	Algebraic structures	6	5	90	25	75	100
Core 10	UMA19C52	Real Analysis	6	5	90	25	75	100
Core 11	UMA19C53	Probability and Statistics	4	4	60	25	75	100
Core 12	UMA19C54	Linear programming problem	5	4	75	25	75	100
Core Elective 1	UMA19CE51	Elective (List enclosed)	5	5	75	25	75	100
Non	UMA19NE51	Mathematical	2	2	30	15	35	50

Major Elective		Logic						
Value Education	U19VE51	Value Education	2	1	30	15	35	50
Self Study Paper	U19SS51	Soft Skills	-	-	-	-	100	100
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	UMA19C61	Complex Analysis	6	5	90	25	75	100
Core 14	UMA19C62	Linear Algebra	6	5	90	25	75	100
Core 15	UMA19C63	Discrete Mathematics	6	4	90	25	75	100
Core 16	UMA19C64	Resource management techniques	5	4	75	25	75	100
Core Elective 2	UMA19CE61	Elective (List enclosed)	5	5	75	25	75	100
SEC	UMA19SE61	Skill Enhanced Course	2	2	30	15	35	50
Part V		**NCC/NSS/Physical Education**	-	1	-	100	-	100
TOTAL			**30**	**26**				
TOTAL CREDITS FOR SEMESTERS I to VI				**140**				

SEC (2 Hours / week)

1) Theory of Numbers

2) Statistical Test of Significance

3) Web Designing with HTML – Practical

4) Theory of Lattices

5) Numerical Methods – Practical

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) Fuzzy sets

2) Fundamentals of Computer Algorithms

3) Numerical Methods

Self study paper: Soft Skills

Curriculum Credits

Part I & II	24 Credits
Core	72 Credits
Core Elective	10 Credits
Allied	20 Credits
AECC	04 Credits
Value Education	01 Credit
Skill Based Elective	04 Credits
Non Major Elective	04 Credits
Part V	01 Credit
Total	140 Credits

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19C11	**Calculus**	**Core**	**4**	**1**	**-**	**4**

L - Lecture T - Tutorial P–Practicals

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

Preamble

The course 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 (according to Bloom's Taxonomy)
CO1	Recall the basic concepts of differentiation, partial differentiation and integration.	K1
CO2	Develop problem solving skills using derivatives and partial derivatives.	K3
CO3	Classify the nature of double points of a curve and determine asymptotes for the curve.	K2, K3
CO4	Solve problems in double and triple integrals using transformation of one coordinate system to another.	K2,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**

Blooms taxonomy

	CA		End of Semester
	First	**Second**	
Knowledge(K1)	**21**	**21**	**40%**
Understand(K2)	**21**	**21**	**40%**
Apply(K3)	**10**	**10**	**20%**
Total Marks	**52**	**52**	**140**

Contents

Unit I **(12 Hours)**

Differentiation**:** nth derivative and Leibnitz's theorem – Partial differentiation – Euler's theorem.

Unit II **(18 Hours)**

Applications of differentiation: p – r equations - Curvature - Evolute – Envelope.

Unit III **(15 Hours)**

Applications of differentiation: Maxima and minima of functions of two variables - Jacobians – Multiple point – Asymptotes

Unit IV **(20 Hours)**

Evaluation of Definite Integrals – Integration by parts – Reduction formulae – Double integrals - Evaluation of double integrals - Triple integrals – Change of variables in double and triple integrals.

Unit V **(10 Hours)**

Beta and Gamma functions - Properties and results involving Beta and Gamma functions

Text Books:

Arumugam and Issac, 2014, Calculus, New Gamma publishing House, Palayamkottai.

Unit	Chapter/section
I	Part I - 2 (2.12, 2.13, 2.14)
II	Part I – 3 (3.3, 3.4, 3.5, 3.6)
III	Part I – 3 (3.7, 3.9, 3.10, 3.11)
IV	Part II – 2 (2.6, 2.7, 2.8, 2.9), Part II – 3(3.1, 3.2, 3.3, 3.4)
V	Part II – 4 (4.1)

References:

1. Vittal. P.R. and Malini. V., 2012, Calculus, Third Edition, Margham Publications, Chennai.
2. Tom M. Apostal, 2007, Calculus – Vol. II –Wiley Student publication, New Delhi.
3. Shanti Narayan, 2002, Integral Calculus, 9th Edition,S. Chand and Company Ltd., New Delhi.
4. Shanti Narayan, 2002, Differential Calculus, 14th Edition, S. Chand and Company Ltd., New Delhi.

Course Designers:

1. Dr. G. Prabakaran
2. Mrs. R. Latha

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	nth derivative and Leibnitz's theorem	4
1.2	Partial differentiation	4
1.3	Euler's theorem	4
2.1	p – r equations	3
2.2	Curvature	6
2.3	Evolute	5
2.4	Envelope	4
3.1	Maxima and minima of functions of two variables	4
3.2	Jacobians	2
3.3	Multiple point	4
3.4	Asymptotes	5
4.1	Evaluation of double integrals	3
4.2	Reduction formulae	4
4.3	Double integrals	2
4.4	Evaluation of double integrals	3
4.5	Triple integrals	4
4.6	Change of variables in double and triple integrals	4
5.1	Beta and Gamma functions	3
5.2	Properties and results involving Beta and Gamma functions	7
Total		**75**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19C21	**Algebra and Trigonometry**	**Core**	**4**	**1**	**-**	**4**

L - Lecture T - Tutorial P–Practicals

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 and 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 (according to Bloom's Taxonomy)
CO1	Find the sum of the series by applying Binomial, Exponential and Logarithmic Series	K1, K3
CO2	Find the sum of the powers of the roots of equations using Newton's method	K1
CO3	Apply transformations of equations and solve the equations	K2, K3
CO4	Recall expressions for trigonometric functions	K1
CO5	Relate circular trigonometric functions and hyperbolic functions	K2

Mapping of COs with PSOs

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

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge(K1)	**21**	**21**	**40%**
Understand(K2)	**21**	**21**	**40%**
Apply(K3)	**10**	**10**	**20%**
Total Marks	**52**	**52**	**140**

Contents

Unit I **(15 Hours)**

Binomial theorem for a rational index – Application of the binomial theorem to summation of series – 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– Strum's Theorem - 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)
II	1	6 (11, 12, 13, 14)
III	1	6 (15.1, 15.2. 17, 19, 27, 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. Dr. G. Prabakaran

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Binomial theorem for a rational index	2
1.2	Application of the binomial theorem to summation of series	3
1.3	Exponential theorem	2
1.4	Summation of series	3
1.5	The Logarithmic Series: Theorem	2
1.6	Modification of logarithmic series	3
2.1	Relations between the roots and coefficients of equations	4
2.2	Symmetric function of the roots	4
2.3	Sum of the powers of the roots of an equation	2
2.4	Newton's theorem on the sum of powers of the roots	5
3.1	Transformations of equations - Roots with signs changed	2
3.2	Roots multiplied by a given number	2
3.3	To increase or decrease the roots of a given equation by a given quantity	3
3.4	Removal of Terms	3
3.5	Strum's Theorem	2
3.6	Horner's Method	3
4.1	Applications of De Moivre's theorem: Expression for $\sin n\theta$, $\cos n\theta$ and $\tan n\theta$	5
4.2	Expression for $\sin^n \theta$ and $\cos^n \theta$	5
4.3	Expansion of $\sin\theta$, $\cos\theta$, $\tan\theta$ in powers of θ	5
5.1	Hyperbolic functions	5
5.2	Inverse Hyperbolic functions	5
5.3	Logarithm of a complex number	5
Total		**75**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19C31	**Differential Equations and Laplace Transform**	**Core**	**5**	**-**	**-**	**5**

L - Lecture T - Tutorial P–Practicals

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

Preamble

The course provides an introduction to ordinary and partial differential equations. Emphasis is placed on the applications for first order and higher order differential equations, systems of differential equations, Laplace transforms and Partial differential equations.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Recognize and solve exact differential equations and Bernoulli equations	K1, K3
CO2	Find the complete solution of a differential equation with constant coefficients by variation of parameters	K1
CO3	Solve linear differential equations with constant coefficients and unit step and unit impulse functions using Laplace transform	K3
CO4	Classify and apply appropriate methods to solve the first order nonlinear partial differential equations	K2, K3
CO5	Explain and solve the problems related to Simple electric circuits, Simple harmonic motion, Simple pendulum and Oscillations of a spring.	K2, K3

Mapping of COs with PSOs

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

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge(K1)	**21**	**21**	**40%**
Understand(K2)	**21**	**21**	**40%**
Apply(K3)	**10**	**10**	**20%**
Total Marks	**52**	**52**	**140**

Contents

Unit I **(15 Hours)**

Differential Equations of first order: Definitions-Formation of Differential Equations-Solution of a Differential Equations-Geometrical Meaning of a Differential Equations- Equations of first order and first degree- Variable separable- Homogeneous Equations- Equations reducible to homogeneous form- Linear Equations-Bernoulli‘s Equations-Exact Differential Equations-Equations reducible to exact equations-Equations of the first order and higher degree – Clairaut‘s equation.

Unit II **(15 Hours)**

Linear Differential Equations: Definitions-Theorems-Operator D -Rules for finding the complementary functions-Inverse operator-Rules for finding the particular integral-Working procedure to solve equations-Method of variation of parameters-Method of undetermined coefficients-Equations reducible to linear equations with constant coefficients-Linear dependence of solutions-Simultaneous linear equations with constant coefficients.

Unit III **(15 Hours)**

Laplace Transforms: Introduction-Definitions-Transforms of elementary functions-Properties of Laplace Transforms-Transforms of periodic functions-Transforms of special functions-Transforms of derivatives-Transforms of integrals- Multiplication by tn- Division by t -Evaluation of integrals by Laplace Transforms-Inverse Transforms-Convolution Theorem-Applications to Differential Equations-Simultaneous linear equations with constant coefficients-Unit step function-Unit impulse function.

Unit IV **(15 Hours)**

Partial Differential Equations: Introduction-Formation of Partial Differential Equations-Solution of a Partial Differential Equation: Equations solvable by direct integration-Linear equations of the first order-Non-Linear Equations of the first order-Charpit‘s Method-Homogeneous linear equations with constant coefficients.

Unit V **(15 Hours)**

Applications of Differential Equations: Introduction-Geometric Applications-Orthogonal Trajectories-Physical Applications-Simple Electric Circuits-Simple harmonic motion-Simple pendulum-Oscillations of a spring.

Text Book:

Grewal.B.S, 2015, Higher Engineering Mathematics – Khanna Publishers,

Unit	Chapter/section
I	11
II	13
III	21
IV	17(17.1 -17.11)
V	12(12.1 – 12.5), 14(14.1 – 14.4)

References:

1. Erwin Kreyszig, 2016, Advanced Engineering Mathematics-, Wiley, 10th Edition, New Delhi.
2. Raisinghania M.D., 2016, Advanced Differential Equations, S.Chand., New Delhi.
3. Daniel A. Murray, 2012, Introductory Course in Differential Equations, University Press, New Delhi.

Course Designers:

1. Dr. M. Senthilkumaran
2. Mrs. R. Latha

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Definitions-Formation of Differential Equations	2
1.2	Solution of a Differential Equations-Geometrical Meaning of a Differential Equations	2
1.3	Equations of first order and first degree Variable separable- Homogeneous	2
1.4	Equations reducible to homogeneous form- Linear Equations-Bernoulli's Equations-	4
1.5	Exact Differential Equations	2
1.6	Equations reducible to exact equations-Equations of the first order and higher degree – Clairaut's equation.	3
2.1	Definitions-Theorems-Operator D	2
2.2	Rules for finding the complementary functions	2
2.3	Inverse operator-Rules for finding the particular integral	3
2.4	Working procedure to solve equations Method of variation of parameters, Method of undetermined coefficients	3
2.5	Equations reducible to linear equations with constant	3

	coefficients-Linear dependence of solutions	
2.6	Simultaneous linear equations with constant coefficients.	2
3.1	Introduction-Definitions-Transforms of elementary functions-Properties of Laplace Transforms-Transforms of periodic functions	3
3.2	Transforms of special functions-Transforms of derivatives-Transforms of integrals	3
3.3	Multiplication by t^n- Division by t -Evaluation of integrals by Laplace Transforms	2
3.4	Inverse Transforms-Convolution Theorem	3
3.5	Applications to Differential Equations Simultaneous linear equations with constant coefficients-Unit step function-Unit impulse function	4
4.1	Introduction-Formationof Partial Differential Equations	2
4.2	Solution of a Partial Differential Equation: Equations solvable by direct integration	3
4.3	Linear equations of the first order-Non-Linear Equations of the first order	4
4.4	Charpit's Method	2
4.5	Homogeneous linear equations with constant coefficients	4
5.1	Introduction-Geometric Applications	3
5.2	Orthogonal Trajectories	3
5.3	Physical Applications-Simple Electric Circuits-	3
5.4	Simple harmonic motion-Simple pendulum-	4
5.5	Oscillations of a spring	2
Total		**75**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19C32	**Analytical Geometry of 3D and Vector Calculus**	**Core**	**4**	**1**	**-**	**4**

L - Lecture T - Tutorial P–Practicals

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

Preamble

Science and engineering involves the study of quantities that change relative to each other. 3D Analytical geometry helps to study the quantities in three dimensional space and vector calculus help to study its changes.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Recall plane concepts in three dimension	K1
CO2	Solve the problems related to lines and planes	K3
CO3	Demonstrate the sphere concepts and relate their properties	K1, K2
CO4	Extend the concepts of differentiation in vector algebra	K2
CO5	Demonstrate Line integrals, surface integrals and apply Stokes theorem, Gauss divergence theorem and Green's theorem	K2, K3

Mapping of COs with PSOs

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

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge(K1)	**21**	**21**	**40%**
Understand(K2)	**21**	**21**	**40%**
Apply(K3)	**10**	**10**	**20%**
Total Marks	**52**	**52**	**140**

Contents

Unit I **(15 Hours)**

Direction Cosines - Equation of a Plane -Angle between two planes-Angle bisectors of two planes.

Unit II **(15 Hours)**

Equation of a straight line –A Plane and a line-Equations of two skew lines in a simple form-The intersection of three planes-Volume of a tetrahedron.

Unit III **(15 Hours)**

Equation of a sphere - Tangent line and Tangent plane –Section of a Sphere.

Unit IV **(15 Hours)**

Vector Algebra–Differentiation of Vectors – Gradient - Divergence and Curl

Unit V **(15 Hours)**

Line integrals- Surface integrals – Theorems of Green, Gauss and Stokes.

Text Book:

Arumugam. S. and Thangapandi Isaac.A., 2014, Analytical Geometry of 3D and Vector Calculus, New Gamma publications, Palayamkottai.

Unit	Chapter/Section
I	1(1.3), 2 (2.1 - 2.3)
II	3 (3.1 - 3.5)
III	4 (4.1 - 4.3)
IV	5 (5.1 - 5.4)
V	7 (7.1 - 7.3)

References:

1. Pandey. H.D., Dubey. S.K.D. and Pandey. S.N., 2011, A text book of Vector Analysis and Geometry,Wisdom Press, New Delhi.
2. Manikavachagam Pillay.T.K. and Natarajan. T, 1997, A Text Book of Analytical Geometry(Two & Three dimension), S. Viswanathan (Printers & Publishers) Pvt Ltd, Chennai.

Course Designers:

1. Mr. M. Madhavan
2. Dr. G. Prabakaran

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Direction Cosines	3
1.2	Equation of a plane	4
1.3	Angle between two planes	4
1.4	Angle bisectors of two planes	4
2.1	Equation of straight line	2
2.2	A plane and a line	3
2.3	Equations of two skew lines in a simple form	3
2.4	The intersection of three planes	3
2.5	Volume of a tetrahedron	4
3.1	Equation of a sphere	5
3.2	Tangent line and Tangent plane	5
3.3	Section of a sphere	5
4.1	Vector Algebra	3
4.2	Differentiation of Vectors	4
4.3	Gradient	4
4.4	Divergence and curl	4
5.1	Line integrals	5
5.2	Surface integrals	5
5.3	Theorems of Green, Gauss and Stokes	5
Total		**75**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19C41	**Sequences and Series**	**Core**	**4**	**-**	**-**	**4**

L - Lecture T - Tutorial P–Practical

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

Preamble

The course deals with the countability of sets. Types and properties of sequences and series of real numbers have been demonstrated in detail.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Analyze the concepts in functions of real numbers	K3
CO2	Demonstrate completely about the sequence and series and their various types	K2
CO3	Illustrate and find limit superior and limit inferior properties of real numbers	K1, K2
CO4	Determine the convergence of real sequences and series	K3
CO5	Deduct the summablity of series of real numbers	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**

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge(K1)	**21**	**21**	**40%**
Understand(K2)	**21**	**21**	**40%**
Apply(K3)	**10**	**10**	**20%**
Total Marks	**52**	**52**	**140**

Contents

Unit I **(12 Hours)**

Sets and functions : Sets and elements – Operations on sets – Functions – Real-valued functions – Equivalence, Countability – Real numbers –Least upper bounds.

Unit II **(12 Hours)**

Sequences of real numbers: Definition of sequence and subsequence–Limit of a sequence–Convergent sequences–Divergent sequences–Bounded sequences – Monotone sequences–Operations on convergence sequences–Operations on divergent sequences.

Unit III **(12 Hours)**

Sequences of real numbers : Limit superior and limit inferior – Cauchy sequences – Summability of sequences – Limit superior and limit inferior for sequences of sets.

Unit IV **(12 Hours)**

Series of real Numbers: Convergence and divergence – Series with non-negative terms – Alternating series – Conditional convergence and absolute convergence – Rearrangements of series – Tests for absolute convergence.

Unit V **(12 Hours)**

Series of real numbers : Series whose terms form a non-increasing sequence - Summation by parts –(C,1) Summability of series – The class l^2– Real numbers and decimal expansions.

Text Book:

Richard R. Goldberg, 1970, Methods of Real Analysis, Oxford & IBH Publishing Co. Pvt.Ltd., New Delhi.

Unit	Chapter/section
I	1 (1.1. - 1.7)
II	2 (2.1 - 2.8)
III	2 (2.9 - 2.12)
IV	3 (3.1 - 3.6)
V	3 (3.7 - 3.11)

References:

1. Satish Shirali, HarKrishan, and Vasudeva.L.,2014, An introduction to Mathematical Analysis, Narosa Publishing House Pvt.Ltd., New Delhi.
2. Somasundaram. D. and Choudhary. B.,2011, A first course in Mathematical Analysis, Narosa Publishing House Pvt.Ltd., New Delhi.
3. Bali N.P., 2009, Sequences and Infinite Series, Firewall Media (An imprint of Laxmi Publications Pvt.Ltd., New Delhi.

Course Designers:

1. Mrs. R. Latha
2. Dr. G. Prabakaran

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Sets and elements	1
1.2	Operations on sets	1
1.3	Functions	2
1.4	Real valued functions	1
1.5	Equalence,Countability	3
1.6	Real numbers	2
1.7	Least upper bounce	2
2.1	Definition of sequence and subsequence	1
2.2	Limit of a sequence	1
2.3	Convergent sequences	2
2.4	Divergent sequences	1
2.5	Bounded sequences	1
2.6	Monotone sequences	2
2.7	Operations on convergence sequences	2
2.8	Operations on divergent sequences	2
3.1	Limit superior and limit inferior	3
3.2	Cauchy sequences	3
3.3	Summability of sequences	3
3.4	Limit superior & limit inferior for sequences of sets	3
4.1	Convergence and divergence	2
4.2	Series with non negative terms	2
4.3	Alternating series	2
4.4	Conditional convergence and absolute convergence	2
4.5	Rearrangement of series	2
4.6	Tests for absolute convergence	2
5.1	Series whose terms form a non increasing sequence	2
5.2	Summation by parts	2
5.3	(C,1) Summability of series	3
5.4	The class l^2	3
5.5	Real numbers and decimal expansions	2
Total		**60**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19C42	**C Programming**	**Core**	**4**	**-**	**-**	**4**

L - Lecture T - Tutorial P – Practicals

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

Preamble

The course deals with different data types, control statements, string functions, arrays, structures and unions in C programming.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Recall the basic concepts of constants, variables and data types	K1
CO2	Demonstrate the different types of operators in C programming language.	K2
CO3	Develop programming skills using the fundamentals and basics.	K3
CO4	Analyze the string handling functions and different types of functions	K3
CO5	Design programs using Structures and unions	K3

Mapping of COs with PSOs

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

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge(K1)	**21**	**21**	**40%**
Understand(K2)	**21**	**21**	**40%**
Apply(K3)	**10**	**10**	**20%**
Total Marks	**52**	**52**	**140**

Contents

Unit I **(12 Hours)**

Constants, Variable and Data Types: Introduction –Character set- C Tokens – Keywords and identifiers – Constants – Variables – Data types – Declaration of variables – Declaration of storage class –Assigning values to variables – Defining symbolic constants – Declaring a variable as Constant -Declaring a variable as volatile. Operators and Expressions: Introduction – Various types of operators – Arithmetic expressions – Evaluation of expressions – Precedence of arithmetic operators – Some computational problems- Type conversions in Expressions – Operator precedence and associativity.

Unit II **(12 Hours)**

Managing Input and Output Operations: Introduction – Reading and writing a character- Formatted input and output. Decision Making and Branching: Introduction Decision Making with different types of if – statements – Switch statement - The ?: operator- The goto statement

Unit III **(12 Hours)**

Decision Making and Looping: Introduction – While, do and for statements – Jumps in loops – Concise Test expressions. Arrays: Introduction – One Dimensional Arrays (Declaration and Initialization) – Two Dimensional and Multi- dimensional Arrays - Dynamic arrays - More about Arrays.

Unit IV **(12 Hours)**

Character Arrays and Strings : Introduction – Declaring and initializing string variables – Reading strings from terminal – Writing strings to screen – Arithmetic operations on characters – Putting strings together – Comparison of two Strings – String handling functions – Table of strings – Other features of strings. User defined functions : Introduction – Need for user – Defined functions – A multi- function program – Elements of user –defined functions – Definition of functions – Return values and their types – Function calls – Function declaration – Different categories of functions – Nesting of functions – Recursion – Passing arrays to functions **–** Passing strings to functions – The scope , visibility and lifetime of variables – Multifile Programs.

Unit V **(12 Hours)**

Structures and Unions : Introduction - Defining a structure – Declaring structure variables – Accessing structure members – Structure initialization – Copying and comparing structure variables – Operations on individual members – Arrays of structures – Arrays within structures – Structures within structures – Structures and functions – Unions – Size of structures – Bit fields.

Text Book:

Balagurusamy. E, 2019, Programming in ANSI C, McGraw Hill Education (India), Private Limited, New Delhi.

Unit	Chapter / Section
I	2 & 3
II	4 & 5
III	6 & 7
IV	8 & 9
V	10

References:

1. Yashavant Kanetkar, 2016, Let us C, 14th Edition, BPB Publications, New Delhi.
2. Ashok N. Kamthane, 2009, Programming with ANSI and Turbo C, Pearson Education, New Delhi.
3. Pradip Dey, Manas Ghosh, 2008, Fundamentals of Computers with Programming in C, Oxford University press, New Delhi.

Course Designers:

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

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Introduction, Character set , C-Tokens , Key words and Identifiers	2
1.2	Constants, Variables , Data types, Declaration of Variables and Storage class	2
1.3	Assigning values to variables , Defining symbolic constants , Declaring variables and constants	1
1.4	Various types of operators , Expressions	2
1.5	Computational problems	1
1.6	Type conversions in expressions & Operators precedence and associativity	2
1.7	Simple C – Programs	2
2.1	Reading and Writing a character	1
2.2	Formatted input and output	2
2.3	Decision making with different types of if statements	2
2.4	Switch statements	2
2.5	?: operator	2
2.6	Goto statement	1
2.7	C- programs	2
3.1	Control structures (different forms)	2
3.2	Concise test expressions	2
3.3	Arrays (One dimensional)	2

3.4	Two dimensional	2
3.5	Dynamic arrays	1
3.6	C- programs	2
3.7	More about arrays	1
4.1	String variables	1
4.2	Reading strings from terminal	2
4.3	Arithmetic operations on characters	1
4.4	String handling functions	2
4.5	Table of strings	2
4.6	User defined functions	1
4.7	Simple C – Programs	2
4.8	Revision	1
5.1	Defining a structure	2
5.2	Declaring structures	2
5.3	Accessing structure members	1
5.4	Copying and comparing structure variables	2
5.5	Operations on individual members	2
5.6	Structures within structures	2
5.7	Size of structures	1
Total		**75**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19CL41	**C Programming – Lab**	**Core Lab**	**-**	**-**	**2**	**1**

L - Lecture T - Tutorial P–Practicals

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

Preamble

Programming in C is a fundamental task to find solution to problems such as testing of prime numbers, convert Fahrenheit to Celsius etc.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Illustrate Programming principles	K2
CO2	Develop skills to solve mathematical problems	K3
CO3	Relate conditional and looping statements	K1
CO4	Design simple projects	K3
CO5	Construct programs using strings and functions	K3

Mapping of COs with PSOs

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

Contents

List of Practicals

1. Fahrenheit to Celsius
2. Simple interest and Compound interest
3. Largest of three numbers
4. Odd/Even Number
5. Reverse the Number
6. Sum of Digits
7. Number of Multiples of 7 between 1 and 100
8. Prime Number
9. Quadratic Equation using switch case
10. Fibbonacci Series
11. Average of n values
12. nCr value
13. Multiplication table
14. Standard deviation
15. Median
16. Ascending order
17. Descending order
18. Sorting a list of Names
19. Matrix addition and subtraction
20. Matrix multiplication

Text Book:

Balagurusamy. E, 2019, Programming in ANSI C, McGraw Hill Education (India), Private Limited, New Delhi.

References:

1. Yashavant Kanetkar, 2016, Let us C, 14th Edition, BPB Publications, New Delhi.
2. Ashok N. Kamthane, 2009, Programming with ANSI and Turbo C, Pearson Education, New Delhi.
3. Pradip Dey, Manas Ghosh, 2008, Fundamentals of Computers with Programming in C , Oxford University press, New Delhi.

Course Designers:

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

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19C51	**Algebraic Structures**	**Core**	**5**	**1**	**-**	**5**

L - Lecture T - Tutorial P–Practical

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

Preamble

The course deals with various types of algebraic structures. The concepts of integral domain and unique factorization domain are studied in detail.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Infer the knowledge in algebraic structures	K2
CO2	Summarize and relate the properties of Groups, Rings and Fields	K1, K2
CO3	Identify the structure preserve mapping in algebraic structure	K3
CO4	Extend the properties of real numbers	K2, K3
CO5	Classify algebraic structures in various disciplines	K2, K3

Mapping of COs with PSOs

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

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge(K1)	**21**	**21**	**40%**
Understand(K2)	**21**	**21**	**40%**
Apply(K3)	**10**	**10**	**20%**
Total Marks	**52**	**52**	**140**

Contents

Unit I **(20 Hours)**

Definition and Examples of groups – Elementary properties of a group - Equivalent definitions of a group - Permutation groups - Subgroups - Cyclic groups – Order of an element - Cosets and Lagrange's theorem.

Unit II **(16 Hours)**

Normal subgroups and quotient groups - Isomorphisms - Homomorphisms.

Unit III **(18 Hours)**

Definition and examples of Rings – Elementary properties of Rings - Isomorphism – Types of Rings - Characteristic of a Ring - Subrings - Ideals - Quotient Rings - Maximal and Prime ideals - Homomorphism of Rings.

Unit IV **(16 Hours)**

Field of quotients of an integral domain - Ordered integral domain – Unique Factorization Domain (U.F.D) - Euclidean domain.

Unit V **(20 Hours)**

Every P.I.D. is a U.F.D. – Polynomial Rings – Polynomial Rings over U.F.D. – Polynomials over Q.

Text Book:

Arumugam. S. and Isaac. A.T., 2016, Modern Algebra, SCITECH publications (India) Pvt. Ltd., Chennai.

Unit	Chapter/Section
I	3(3.1 – 3.8)
II	3(3.9 – 3.11)
III	4(4.1 – 4.10)
IV	4(4.11 – 4.14)
V	4(4.15 – 4.18)

References:

1. Herstein. I.N.,2014, Topics in Algebra, Wiley India Pvt. Ltd., New Delhi.
2. Vijay K Khanna and Bhambri. S.K., 2011, A course in Abstract Algebra, Vikas Publishing House Pvt. Ltd., New Delhi.
3. Kenneth Hoffman and Ray Kunze, 2009, Linear Algebra, PHI Learning Pvt. Ltd., New Delhi.

Course Designers:

1. Dr. G. Prabakaran
2. Dr. M. Senthilkumaran

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Definition and Examples of groups	2
1.2	Elementary properties of a group	1
1.3	Equivalent definitions of a group	2
1.4	Permutation groups	3
1.5	Subgroups	3
1.6	Cyclic group	3
1.7	Order of an element	3
1.8	Cosets and Lagrange's theorem	3
2.1	Normal subgroups and quotient groups	6
2.2	Isomorphisms	5
2.3	Homomorphisms	5
3.1	Definition and examples of Rings	1
3.2	Elementary properties of Rings	1
3.3	Isomorphism	3
3.4	Types of Rings	3
3.5	Characteristic of a Ring	1
3.6	Subrings	1
3.7	Ideals	2
3.8	Quotient Rings	2
3.9	Maximal and Prime ideals	3
3.10	Homomorphism of Rings	1
4.1	Field of quotients of an integral domain	2
4.2	Ordered integral domain	3
4.3	Unique Factorization Domain	5
4.4	Euclidean domain	6
5.1	Every P.I.D. is a U.F.D.	6
5.2	Polynomial Rings	6
5.3	Polynomial Rings over U.F.D.	4
5.4	Polynomials over Q	4
Total		**90**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19C52	**Real Analysis**	**Core**	**5**	**1**	**-**	**5**

L - Lecture T - Tutorial P–Practicals

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

Preamble

The course focuses on properties of real numbers, sequences and their limits, continuous functions on metric spaces, connectedness and compactness in metric spaces.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Define and analyze the properties of Riemann integration.	K1,K3
CO2	Demonstrate definitions and theorems concerning metric spaces	K2
CO3	Explain the concepts of completeness and connectedness in metric spaces	K2
CO4	Distinguish continuity and uniform continuity	K3
CO5	Develop simple proofs for some standard theorems	K3

Mapping of COs with PSOs

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

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge(K1)	**21**	**21**	**40%**
Understand(K2)	**21**	**21**	**40%**
Apply(K3)	**10**	**10**	**20%**
Total Marks	**52**	**52**	**140**

Contents

Unit I **(18 Hours)**

Limits and metric spaces: Limit of a function on the real line – Metric spaces – Limits in metric spaces.

Unit II **(18 Hours)**

Continuous functions on metric spaces: Functions continuous at a point on the real line Reformulation – Functions continuous on a metric space – Open sets – Closed sets – Discontinuous Functions R^1.

Unit III **(18 Hours)**

Connectedness, Completeness and Compactness: More about open sets – Connected sets – Bounded sets and totally bounded sets – Complete metric spaces.

Unit IV **(18 Hours)**

Connectedness, Completeness and Compactness: Compact metric spaces – Continuous functions on compact metric spaces – Continuity of the inverse function – Uniform continuity.

Unit V **(18 Hours)**

Calculus: Sets of measure zero – Definition of the Riemann Integral – Existence of the Riemann Integral – Properties of the Riemann Integral.

Text Book:

Richard R.Goldberg,1970, Methods of Real Analysis, Oxford & IBH Publishing Co. Pvt.Ltd.,New Delhi.

Unit	Chapter/section
I	4 (4.1 - 4.3)
II	5 (5.1 - 5.6)
III	6 (6.1 - 6.4)
IV	6 (6.5 - 6.8)
V	7 (7.1 - 7.4)

References:

1. Arumugam. S. and Thangapandi Isaac. A., 2012,Modern Analysis, New Gamma publishing house, Palayamkkottai
2. Somasundaram. D. and Choudary. B., 2011,A first course in Mathematical Analysis, Narosa Publishing House Pvt. Ltd., New Delhi.
3. Chandrasekara Rao. K. and Narayanan. K.S., 2008, Real Analysis,Vol.I, Second Edition,S. Viswanathan (Printers and Publishers) Pvt. Ltd., Chennai.

Course Designers:

1. Mrs. R. Latha
2. Dr. G. Prabakaran

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Limit of a function on the real line	6
1.2	Metric spaces	7
1.3	Limits in metric spaces	5
2.1	Functions continuous at a point on the real line	2
2.2	Reformulation	2
2.3	Functions continuous on a metric spaces	3
2.4	Open sets	4
2.5	Closed sets	4
2.6	Discontinuous functions on R^1	3
3.1	More about open sets	3
3.2	Connected sets	5
3.3	Bounded sets and totally bounded sets	5
3.4	Complete metric spaces	5
4.1	Compact metric spaces	4
4.2	Continuous functions on compact metric spaces	5
4.3	Continuity of the inverse function	4
4.4	Uniform continuity	5
5.1	Sets of measure zero	4
5.2	Definition of the Riemann integral	5
5.3	Existence of the Riemann integral	4
5.4	Properties of the Riemann integrals	5
Total		**90**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19C53	**Probability and Statistics**	**Core**	**4**	**-**	**-**	**4**

L - Lecture T - Tutorial P–Practicals

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

Preamble

The course is designed to provide the basic concepts of data analysis, statistical computation and theoretical distributions such as Binomial, Poisson, Normal, etc.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	List various measures of dispersion and define skewness and kurtosis	K1
CO2	Choose the appropriate measures and analyze the given data set	K1, K3
CO3	Interpret different types of distributions and discuss their statistical properties	K2, K3
CO4	Identify the appropriate probability distribution for a given situation	K3
CO5	Find the correlation coefficient for a Bivariate frequency distribution	K1

Mapping of COs with PSOs

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

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge(K1)	**21**	**21**	**40%**
Understand(K2)	**21**	**21**	**40%**
Apply(K3)	**10**	**10**	**20%**
Total Marks	**52**	**52**	**140**

Contents

Unit I **(12 Hours)**

Measures of Dispersion, Skewness and Kurtosis: Dispersion –Characteristics for an ideal measure of Dispersion – Measures of Dispersion – Range – Quartile Deviation – Mean deviation – Standard Deviation and Root mean square deviation - Coefficient of Dispersion – Moments – Pearson's β and γ Co-efficients – Skewness – Kurtosis.

Unit II **(12 Hours)**

Mathematical Expectation and Generating Functions: Mathematical Expectation– Addition theorem of Expectation – Multiplication theorem of expectation – Co-variance – Expectation of a linear combination of random variables -Variance of a linear combination of random variables - Expectation of a continuous random variable – Conditional expectation and Conditional variance - Moment Generating Function – Cumulants - Characteristic Function.

Unit III **(12 Hours)**

Theoretical Discrete Distributions: Introduction - Bernoulli Distribution - Binomial Distribution - Poisson Distribution.

Unit IV **(12 Hours)**

Theoretical Continuous Distributions: Rectangular Distribution - Normal Distribution - Gamma Distribution - Beta Distribution of First Kind - Beta Distribution of Second Kind - The Exponential Distribution**.**

Unit V **(12 Hours)**

Correlation and Regression: Bivariate Distribution, Correlation - Scatter diagram – Karl Pearson's coefficient of correlation - Calculation of the correlation coefficient for a Bivariate frequency distribution - Probable error of correlation coefficient - Rank Correlation - Regression.

Text Book:

Gupta. S.C. and Kapoor. V.K., 2015, Elements of Mathematical Statistics, Third Edition, Sultan Chand & Sons, Educational Publishers, New Delhi.

Unit	Chapter/Sections
I	3
II	6 (6.1-6.11)
III	7
IV	8
V	10

References:

1. Arumugam. S.andThangapandi Isaac. A., Statistics, 2011, New Gamma Publishing House, Palayamkkottai.
2. Gupta. S.C. and Kapoor. V.K.,2007, Fundamentals of Mathematical Statistics, Eleventh edition, Sultan Chand & sons, New Delhi.
3. Vittal. P.R., 2013,Mathematical Statistics, Margham Publications, Chennai.

Course Designers:

1. Mrs. R. Latha
2. Dr. M. Senthilkumaran

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Dispersion, Characteristics for an ideal measure of dispersion, Measures of dispersion, Range, Q.D	1
1.2	Mean deviation, Standard deviation and Root mean square deviation	2
1.3	Coefficient of dispersion	2
1.4	Moments	3
1.5	Pearson's β and γ Co-efficients	2
1.6	Skewness	1
1.7	Kurtosis	1
2.1	Mathematical Expectation– Addition theorem of Expectation – Multiplication theorem of expectation	3
2.2	Co-variance	1
2.3	Expectation and Variance of a linear combination of random variables - Expectation of a continuous random variable – Conditional expectation and Conditional variance	4
2.4	Moment Generating Function	2
2.5	Cumulants	1
2.6	Characteristic Function	1
3.1	Bernoulli Distribution	2
3.2	Binomial Distribution	5
3.3	Poisson Distribution	5
4.1	Rectangular distribution	1
4.2	Normal distribution	5
4.3	Gamma, beta and exponential distributions	6
5.1	Bivariate Distribution, Correlation, Scatter diagram, Karl Pearson's coefficient of correlation	4
5.2	Calculation of the correlation coefficient for a Bivariate frequency distribution-Probable error of correlation coefficient	2
5.3	Rank Correlation, Regression.	6
Total		60

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19C54	**Linear Programming Problem**	**Core**	**4**	**1**	**-**	**4**

L - Lecture T - Tutorial P – Practicals

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

Preamble

The course is a scientific approach to aid decision making and improving efficiency of the system by applying advanced analytical methods such as simplex method, Two-phase method, dual simplex method, etc.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Demonstrate OR approach in decision making	K2
CO2	Formulate mathematical LPP models and find their solutions	K1, K3
CO3	Translate LPP using duality principle and find their solutions	K1, K2
CO4	Recall and apply simplex method and its extensions	K1, K3
CO5	Recognize, solve and interpret transportation and assignment problems	K2, K3

Mapping of COs with PSOs

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

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge(K1)	**21**	**21**	**40%**
Understand(K2)	**21**	**21**	**40%**
Apply(K3)	**10**	**10**	**20%**
Total Marks	**52**	**52**	**140**

Contents

Unit I **(15 Hours)**

Linear Programming Problem(LPP)- Mathematical formulation: Introduction – Linear Programming Problem – Mathematical formulation of the problem – Illustration on Mathematical formulation of LPPs. Linear Programming Problem – Graphical solution and extension: Introduction – Graphical solution method – Some exceptional cases-General Linear Programming Problem – Canonical and standard forms of LPP – Insights into the simplex method.

Unit II **(15 Hours)**

Linear Programming Problem- Simplex method: Introduction – Fundamental properties of solutions- The computational procedure- Use of artificial variables- Degeneracy in Linear Programming.

Unit III **(15 Hours)**

Duality in Linear Programming: Introduction – General Primal – Dual pair – Formulating a dual Problem – Primal – Dual pair in matrix form – Duality theorems – Complementary slackness Theorem - Duality and simplex method – Dual simplex method.

Unit IV **(15 Hours)**

Transportation Problem:Introduction - LP formulation of the Transportation Problem - The Transportation table- Loops in Transportation table-Solution of a Transportation Problem-Finding an initial basic feasible solution- Test for optimality – Degeneracy in Transportation Problem - Transportation Algorithm (MODI Method).

Unit V **(15 Hours)**

Assignment Problem: Introduction-Mathematical formulation of the problem – Solution methods of the Assignment problem – Special cases in Assignment Problem-The Travelling Salesman Problem.

Text Book:

Kanti Swarup, Gupta. P.K. and Man Mohan, 2014, Operations Research, Seventeenth Edition, Sultan Chand & Sons, New Delhi.

Unit	Chapter/Section
I	2(2.1-2.4), 3(3.1-3.6)
II	4(4.1-4.5)
III	5(5.1-5.7, 5.9)
IV	10(10.1, 10.2, 10.5, 10.6, 10.8-10.10, 10.12, 10.l3)
V	11(11.1-11.4,11.7)

References:

1. Hamdy A. Taha, 2012, Operations Research – An Introduction, 9th Edition, Pearson Education, New Delhi.
2. Kalavathy. S.,2013, Operations Research, 4th Edition, Vikas Publishing House Pvt. Ltd., New Delhi.
3. Sharma. S.D.,2002, Operations Research, 13th Edition, Kedar Nath Ramnath & Co., Meerat.

Course Designers:

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

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Introduction	1
1.2	Linear Programming Problem	1
1.3	Mathematical formulation of problem	1
1.4	Illustration on mathematical formulation of LPP's	1
1.5	LPP- Graphical solution and extension	1
1.6	Introduction	1
1.7	Graphical solution method	3
1.8	Some exceptional cases	2
1.9	General LPP	2
1.10	Canonical and Standard Forms of LPP.	1
1.11	Insights into the simplex method	1
2.1	Introduction	2
2.2	Fundamental properties of solutions	2
2.3	The Computational Procedure	4
2.4	Use of Artificial Variables	5

2.5	Degeneracy in linear programming	2
3.1	Introduction	1
3.2	General primal-dual Pair	2
3.3	Formulating a dual Problem	4
3.4	Primal dual pair in matrix form	1
3.5	Duality theorems	1
3.6	Complementary slackness theorems	1
3.7	Duality and simplex method	3
3.8	Dual simplex method	2
4.1	Introduction	1
4.2	LP formulation of the transportation problem (TP)	1
4.3	The Transportation Table	1
4.4	Loops in transportation table	2
4.5	Solution of a transportation problem	2
4.6	Finding an initial basic feasible Solution	1
4.7	Test for optimality	3
4.8	Degeneracy in transportation problem	2
4.9	Transportation algorithm (MODI Method)	2
5.1	Introduction	1
5.2	Mathematical formulation of the problem	4
5.3	Solution methods of Assignment problem	4
5.4	Special cases in Assignment Problems	4
5.5	The travelling salesman problem	2
Total		**75**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19C61	**Complex Analysis**	**Core**	**5**	**1**	**-**	**5**

L - Lecture T - Tutorial P–Practicals

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

Preamble

The course introduces limit, continuity and differentiability of functions of complex variables. Complex functions are expanded as Taylor and Laurent's series. Contour integrals are evaluated using residues.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Construct analytic functions and conformal mapping.	K3
CO2	Analyze the properties of bilinear transformations.	K3
CO3	Classify and evaluate contour integration.	K2, K3
CO4	Find the Taylor and Laurent's series expansions for complex functions	K1
CO5	Discuss the nature of singularities	K3

Mapping of COs with PSOs

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

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge(K1)	**21**	**21**	**40%**
Understand(K2)	**21**	**21**	**40%**
Apply(K3)	**10**	**10**	**20%**
Total Marks	**52**	**52**	**140**

Contents

Unit I **(18 Hours)**

Analytic functions : Functions of a complex variable – Limits – Theorems on limit – Continuous functions – Differentiability – The Cauchy – Riemann equations –Analytic functions – Harmonic functions – Conformal mapping.

Unit II **(18 Hours)**

Bilinear transformations: Elementary transformations – Bilinear transformations – Cross ratio – Fixed points of Bilinear transformations – Some special bilinear transformations – Mapping by elementary functions: The mappings $w = z^2$, $w = e^z$, $w = \sin z$ and $w = \frac{1}{2}(z + 1/z)$.

Unit III **(18 Hours)**

Complex integration: Definite integral - Cauchy‘s theorem– Cauchy‘s integral formula – Higher derivatives.

Unit IV **(18 Hours)**

Series expansions: Taylor‘s series– Laurent‘s series – Zeros of an analytic functions – Singularities.

Unit V **(18 Hours)**

Calculus of residues: Residues– Cauchy‘s residue theorem – Evaluation of definite integrals.

Text Book:

Arumugam. S., ThangapandiIssac. A. and A. Somasundaram, 2015, Complex Analysis, SciTech publications (India) Pvt. Ltd. Chennai.

Unit	Chapter/Section
I	2(2.1 – 2.9)
II	3(3.1 – 3.5) 5(5.1, 5.3, 5.4, 5.7)
III	6(6.1 – 6.4)
IV	7(7.1 – 7.4)
V	8(8.1 – 8.3)

References:

1. Roopkumar. R, 2015, Complex analysis, Dorling Kinderley Pvt. Ltd , New Delhi.
2. ManickavasagamPillay T.K. and Narayanan. S., 2008, Complex Analysis, S. V. Publishers, India.
3. Karunakaran V, 2006, Complex Analysis, Narosa Publishing House Pvt. Ltd., Second Edition, New Delhi.

Course Designers:

1. Mrs. S. Shanavas Parvin
2. Mrs. K. Ponmari

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Functions of a complex variable	2
1.2	Limits	1
1.3	Theorems on limits	1
1.4	Continuousfunctions	1
1.5	Differentiability	2
1.6	The Cauchy – Riemann equations	3
1.7	Analytic functions	3
1.8	Harmonic functions	2
1.9	Conformal mapping.	3
2.1	Elementary transformations	1
2.2	Bilinear transformations	2
2.3	Cross ratio	2
2.4	Fixed points of Bilinear transformations	1
2.5	Some special bilinear transformations	2
2.6	The mapping $w = z^2$	2
2.7	The mapping $w = e^z$	2
2.8	The mapping $w = \sin z$	3
2.9	The mapping $w = \frac{1}{2}(z + 1/z)$	3
3.1	Definite integral	3
3.2	Cauchy's theorem	5
3.3	Cauchy's integral formula	5
3.4	Higher derivatives	5
4.1	Taylor's series	5
4.2	Laurent's series	5
4.3	Zeros of an analytic functions	4
4.4	Singularities.	4
5.1	Residues	6
5.2	Cauchy's residue theorem	6
5.3	Evaluation of definite integrals	6
Total		**90**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19C62	**Linear Algebra**	**Core**	**5**	**1**	**-**	**5**

L - Lecture T - Tutorial P - Practicals

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

Preamble

The course deals with linear independence, basis and dimension of a vector space and also linear transformation between vector spaces. Eigenvalues and Eigenvectors of a given square matrix are found and inverse of a matrix is found using Cayley- Hamilton theorem.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Determine whether a system of equations is consistent and find its general solution	K1, K3
CO2	Demonstrate various characterization of nonsingular matrices	K2
CO3	Determine the dimension of a vector space	K3
CO4	Find the matrix of a linear transformation	K1
CO5	Define orthogonality in an inner product space and construct orthonormal basis	K1, K3

Mapping of COs with PSOs

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

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge(K1)	**21**	**21**	**40%**
Understand(K2)	**21**	**21**	**40%**
Apply(K3)	**10**	**10**	**20%**
Total Marks	**52**	**52**	**140**

Contents :

Unit I **(18 Hours)**

Definition and examples of vector spaces– Subspaces - Linear transformation– Span of a set.

Unit II **(18 Hours)**

Linear independence - Basis and dimension – Rank and Nullity – Matrix of a linear transformation.

Unit III **(18 Hours)**

Definition and examples of inner product spaces - Orthogonality – Orthogonal Complement.

Unit IV **(20 Hours)**

Algebra of Matrices – Types of Matrices – The Inverse of a Matrix – Elementary Transformations – Rank of a Matrix – Simultaneous Linear Equations**.**

Unit V **(16 Hours)**

Characteristic Equation and Cayley-Hamilton theorem – Eigen values and Eigen Vectors – Bilinear forms – Quadratic forms

Text Book:

Arumugam. S. and Isaac. A.T., 2016, Modern Algebra, SCITECH publications (India) Pvt., Chennai.

Unit	Chapter/Section
I	3(3.1 – 3.8)
II	3(3.9 – 3.11)
III	4(4.1 – 4.10)
IV	4(4.11 – 4.14)
V	4(4.15 – 4.18)

References:

1. Herstein. I.N., 2014, Topics in Algebra, Wiley India Pvt. Ltd, Second Edition, New Delhi.
2. Vijay K Khanna and Bhambri. S.K., 2011, A course in Abstract Algebra, Vikas Publishing House Pvt. Ltd., New Delhi.
3. Kenneth Hoffman and Ray Kunze, 2009, Linear Algebra, PHI Learning Pvt. Ltd., New Delhi.

Course Designers:

1. Dr. G. Prabakaran
2. Dr. M. Senthilkumaran

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Definition and examples of vector spaces	3
1.2	Subspaces Linear transformation– Span of a set	5
1.3	Linear transformation	5
1.4	Span of a set	5
2.1	Linear independence	4
2.2	Basis and dimension	5
2.3	Rank and Nullity	4
2.4	Matrix of a linear Transformation	5
3.1	Definition and examples of inner product spaces	6
3.2	Orthogonality	6
3.3	Orthogonal Complement	6
4.1	Algebra of Matrices	2
4.2	Types of Matrices	4
4.3	The Inverse of a Matrix	4
4.4	Elementary Transformations	3
4.5	Rank of a Matrix	3
4.6	Simultaneous Linear Equations	4
5.1	Characteristic Equation	4
5.2	Cayley-Hamilton theorem	4
5.3	Eigen values	4
5.4	Eigen Vectors	4
Total		**90**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19C63	**Discrete Mathematics**	**Core**	**4**	**2**	**-**	**4**

L - Lecture T - Tutorial P–Practicals

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

Preamble

The course introduces the graphs, trees, Eulerian graphs, Hamiltonian cycles, Lattices and Boolean Algebras. Graphs are described as mathematical models for real life problems.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Recall and apply the fundamental concepts in Graph Theory	K1, K3
CO2	Develop the proof writing skills	K3
CO3	Demonstrate graph theory based tools in solving practical problems	K2, K3
CO4	Determine whether a graph is planar	K3
CO5	Formulate and interpret Boolean Algebras	K3, K2

Mapping of COs with PSOs

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

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge(K1)	**21**	**21**	**40%**
Understand(K2)	**21**	**21**	**40%**
Apply(K3)	**10**	**10**	**20%**
Total Marks	**52**	**52**	**140**

Contents:

Unit I **(18 Hours)**

Graphs: Varieties of graphs – Walks and connectedness – Degrees. Blocks: Cut points, bridges, and blocks – Block graphs and cut point graphs.

Unit II **(16 Hours)**

Trees: Characterization of trees – Centers and centroids. Connectivity: Connectivity and line-connectivity.

Unit III **(16 Hours)**

Traversability: Eulerian graphs – Hamiltonian graphs. Planarity: Plane and planar graphs.

Unit IV **(20 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 Form

Unit V **(20 Hours)**

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

Text Books:

1. Harary, 2001, Graph Theory, Narosa Publishing House, New Delhi.
2. Venkataraman. M.K., Sridharan. N. and Chandrasekaran. N., 2012, Discrete Mathematics, The National Publishing Company, Chennai.

Units	Book	Chapter / Sections
I	1	2 (Pages 8–15,21– 25), 3 (Full)
II	1	4(Pages 32–36), 5 (Pages 43–47)
III	1	7 (Full),11 (Pages 102–106)
IV	2	IX(1 – 12)
V	2	X (1–4)

References:

1. Arumugam. S., and Ramachandran. S., 2001, Invitation to Graph Theory, Scitech Publications (India) Pvt. Ltd, Chennai.
2. Bondy. J.A. and Murty. U.S.R., 2008, Graph Theory, Springer, New York.
3. Narsingh Deo, 2001, Graph Theory with Applications to Engineering and computer Science, Prentice – Hall of India.
4. Trembley. J.P. and Manohar. R., 2001, Discrete Mathematical Structures with Applications to Compute Science, Tata McGraw –Hill Publishing Company Ltd, New Delhi.
5. Seymour Lipschutz and Marc Lars Lipson, 2002, Discrete Mathematics, Tata McGraw Hill Publishing Company Ltd., New Delhi.

Course Designers:

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

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Graphs: Varieties of graphs	4
1.2	Walks and connectedness	4
1.3	Degrees	2
1.4	Blocks: Cutpoints, bridges, and blocks	4
1.5	Block graphs and cutpoint graphs	4
2.1	Trees: Characterization of trees	4
2.2	Centers and centroids	4
2.3	Connectivity: Connectivity and line-connectivity	8
3.1	Traversability: Eulerian graphs	3
3.2	Hamiltonian graphs	7
3.3	Planarity: Plane and planar graphs	6
4.1	Logic :Introduction – TF-statements – Connectives – Atomic and compound statements – Well Formed (Statement) Formulae	5
4.2	Truth table of a Formula – Tautology – Tautological Implications and Equivalence of Formulae	5
4.3	Replacement Process – Functionally complete sets of connectives and Duality law	5
4.4	Normal Forms – Principal Normal Form	5
5.1	Lattices	5
5.2	Some Properties of Lattices	4
5.3	New Lattices	4
5.4	Modular and Distributive Lattices	7
Total		**90**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19C64	**Resource Management Techniques**	**Core**	**4**	**1**	**-**	**4**

L - Lecture T - Tutorial P–Practicals

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

Preamble

The course deals with the sequencing problems, queueing theory, networks scheduling by PERT/CPM, game theory and Inventory Control Problems.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Choose the mathematical tools that are needed to solve sequencing problems.	K1, K3
CO2	Apply and extend queueing models to analyze real world models.	K2, K3
CO3	Apply PERT and CPM techniques to plan, schedule and control project activities.	K3
CO4	Recall mathematical skills to analyze and solve problems in game	K1, K3
CO5	Predict the demand and supply in transaction of goods.	K3

Mapping of COs with PSOs

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

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge(K1)	**21**	**21**	**40%**
Understand(K2)	**21**	**21**	**40%**
Apply(K3)	**10**	**10**	**20%**
Total Marks	**52**	**52**	**140**

Contents

Unit I **(15 Hours)**

Sequencing Problem: Introduction - Problem of sequencing - Basic terms used in sequencing - Processing n jobs through two machines - Processing n jobs through k machines - Processing 2 jobs through k machines.

Unit II **(15 Hours)**

Queueing Theory: Introduction – Queueing system – Elements of a queueing system Operating characteristics of a queueing system – Probability distributions in queueing system Classification of queueing models – Definition of transient and steady states – Poisson queueing systems (Models I to V)

Unit III **(15 Hours)**

Network scheduling by PERT/CPM: Introduction **–** Network**:** Basic components – Rules of network construction – Critical path analysis – Probability consideration in PERT – Distinction between PERT and CPM.

Unit IV **(15 Hours)**

Games and Strategies :Introduction –Two - person zero **–** sum games – Some basic terms - The maximin – minimax principle - Games without saddle points-Mixed strategies - Graphic solution of 2 x n and m x 2 games - Dominance property.

Unit V **(15 Hours)**

Inventory Control -I : Introduction **–** Types of inventories - Reasons for carrying inventories - The inventory decisions - Objectives of scientific inventory control - Costs associated with inventories - Factors affecting inventory control - An inventory control problem - The concept of EOQ - Deterministic inventory problems with no shortages-Deterministic inventory problems with shortages – Problem of EOQ with price breaks.

Text Book:

Kanti Swarup, Gupta. P.K. and Man Mohan, 2014, Operations Research, Sultan Chand & Sons, New Delhi.

Unit	Chapter/Sections
I	12(12:1 – 12:6)
II	21(21:1 – 21:4, 21:6–21:9)
III	25(25:1,25:2, 25:4, 25:6, 25:7, 25:8)
IV	17(17:1 – 17:7)
V	19(19:1 – 19:12)

References:

1. Kalavathy. S., 2013, Operations Research, 4th Edition, Vikas Publishing House Pvt. Ltd., New Delhi.
2. Hamdy A. Taha, 2012, Operations Research – An Introduction, 9th Edition, Pearson Education. New Delhi.
3. Sharma. S.D.,2002, Operations Research, 13th Edition, Kedar Nath Ramnath & Co., Meerat.

Course Designers:

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

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Sequencing Problem: Introduction - Problem of sequencing - Basic terms used in sequencing	5
1.2	Processing n jobs through two machines	5
1.3	Processing n jobs through k machines	3
1.4	Processing 2 jobs through k machines	2
2.1	Queueing Theory: Introduction – Queueing system – Elements of a queueing system - Operating characteristics of a queueing system	5
2.2	Probability distributions in queueing system - Classification of queueing models – Definition of transient and steady states	5
2.3	Poisson queueing systems (Models I to V)	5
3.1	Network scheduling by PERT/CPM: Introduction – Network**:** Basic components – Rules of network construction	8
3.2	Critical path analysis – Probability consideration in PERT- Distinction between PERT and CPM.	7
4.1	Games and Strategies :Introduction –Two - person zero – sum games	5
4.2	Some basic terms - The maximin - minimaxprinciple	3
4.3	Games without saddle points-Mixed strategies - Graphic solution of 2 x n and m x 2 games	5
4.4	Dominance property	2
5.1	Inventory Control -I : Introduction – Types of inventories - Reasons for carrying inventories - The inventory decisions - Objectives of scientific inventory control - Costs associated with inventories	5
5.2	Factors affecting inventory control - An inventory control problem - The concept of EOQ	5
5.3	Deterministic inventory problems with no shortages-Deterministic inventory problems with shortages – Problem of EOQ with price breaks	5
Total		**75**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19SE(A)	**Theory of Numbers**	**SEC**	**2**	**-**	**-**	**2**

L - Lecture T - Tutorial P–Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
Second/Third	Fourth/Sixth	15	35	50

Preamble

The course deals with equivalence relations, divisibility in Z, congruences and Euler functions.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Find properties of natural numbers	K1
CO2	Prove results involving divisibility and greatest common divisors	K3
CO3	Demonstrate the knowledge of divisibility and congruences	K2
CO4	Solve systems of linear congruences	K3

Mapping of COs with PSOs

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

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge(K1)	**21**	**21**	**40%**
Understand(K2)	**21**	**21**	**40%**
Apply(K3)	**10**	**10**	**20%**
Total Marks	**52**	**52**	**140**

Contents

Unit I **(15 Hours)**

Natural Numbers and the Principle of Induction – Equivalence relations – Divisibility in Z.

Unit II **(15 Hours)**

Congruences – Linear Congruence – Simultaneous congruences – Euler‘s function.

Text Book:

Arumugam, S. and Thangapandi Issac. A. 2011. Algebra: Theory of Equations Theory of Numbers and Trigonometry, New Gamma Publishing House, Palayamkotai.

Unit	Chapter/section
I	1 and 2
II	3(3.1 – 3.4)

References:

1. George E. Andrew. 1992. Number Theory, Hindusthan Publishing Corporation, New Delhi.
2.Manicavachagom Pillay, T.K, Natarajan, T and Ganapathy, K.S. 2015. Algebra Volume II, S. Viswanathan(Printers and Publishers) PVT. Ltd., Chennai.
3.Martin Erickson and Anthony Vazzana. 2009. Introduction to Analytic Number Theory, Chapman and Hall /CRC publications, Florida.

Course Designers:

1. Dr. G. Prabakaran
2. Mrs. R. Latha

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Natural Numbers and the Principle of Induction	5
1.2	Equivalence relations	5
1.3	Divisibility in Z	5
2.1	Congruences	3
2.2	Linear Congruence	3
2.3	Simultaneous congruences	4
2.4	Euler’s function	5
Total		30

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19SE(B)	**Statistical Test of Significance**	**SEC**	**2**	**-**	**-**	**2**

L - Lecture T - Tutorial P – Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
Second/Third	Fourth/Sixth	15	35	50

Preamble

The course is to prepare students to make statistical analysis on a data.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Relate Type 1 error and statistical significance	K1
CO2	Interpret statistical and practical significance	K2, K3
CO3	Explain the meaning of significance level in context	K2
CO4	Create an ANOVA summary table for one way and two way classifications	K3

Mapping of COs with PSOs

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

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge(K1)	**21**	**21**	**40%**
Understand(K2)	**21**	**21**	**40%**
Apply(K3)	**10**	**10**	**20%**
Total Marks	**52**	**52**	**140**

Contents

Unit I **(21 Hours)**

Exact Sampling Distribution (Chi-Square Distribution):Chi-square Variate Applications of Chi-square Distribution – Chi-square Test as a Test for Population Variance – Chi-square Test of Goodness of Fit – Student‘s 't' (Definition) – Fisher‘s 't' (Definition) – Applications of t-distribution – Test for Single Mean – t-Test for Difference of Means – tTest for Testing Significance of an Observed Sample Correlation Coefficient – F-statistic (Definition) –Applications of F-distribution – F-test for Equality of Population Variance.

Unit II **(09 Hours)**

Analysis of Variance: Introduction – One-way Classification – Mathematical Analysis of the Model – Two-way Classification.

Text Book:

Gupta.S.C. and Kapoor.V.K., 2015, Elements of Mathematical Statistics, Third Edition, Sultan Chand & Sons, Educational Publishers, New Delhi.

Unit	Chapter/Section
I	13(13.1,13.5-13.5.2), 14(14.2,14.2.2,14.2.5-14.3.2)
II	17(17.1-17.3)

References:

1. Vittal. P.R., 2013,Mathematical Statistics, Margham Publications, Chennai.
2. Arumugam. S.and Thangapandi Isaac. A., Statistics, 2011, New Gamma Publishing House, Palayamkkottai.
3. Gupta. S.C. and Kapoor. V.K., 2007, Fundamentals of Mathematical Statistics, Eleventh edition, Sultan Chand & sons, New Delhi.

Course Designers:

1. Mrs. R. Latha
2. Dr. M. Senthilkumaran

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Chi-square test of significance	3
1.2	Test for Population Variance	3
1.3	t-Test for Difference of Means	3
1.4	Fisher's t-test	3
1.5	F distribution	3
1.6	F distribution	3
1.7	Applications of F-distribution	3
2.1	Introduction to ANOVA table	3
2.2	One-way Classification	3
2.3	Two-way Classification	3
Total		**30**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19SE(C)	**Web Designing with HTML**	**SEC**	**-**	**-**	**2**	**2**

L - Lecture T - Tutorial P–Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
Second/Third	Fourth/Sixth	15	35	50

Preamble

Web Designing with HTML focuses on the basics of HTML programming concepts and Web page design techniques.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Recollect some basics of internet applications	K1
CO2	Demonstrate basics of HTML tags and its functions	K2
CO3	Explain the concepts of tables , lists and frames in HTML	K2
CO4	Design web sites using appropriate security principles	K3

Mapping of COs with PSOs

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

Contents

1. Creating Web Page Headings
2. Creating Web Page's body
3. Setting Web Page color
4. Creating Bold text, Italic text , Big text and Small text
5. Creating Subscripts and Superscripts
6. Making text blink
7. Displaying an address
8. Creating Horizontal Rules
9. Creating Columns
10. Controlling Horizontal and Vertical spacing
11. Creating a personal profile web page with a suitable background design, background color and a text color.
12. Creating a HTML document with menu using ordered and unordered list.
13. Creating tables in HTML with various options.
14. Designing a web page using Frames.
15. Developing a complete web page using Frames and Framesets which gives the information about an organization or an institution.

Text Book:

"World Wide Web Design with HTML", C.Xavier , Tata MCGraw Hill Education Private Limited New Delhi, 2010.

References:

1. HTML Black Book, Steven Holzner, dreamtech, 2006.
2. HTML Professional projects, John W. Gosney, Thomson Course technology , Eswar Press, Chennai, 2004.

Web Resources:

1. www.tutorialspoint.com
2. www.w3schools.com
3. www.echoecho.com
4. www.learn-html.org

Course Designers:

1. Dr. B. Arivazhagan
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 B.Sc. Mathematics on or after June 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19SE(D)	**Theory of Lattices**	**SEC**	**2**	**-**	**-**	**2**

L - Lecture T - Tutorial P–Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
Second/Third	Fourth/Sixth	15	35	50

Preamble

The course provides the standard properties of lattices, modular, distributive lattices and Boolean polynomials.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Demonstrate the concept of Lattices through algebraic operations.	K2
CO2	Analyze the different types of lattices.	K3
CO3	Recall the fundamental notions from lattice theory and properties of lattices	K1
CO4	Analyze the concepts of Boolean polynomials and Karnaugh map.	K3

Mapping of COs with PSOs

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

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge(K1)	**21**	**21**	**40%**
Understand(K2)	**21**	**21**	**40%**
Apply(K3)	**10**	**10**	**20%**
Total Marks	**52**	**52**	**140**

Contents

Unit I **(15 Hours)**

Lattices – Some Properties of Lattices – New Lattices – Modular and Distributive Lattices.

Unit II **(15 Hours)**

Boolean Algebras – Boolean Polynomials – Karnaugh Map.

Text Book:

Venkataraman. M.K., Sridharan. N. and Chandrasekaran. N, 2012, Discrete Mathematics, The National Publishing Company. Chennai.

Unit	Chapter/Section
I	X(1 – 4)
II	X(5 – 7)

References:

1. Trembley. J.P. and Manohar. R., 2001, Discrete Mathematical Structures with Applications to Compute Science, Tata McGraw –Hill Publishing Company Ltd., New Delhi.
2. Chandrasekhara Rao. K., 2012, Discrete Mathematic, Narosa Publishing company, New Delhi.
3. Kenneth H. Rosen, 1999, Discrete Mathematics and its Applications, Tata McGraw –Hill,1999, Chennai.

Course Designers:

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

Lecture Schedule

Unit	Topics	Lecture Hrs
1.1	Lattices	2
1.2	Hasse Diagrams	2
1.3	Least upper bound and Greatest lower	1
1.4	Some properties of lattices	4
1.5	New lattice and lattice homomorphism	1
1.6	Modular and Distributive Lattices	3
1.7	Problems	2
2.1	Boolean Algebras	4
2.2	Boolean Polynomials	5
2.3	Karnaugh map	6
Total		**30**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19SE(E)	**Numerical Methods – Lab**	**SEC**	**-**	**-**	**2**	**2**

L - Lecture T - Tutorial P–Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
Second/Third	Fourth/Sixth	15	35	50

Preamble

The course is designed to develop C programmes for finding numerical solutions of algebraic and differential equations.

Course Outcomes

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

#	Course Outcome	Knowledge Level
CO1	Select appropriate method for finding numerical solutions of algebraic and transcendental equations using C programming	K1, K3
CO2	Develop the programme for various methods such as Bisection, Newton Raphson and Gauss Elimination	K3.
CO3	Design programme for Evaluating definite integrals	K3
CO4	Illustrate conditional and looping statements in solving numerical problems.	K2

Mapping of COs with PSOs

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

Contents

List of Practicals

1. Finding a root of the given equation using bisection method.
2. Finding a root of a given equation using Newton Raphson method.
3. Solving the given system of equation by Gauss elimination method.
4. Finding f(x) at given x using Newton‘s interpolation formula.
5. Finding f(x) at given x using Lagrange‘s interpolation formula.
6. Evaluating dy/dx, at a given x using Newton‘s differentiation formula.
7. Evaluating $\int$ f(x) dx using Trapezoidal rule.
8. Evaluating $\int$ f(x) dx using Simpson‘s 1/3 rule.
9. Solving the given differential equation by Euler‘s method.
10. Solving the given differential equation by Runge-Kutta method (4th Order only).

References:

1. Arumugam. S., Thangapandi Isaac. A. and Somasundaram. A., 2015, Numerical Methods, Second Edition, SciTech Publications (India) Pvt. Ltd., Chennai.
2. Venkataraman.M.K., 2009, Numerical Methods in Science and Engineering, 5th Edition, The National Publishing company, Chennai.
3. Kandasamy.P., Thilagavathy. K. and Gunavathy.K., 2006. Numerical Methods, 3rd Edition,S. Chand & Company Pvt. Ltd., New Delhi.

Course Designers:

1. Mrs. K. Ponmari
2. Mrs. S. Shanavas Parvin

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19NE31	**Mathematical Aptitude for Competitive Examinations**	**NME**	**2**	**-**	**-**	**2**

L - Lecture T - Tutorial P–Practicals

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

Preamble

The course provides various mathematical aptitude techniques of solving problems in Percentages, Profit and Loss, Simple and compound interest etc.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Formulate the problem quantitatively and recall appropriate arithmetical methods to solve the problem.	K1, K3
CO2	Demonstrate various principles involved in solving mathematical problems.	K2
CO3	Evaluate various real life situations by resorting to analysis of key issues and factors	K3
CO4	Develop various mathematical skills to solve the problems	K3

Mapping of COs with PSOs

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

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge(K1)	**40%**	**40%**	**40%**
Understand(K2)	**40%**	**40%**	**40%**
Apply(K3)	**20%**	**20%**	**20%**
Total Marks	**30**	**30**	**65**

Contents

Unit I **(15 Hours)**

H. C. F and L. C. M of Numbers – Decimal Fractions – Average – Percentage – Profit and Loss – Ratio and Proportion.

Unit II **(15 Hours)**

Time and Distance – Simple interest – Compound interest – True discount – Banker‘s discount.

Text Book:

Agarwal. R.S., 2013, Quantitative Aptitude, S. Chand and Co., Delhi.

Unit	Chapter/section
I	2, 3, 6, 10, 11, 12
II	17, 21, 22, 32, 33

References:

1. Arora. P.N. and Arora. S.,2009, Quantitative Aptitude Mathematics, Volume- 1 S Chand & Company Ltd., New Delhi.
2. Kothari. C.R., 1989, Quantitative Techniques,Vikas Publishing House Pvt. Ltd., New Delhi.
3. Srinivasan. T.M., Perumalswamy. S. and Gopala Krishnan. M.D., 1985, Elements of Quantitative Techniques, Emerald Publishers, Chennai.

Course Designers:

1. Dr. G. Prabakaran
2. Mrs. S. Shanavas Parvin

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	H. C. F and L. C. M of Number	4
1.2	Decimal Fractions	2
1.3	Average	2
1.4	Percentage	2
1.5	Profit and Loss	3
1.6	Ratio and Proportion	2
2.1	Time and Distance	3
2.2	Simple interest	3
2.3	Compound interest	3
2.4	True discount	3
2.5	Banker’s discount	3
Total		**30**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19NE51	**Mathematical Logic**	NME	**2**	**-**	**-**	**2**

L - Lecture T - Tutorial P–Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
Third	Fifth	15	35	50

Preamble

The course focus on different types of statements(T/F, atomic and compound), tautology and theory of inference.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Define proposition and argument	K1
CO2	Explain propositional connectives.	K2
CO3	Analyze natural language arguments by means of symbolic propositional logic	K3
CO4	Explain the concepts of theory of inference.	K2, K3

Mapping of COs with PSOs

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

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge(K1)	**40%**	**40%**	**40%**
Understand(K2)	**40%**	**40%**	**40%**
Apply(K3)	**20%**	**20%**	**20%**
Total Marks	**30**	**30**	**65**

Contents:

Unit I **(15 Hours)**

Introduction – TF Statements – Connectives – Atomic and Compound Statements – Well Formed (Statement) Formulae – Truth table of a formula.

Unit II **(15 Hours)**

Tautology – Tautological implications and equivalence of formulae – Theory of Inference.

Text Book:

Venkatraman. M.K., Sridharan. N. and Chandrasekaran. N., 2012, Discrete Mathematics, The National Publishing Company, Chennai.

Unit	Chapter/Section
I	IX(1-6)
II	IX (7,8 and 13)

References:

1. Veerarajan. T.,2007,Discrete Mathematics with Graph Theory and Combinatorics, Tata McGraw- Hill Publishing Company Limited, New Delhi.
2. Semyour Lipschutz and Marc Lars Lipson, 2006, Discrete Mathematics, Second Edition, Tata McGraw- Hill Publishing Company Limited, New Delhi.
3. Trembley. J.P. and Manohar. R.,2001, Discrete Mathematical Structures with Applications to Computer Science,Tata McGraw – Hill Publishing Company Limited, New Delhi.

Course Designers:

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

Lecture Schedule

Unit	Topics	Lecture Hrs
1.1	Introduction	2
1.2	TF statements	3
1.3	Connectives , Atomic and compound	2
1.4	Well formed formulae	2
1.5	Truth table of formulae	1
1.6	Problems	2
1.7	More problems	3
2.1	Tautology	2
2.2	Tautological implications	2
2.3	Theory of inference	6
2.4	Problems	4
2.5	Revision	1
Total		**30**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19CE51(A)	**Mechanics**	**Core Elective**	**5**	**-**	**-**	**5**

L - Lecture T - Tutorial P – Practicals

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

Preamble

The course provides advanced knowledge in laws of mechanics and dynamic system.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Recall the conditions of equilibrium of forces acting on a body	K1
CO2	Demonstrate laws of friction and solve related problems	K2,K3
CO3	Determine the motion on the surface of smooth inclined plane	K3
CO4	Solve the problems on collision of elastic bodies	K3
CO5	Discuss geometrical representation of simple harmonic motion	K3

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**				
CO2			**S**		
CO3		**S**			
CO4				**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%**
Total Marks	**52**	**52**	**140**

Contents

Unit I **(15 Hours)**

Definition – Resultant and components - Parallelogram of forces – Resultant of two forces – Triangle of forces – Perpendicular triangle of forces – Converse of triangle of forces - Polygon of forces – Lami‘s theorem – Extended form of the parallelogram law of forces – Components of a force along two given directions –Resultant of any number of forces – Resultant of any number of coplanar forces - Condition of equilibrium of any number of forces acting upon a particle.

Unit II **(15 Hours)**

Friction :Introduction – Experimental results – Statistical , dynamical and limiting friction – Laws of friction – Friction-a passive force – Coefficient of friction – Angle of friction – Cone of friction – Numerical values – Equilibrium of a particle on a rough inclined plane under a force parallel to the plane – Equilibrium of a body on a rough inclined plane under any force- Problems on friction(simple problems only).

Unit III **(15 Hours)**

Projectiles : Definitions – Two fundamental principles - Path of a projectile is a parabola – Characteristic of the motion of a projectile – Maximum horizontal range –Two possible directions to obtain a given range– Velocity at the end of time ‗t‘ – Two possible directions to reach a given point Range on the inclined plane – Motion on the surface of smooth inclined plane.

Unit IV **(15 Hours)**

Collision of elastic bodies : Introduction - Definition – Fundamental laws of impact – Impact of a smooth sphere on a fixed smooth plane – Direct impact of two smooth spheres - Loss of kinetic energy due to direct impact of two smooth spheres – Loss of kinetic energy due to oblique impact of two smooth spheres.

Unit V **(15 Hours)**

Simple harmonic motion : Introduction – Simple harmonic motion in a straight line – General solution of simple harmonic motion equation – Geometrical representation of SHM – Change of origin – Composition of two simple harmonic motion of same period in the same straight line – Composition of two simple harmonic motion of same period in the two perpendicular directions – Simple pendulum – Period of oscillation of a Simple pendulum – Equivalent Simple pendulum – The seconds Simple pendulum.

Text Books:

1. Venkataraman. M.K., 2012, Statics, Agasthiar publications, Chennai.
2. Venkataraman. M.K., 2012, Dynamics, Agasthiar publications, Chennai.

Unit	Book	Chapter/Section
I	1	2(1 – 16)
II	1	7(1 – 13)
III	2	6(6.1 – 6.16)
IV	2	8(8.1 – 8.8)
V	2	10(10.1 – 10.7, 10.12 – 10.15)

Reference Books:

1. Khanna. M.L., 2008, Dynamics, Pragati Pragasam Ltd., U.P.
2. Khanna. M.L., 2008, Statics, Pragati Pragasam Ltd., U.P.
3. Duraipandian. P., Laxmi Duraipandian and Muthamizh Jeyapragasam, 2012, Mechanics, S. Chand and Company Ltd., Chennai.
4. Manichavasagham pillay. T.K., 2009, Statics, National Publishing & Co., Chennai.

Course Designers:

1. Mr. M. Madhavan
2. Dr. G. Prabakaran

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Resultant and components, Parallelogram of forces, Resultant of two forces	2
1.2	Triangle law of forces, Perpendicular triangle of forces,	2
1.3	Converse of triangle of forces	2
1.4	Polygon of forces, Lami's theorem	2
1.5	Extended form of the parallelogram law of forces	2
1.6	Components of a force along two given directions, Resultant of any number of forces	3
1.7	Condition of equilibrium of any number of forces	2
2.1	Experimental results, Statistical , dynamical and limiting friction, Laws of friction, Friction-a passive force,	4
2.2	Coefficient of friction, Angle of friction	2
2.3	Cone of friction, Numerical values,	2
2.4	Equilibrium of a particle on a rough inclined plane under a force parallel to the plane	3
2.5	Equilibrium of a body on a rough inclined plane under any force	2
2.6	Simple Problems on friction.	2
3.1	Two fundamental principles, Path of a projectile	3
3.2	Characteristic of the motion	2
3.3	Two possible direction's	3

3.4	Velocity at the end of time ‘t’	2
3.5	Range on the inclined plane	2
3.6	Motion on the surface of smooth inclined plane.	3
4.1	Definition – Fundamental laws of impact	3
4.2	Impact of a smooth sphere	3
4.3	Direct impact of two smooth spheres	3
4.4	oblique impact of two smooth spheres.	3
4.5	Loss of kinetic energy	3
5.1	Simple harmonic motion in a straight line	2
5.2	General solution of simple harmonic motion equation	2
5.3	Geometrical representation of SHM, Change of origin	3
5.4	Composition of two simple harmonic motion of same period	2
5.5	Simple pendulum , Period of oscillation	2
5.6	The seconds Simple pendulum.	2
5.7	Loss or gain in the number of oscillation	2
Total		**75**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19CE51(B)	**Combinatorics**	**Core Elective**	**5**	**-**	**-**	**5**

L - Lecture T - Tutorial P–Practicals

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

Preamble

Combinatorics has important applications in virtually all areas of mathematics as well as natural sciences and the course provides advanced knowledge of concepts and theorems in combinatorial ideas.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Relate and apply sum and product rules.	K1, K3
CO2	Analyze and solve problems related to Permutation and Combination.	K3
CO3	Make use of Inclusion-Exclusion Principle to solve problems on generalized permutation and combination	K3
CO4	Demonstrate ordinary and exponential generating functions	K2
CO5	Solve Problems using Recurrence Relations.	K3

Mapping of COs with PSOs

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

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge(K1)	40%	40%	40%
Understand(K2)	40%	40%	40%
Apply(K3)	20%	20%	20%
Total Marks	52	52	140

Contents

Unit I **(17 Hours)**

The Sum Rule and the Product Rule – The Pigeonhole Principle - Solved Problems on The Sum Rule and the Product Rule - Solved Problems on The Pigeonhole Principle.

Unit II **(17 Hours)**

Permutations and Combinations -Solved Problems on Permutations and Combinations.

Unit III **(13 Hours)**

Generalized Permutations and Combinations –The Inclusion-Exclusion Principle - Solved Problems on Generalized Permutations and Combinations - Solved Problems on The Inclusion-Exclusion Principle - Solved Problems on Generalized Inclusion-Exclusion Principle.

Unit IV **(15 Hours)**

Ordinary and Exponential Generating Functions - Solved Problems on Ordinary Generating Functions -Solved Problems on Exponential Generating Functions.

Unit V **(13 Hours)**

Recurrence Relations- Solved Problems on Recurrence Relations and Associated Generating Functions.

Text Book:

Balakrishnan. V.K., 1995, Theory and Problems of Combinatorics, Schaum‘s Outline Series, McGraw-Hill, Inc., Singapore.

Unit	Chapter/Sections
I	Chapter 1 (1.1,1.3)
II	Chapter 1(1.2)
III	Chapter 2 (2.1, 2.3)
IV	Chapter 3 (3.1)
V	Chapter 3 (3.3)

References:

1. Alan Tucker, 2012, Applied Combinatorics, 6th Edition, Wiley, New Jersey
2. Ralph P. Grimaldi, and Ramana. B.V., 2004, Discrete and Combinatorial Mathematics, Pearson Education, Inc., Copyright 2007, Dorling Kindersley (India) Pvt. Ltd.
3. Krishnamurthy. V., 1985, Combinatorics Theory and Applications, East- West Press Pvt. Ltd., India.

Course Designers:

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

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	The Sum Rule and the Product Rule	1
1.2	Solved Problems on The Sum Rule and the Product Rule	8
1.3	The Pigeonhole Principle	2
1.4	Solved Problems on The Pigeonhole Principle	6
2.1	Permutations and Combinations	2
2.2	Solved Problems on Permutations and Combinations	15
3.1	Generalized Permutations and Combinations	2
3.2	Solved Problems on Generalized Permutations and Combinations	3
3.3	The Inclusion-Exclusion Principle	1
3.4	Solved Problems on The Inclusion-Exclusion Principle	2
3.5	Solved Problems on Generalized Inclusion-Exclusion Principle	5
4.1	Ordinary and Exponential Generating Functions	3
4.2	Solved Problems on Ordinary Generating Functions Euler's formula	12
5.1	Recurrence Relations	1
5.2	Solved Problems on Recurrence Relations and Associated Generating Functions	12
Total		**75**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19CE51(C)	**Cryptography**	**Core Elective**	**5**	**-**	**-**	**5**

L - Lecture T - Tutorial P–Practicals

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

Preamble

The course introduces cryptographic principles and standard cryptographic algorithm such as data encryption standard (DES) and advanced encryption standards (AES).

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Recall the fundamentals of cryptography	K1
CO2	Demonstrate standard cryptographic algorithms used to analyze confidentiality, integrity and authenticity.	K2,K3
CO3	List and Identify the security issues in the network, key distribution and management schemes.	K1, K3
CO4	Design encryption techniques to secure data in transit networks.	K3
CO5	Evaluate security mechanisms in theory of networks	K3

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**				
CO2	**S**		**M**		**L**
CO3					**S**
CO4				**M**	
CO5		**S**		**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%**
Total Marks	**52**	**52**	**140**

Contents

Unit I **(15 Hours)**

Introduction: Security goals – Cryptographic attacks – Services and mechanism – Techniques.

Mathematics of Cryptography: Integer arithmetic – Modular arithmetic – Matrices – Linear congruence.

Unit II **(15 Hours)**

Traditional symmetric – Key ciphers: Introduction – Substitution ciphers- Transposition ciphers – Stream and block ciphers.

Unit III **(15 Hours)**

Mathematics of symmetric – Key cryptography: Algebraic structures - GF(2^n) Fields Introduction to modern symmetric – Key ciphers: Modern block ciphers – Modern stream ciphers.

Unit IV **(15 Hours)**

Data Encryption Standard (DES): Introduction – DES structure – DES analysis – Security of DES – Multiple DES (Conventional Encryption Algorithms) – Examples of block ciphers influenced by DES.

Unit V **(15 Hours)**

Advanced Encryption Standard (AES): Introduction – Transformations – Key expansion – The AES Ciphers – Examples – Analysis of AES.

Text Book:

Behrouz A. Forouzan and Debdeep Mukhopadhyay, 2013, Cryptography and Network Security, 2nd Edition, McGraw Hill Education (India) Private Limited, New Delhi.

Unit	Chapter/Sections
I	1(1.1-1.4), 2(2.1 – 2.4)
II	3(3.1-3.4)
III	4(4.1-4.2), 5(5.1- 5.2)
IV	6 (6.1- 6.6)
V	7 (7.1-7.6)

References:

1. Atul Kahate, 2014, Cryptography and Network Security, Third Edition, McGraw Hill Education(India) Private Limited, New Delhi.
2. Bruce Schneier, 2012, Applied Cryptography:Protocols, Algorithms and Source code in C, 2nd Edition, Wiley India New Delhi.
3. Stallings, 2013, Cryptography and Network Security,: Principles and Practice, Sixth Edition, Pearson Education, New Delhi, India.

Course Designers:

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

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Introduction: Security goals – Cryptographic attacks	5
1.2	Services and mechanism –Techniques.	3
1.3	Mathematics of Cryptography: Integer arithmetic – Modular arithmetic – Matrices –	5
1.4	Linear congruence.	2
2.1	Traditional symmetric – Key ciphers: Introduction – Substitution ciphers-	5
2.2	Transposition ciphers – Stream and block cipher	3
2.3	Traditional symmetric – Key ciphers: Introduction – Substitution ciphers-	5
2.4	Transposition ciphers – Stream and block ciphers.	2
3.1	Mathematics of symmetric – Key cryptography: Algebraic structures - GF(2^n) Fields	8
3.2	Introduction to modern symmetric – Key ciphers: Modern block ciphers – Modern stream ciphers.	7
4.1	Data Encryption Standard (DES): Introduction – DES structure	5
4.2	DES analysis – Security of DES	3
4.3	Multiple DES (Conventional Encryption Algorithms) – Examples of block ciphers influenced by DES.	7
5.1	Advanced Encryption Standard (AES): Introduction – Transformations	4
5.2	Key expansion – The AES Ciphers	7
5.3	Examples – Analysis of AES.	4
Total		**75**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19CE61(A)	**Fuzzy Sets**	**Core Elective**	**5**	**-**	**-**	**5**

L - Lecture T - Tutorial P–Practicals

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

Preamble

The course deals with the fundamentals of fuzzy sets, fuzzy logic, fuzzy measures, fuzzy relations and its applications.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Explain the concept of fuzzy sets and crisp sets in brief	K2, K3
CO2	Define operations and relations in fuzzy sets	K1
CO3	Demonstrate the operations on fuzzy sets	K2
CO4	Analyze the relationship among fuzzy measures	K3
CO5	Apply fuzzy theory in Engineering, Management and Medicine	K3

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1			**S**	**M**	
CO2		**S**	**M**		
CO3	**S**	**M**			
CO4			**S**	**M**	
CO5				**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%**
Total Marks	**52**	**52**	**140**

Contents

Unit I **(15 Hours)**

Crisp Sets and Fuzzy Sets: Introduction – Crisp Sets: An Overview – The Notion of Fuzzy Sets – Basic Concepts of Fuzzy Sets - Classical Logic: An Overview – Fuzzy Logic.

Unit II **(15 Hours)**

Operations on Fuzzy Sets: General Discussion – Fuzzy Complement – Fuzzy Union – Fuzzy Intersection.

Unit III **(15 Hours)**

Fuzzy Relations: Crisp and Fuzzy Relations – Binary Relations – Binary Relations on a Single Set – Equivalence and Similarity Relations – Compatibility or Tolerance Relations – Orderings.

Unit IV **(15 Hours)**

Fuzzy Measures: General Discussion – Belief and Plausibility Measures – Probability Measures – Possibility and Necessity Measures – Relationship among Classes of Fuzzy Measures.

Unit V **(15 Hours)**

Applications: Engineering - Medicine – Management and Decision Making.

Text Book:

George J. Klir and Tina A. Folger, 2012. Fuzzy Sets, Uncertainty and Information, PHI Learning Private Limited, New Delhi – 110001.

Unit	Chapter/section
I	1(1.1 – 1.6)
II	2(2.1 – 2.4)
III	3(3.1 – 3.6)
IV	4(4.1 – 4.5)
V	6(6.3 – 6.5)

References:

1. George J. Klir and Bo Yuan. 2012, Fuzzy Sets and Fuzzy Logic Theory and Applications, Prentice-Hall of India.
2. Ganesh, M. 2015, Introduction to Fuzzy Sets and Fuzzy Logic, Prentice-Hall of India.
3. Zimmermann, H.J. 1996, Fuzzy Set Theory and its Applications, Allied Publishers Ltd., Chennai.

Course Designers:

1. Dr. K. Kayathri
2. Dr. M. Senthilkumaran

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Crisp Sets and Fuzzy Sets: Introduction	1
1.2	Crisp Sets: An Overview	2
1.3	The Notion of Fuzzy Sets	3
1.4	Basic Concepts of Fuzzy Sets	3
1.5	Classical Logic: An Overview	3
1.6	Fuzzy Logic	3
2.1	Operations on Fuzzy Sets: General Discussion	1
2.2	Fuzzy Complements	6
2.3	Fuzzy Union	4
2.4	Fuzzy Intersection	4
3.1	Fuzzy Relations: Crisp and Fuzzy Relations	3
3.2	Binary Relations	3
3.3	Binary Relations on a Single Set	2
3.4	Equivalence and Similarity Relations	2
3.5	Compatibility or Tolerance Relations	2
3.6	Orderings	3
4.1	Fuzzy Measures: General Discussion	2
4.2	Belief and Plausibility Measures	4
4.3	Probability Measures	2
4.4	Possibility and Necessity Measures	5
4.5	Relationship among Classes of Fuzzy Measures	2
5.1	Applications: Engineering	4
5.2	Medicine	6
5.3	Management and Decision Making	5
Total		**75**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19CE61(B)	**Fundamentals of Computer Algorithms**	**Core Elective**	**5**	**-**	**-**	**5**

L - Lecture T - Tutorial P–Practicals

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

Preamble

Computer algorithms deals with designing and analyzing of algorithms and the basic principles of algorithm design techniques like divide and conquer , Greedy strategy, Dynamic programming and backtracking.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Recall some basic programming principles and algorithm design techniques	K1
CO2	Demonstrate the correctness of divide and conquer algorithms and solve some problems	K2,K3
CO3	Classify Greedy strategy algorithms and Solve some problems	K2,K3
CO4	Solve dynamic programming problems	K3

K1 - Knowledge K2 - Understand K3 - Apply

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**				
CO2		**M**	**M**		
CO3				**M**	**S**
CO4				**S**	**M**
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%**
Total Marks	**52**	**52**	**140**

Contents

Unit I **(15 Hours)**

Introduction: What is an algorithm? – Algorithm specification – Performance analysis – Randomized algorithms.

Unit II **(15 Hours)**

Divide – and – Conquer: General method – Binary search – Finding the maximum and minimum – Merge sort – Quicksort – Selection – Strassen's Matrix multiplication.

Unit III **(15 Hours)**

Greedy Method: The General method – Knapsack problem – Tree vertex splitting – Job sequencing with deadlines – Minimum cost spanning trees.

Unit IV **(15 Hours)**

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

Unit V **(15 Hours)**

Backtracking: The General method – The 8 – queens problem – Sum of subsets - Graph coloring.

Text Book:

Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, 2010, Fundamentals of Computer Algorithms , Galgotial Publications Ltd , New Delhi.

Unit	Chapters/ Sections
I	1 (1.1- 1.4)
II	3(3.1-3.7)
III	4(4.1- 4.5)
IV	5(5.1-5.4)
V	7(7.1-7.4)

References:

1. Sara Baase , Allen Van Gelder, 2003, Computer Algorithms Introduction to Design and Analysis, Third Edition , Pearson Education, New Delhi.
2. G. A. Vijayalakshmi Pai, 2008, Data Structures and Algorithms Concepts , Techniques and Applications , Tata McGraw- Hill Publishing Company Limited, New Delhi.
3. R.C.T. Lee, S. S. Tseng, R. C. Chang, Y.T.Tsai,2013, Introduction to Design and Analysis of Algorithms A Strategic Approach, McGraw Hill Education(India)Private Limited, New Delhi.

Course Designers:

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

Lecture Schedule

Unit	Topics	Lecture hrs.
1.1	Algorithm specification	2
1.2	Recursive Algorithms	3
1.3	Performance Analysis	2
1.4	Space complexity and Time complexity	2
1.5	Asymptotic notation	1
1.6	Performance Measurement	2
1.7	Randomized Algorithms	3
2.1	General Method	2
2.2	Binary Search	2
2.3	Merge Sort	2
2.4	Quick Sort	2
2.5	Performance measurement	2
2.6	Strassen's Matrix Multiplication	2
2.7	Class Test	1
2.8	Seminar	2
3.1	General Method	2
3.2	Knapsack problem	2
3.3	Tree vertex splitting	2
3.4	Job sequencing with deadlines	2
3.5	Minimum cost spanning trees	2
3.6	Tutorials	3
3.8	Class test	2
4.1	General Method	1
4.2	Multi stage graphs	3
4.3	String Editing	2
4.4	All pairs shortest paths	3
4.5	Single source shortest paths	2
4.6	Seminar	1

4.7	Class Test	2
4.8	Revision Exercise	1
5.1	The general method	2
5.2	The 8 – Queen problem	2
5.3	Sum of subsets problem	2
5.4	Graph coloring	3
5.5	Class test	2
5.6	Preparatory Test	2
5.7	Seminar & Review	2
Total		**75**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19CE61(C)	**Numerical Methods**	**Core**	**5**	**-**	**-**	**5**

L - Lecture T - Tutorial P–Practicals

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

Preamble

The course introduces fundamental concepts of Numerical methods for handling of mathematical problems frequently encountered in engineering computations. Numerical solutions of Algebraic, transcendental equations and system of simultaneous linear equations have been determined.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Develop the skills in solving algebraic, transcendental, differential and integral equations numerically	K3
CO2	Discuss and demonstrate the concept of interpolation	K2, K3
CO3	Extend the standard numerical techniques as a powerful tool in scientific. computing.	K2
CO4	Interpret, analyze and evaluate results from numerical computations	K3
CO5	Choose, formulate and implement appropriate numerical methods for solving science and engineering problems	K1,K3

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1		**S**	**M**		
CO2		**S**			
CO3				**M**	
CO4					**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%
Total Marks	52	52	140

Contents

Unit I **(15 Hours)**

Solution of Algebraic and Transcendental Equations: Introduction – Bisection method – Method of false position– Iteration method – Newton-Raphson Method – Some deductions from Newton-Raphson formula.

Unit II **(15 Hours)**

Solution of Simultaneous Algebraic Equations: Solution of linear simultaneous equations – Direct methods of solution: Gauss elimination method –Gauss-Jordan method – Iterative Methods of solution: Jacobi‘s iteration method – Gauss - Seidal iteration method.

Unit III **(15 Hours)**

Interpolation: Introduction – Newton‘s forward interpolation formula – Newton‘s backward interpolation formula – Interpolation with unequal intervals –Lagrange‘s interpolation formula – Divided differences – Newton‘s divided difference formula.

Unit IV **(15 Hours)**

Numerical Differentiation and Integration: Numerical differentiation – Formulae for derivatives: Derivatives using Newton‘s forward difference formula – Derivatives using Newton‘s backward difference formula – Maxima and minima of a tabulated function – Numerical integration – Newton-Cotes quadrature formula: Trapezoidal rule – Simpson‘s 1/3 rule – Simpson‘s 3/8 rule.

Unit V **(15 Hours)**

Numerical Solution of ordinary differential equations: Introduction – Taylor‘s series method – Euler‘s method – Modified Euler‘s method – Runge-Kutta method – Predictor Corrector methods – Milne‘s method.

Text Book:

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

Unit	Chapter/section
I	2(2.1, 2.8, 2.9, 2.11-2.13)
II	3(3.3, 3.4(3, 4), 3.5(1, 2))
III	7(7.1-7.3, 7.11 – 7.14)
IV	8(8.1, 8.2(1, 2), 8.3, 8.4, 8.5(I, II,III))
V	10(10.1, 10.3 – 10.5,10.7-10.9)

References:

1. Arumugam. S., Thangapandi Isaac. A. and Somasundaram. A., 2015, Numerical Methods, Second Edition, SciTech Publications (India) Pvt. Ltd., Chennai.
2. Venkataraman.M.K.,2009, Numerical Methods in Science and Engineering, 5th Edition, The National Publishing company, Chennai.

3. Kandasamy.P., Thilagavathy. K. and Gunavathy.K., 2006. Numerical Methods, 3rd Edition,S. Chand & Company Pvt. Ltd., New Delhi.

Course Designers:

1. Mrs. K. Ponmari
2. Mrs. S. Shanavas Parvin

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Introduction	1
1.2	Bisection method	3
1.3	Method of false position	3
1.4	Iteration method	3
1.5	Newton - Raphson Method	3
1.6	Some deductions from Newton-Raphson formula	2
2.1	Solution of simultaneous algebraic equations	3
2.2	Gauss elimination method	3
2.3	Gauss - Jordan elimination method	3
2.4	Jacobi's iteration method	3
2.5	Gauss-Seidal iteration method	3
3.1	Interpolation: Introduction	1
3.2	Newton's forward interpolation formula	3
3.3	Newton's backward interpolation formula	3
3.4	Interpolation with unequal intervals and Lagrange's interpolation formula	3
3.5	Divided differences	2
3.6	Newton's divided difference formula	3
4.1	Numerical differentiation	3
4.2	Derivatives using Newton's forward difference formula	3
4.3	Derivatives using Newton's backward difference formula	3
4.4	Maxima and minima of a tabulated function	3
4.5	Numerical integration and Newton-Cotes quadrature formula	3
5.1	Numerical Solution of Ordinary Differential Equations: Introduction	1
5.2	Taylor's series method	3
5.3	Euler's method	3
5.4	Modified Euler's method	2
5.5	Runge-Kutta method	3
5.6	Predictor Corrector method and Milne's method	3
Total		**75**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19GE11P	**Allied Mathematics - I for Physics**	**Generic Elective**	**5**	**-**	**-**	**5**

L - Lecture T - Tutorial P–Practicals

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

Preamble

The course deals with mathematical methods used in various disciplines

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Find the nature of the roots of an equation	K1
CO2	Solve higher degree equations using various methods	K3
CO3	Define and Explain the concept of curvature and evolute	K1,K2,K3
CO4	List the difference operators and apply interpolation to real life problems	K1,K3
CO5	Demonstrate understanding of series notation and estimate sums of infinite arithmetic or geometric series.	K2,K3

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1			**S**		
CO2				**S**	
CO3		**S**			
CO4	**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%**
Total Marks	**52**	**52**	**140**

Contents

Unit I **(15 Hours)**

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

Unit II **(15 Hours)**

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

Unit III **(15 Hours)**

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

Unit IV **(15 Hours)**

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

Unit V **(15 Hours)**

Algebra: Exponential series – The Logarithmic series.

Text Book:

S. Narayanan, R. HanumanthaRao, T. K. ManicavachagomPillay and Dr. P. Kandaswamy, 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. S. Arumugam and A. Thangapandi Isaac, July 2011. Algebra: Theory of Equations, Theory of Numbers and Trigonometry, New Gamma Publishing House, Palayamkottai.

2.T. K. ManicavachagomPillay, T. Natarajan and K. S. Ganapathy, 2010, Algebra, Volume – I, S. Viswanathan (Printers & Publishers) Pvt. Ltd., Chennai.

3.P. Balasubrahmanyam and K. G. Subramanian**,** 1996, Ancillary Mathematics, Volume – I, Tata McGraw-Hill Publishing Company Limited, New Delhi.

Course Designers:

1. Dr. R. Angeline Chella Rajathi
2. Mrs. K. Ponmari

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Nature of the roots	5
1.2	Relation between the coefficients and the roots of an	5
1.3	Transformations of equations.	5
2.1	Reciprocal equations	4
2.2	Transforms in general	3
2.3	Horner's method	4
2.4	Newton's method	4
3.1	Circle, radius and centre of curvature	5
3.2	Evolute and Involute	5
3.3	p-r equation of a curve	5
4.1	Interpolation	5
4.2	Binomial method	5
4.3	Lagrange's interpolation formula	5
5.1	Exponential series	7
5.2	The Logarithmic series	8
Total		**75**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19GE21P	**Allied Mathematics - II for Physics**	**Generic Elective**	**5**	**-**	**-**	**5**

L - Lecture T - Tutorial P–Practicals

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

Preamble

The course deals with the method of solving various ordinary and partial differential equations.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Classify the integrals and apply the appropriate techniques on integration	K2, K3
CO2	Solve ordinary differential equations using various methods	K3
CO3	Formulate partial differential equations and solve it	K3
CO4	Find Laplace transform and solve linear differential equations using Laplace Transforms	K1, K3
CO5	Build a 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**			

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge(K1)	**40%**	**40%**	**40%**
Understand(K2)	**40%**	**40%**	**40%**
Apply(K3)	**20%**	**20%**	**20%**
Total Marks	**52**	**52**	**140**

Contents

Unit I **(15 Hours)**

Integration : Reduction formulae - Bernoulli's formula.

Unit II **(15 Hours)**

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

Unit III **(15 Hours)**

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

Unit IV **(15 Hours)**

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

Unit V **(15 Hours)**

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

Text Book:

S. Narayanan, R. HanumanthaRao, T. K. ManicavachagomPillay and Dr. P. Kandaswamy, Reprint June 2009, 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. S. Arumugam and A. Thangapandi Isaac, July 2011. Differential Equations, New Gamma Publishing House, Palayamkottai.
2. T. K. ManicavachagomPillay, T. Natarajan and K. S. Ganapathy, 2010, Calculus, Volume – II, S. Viswanathan (Printers & Publishers) Pvt. Ltd., Chennai.
3. P. Balasubrahmanyam and K. G. Subramanian**,** 1996, Ancillary Mathematics, Volume – II, Tata McGraw-Hill Publishing Company Limited, New Delhi.

Course Designers:

1. Dr. R. Angeline Chella Rajathi
2. Mrs. K. Ponmari

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Reduction formulae	8
1.2	Bernoulli's formula	7
2.1	Exact differential equations	8
2.2	Practical rule for solving an exact differential equation	7
3.1	Derivation of partial differential equations	3
3.2	Different integrals of partial differential equations	3
3.3	Standard type of first order equations	3
3.4	Lagrange's equation	3
3.5	Charpit's method	3
4.1	Definition & Problems	5
4.2	Inverse Laplace transform	5
4.3	Solving an ordinary differential equations	5
5.1	Fourier Series – Introduction	1
5.2	Even and odd functions	3
5.3	Half range Fourier series	4
5.4	Development in Cosine series	3
5.5	Development in sine series	4
Total		**75**

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. Chemistry on or after June 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19GE31C	**Allied Mathematics - I for Chemistry**	**Generic Elective**	**5**	**-**	**-**	**5**

L - Lecture T - Tutorial P–Practicals

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

Preamble

The course deals with mathematical methods used in various disciplines

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Find the nature of the roots of an equation	K1
CO2	Solve higher degree equations using various methods	K3
CO3	Define and Explain the concept of curvature and evolute	K1,K2,K3
CO4	List the difference operators and apply interpolation to real life problems	K1,K3
CO5	Find the eigen values and eigenvectors of a square matrix and extend the idea to diagonalisation	K1,K2

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1			**S**		
CO2				**S**	
CO3		**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%**
Total Marks	**52**	**52**	**140**

Contents

Unit I **(15 Hours)**

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

Unit II **(15 Hours)**

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

Unit III **(15 Hours)**

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

Unit IV **(15 Hours)**

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

Unit V **(15 Hours)**

Matrices: Eigen values and Eigen vectors – Similar matrices – Cayley-Hamilton theorem – Eigen values for Symmetric matrices

Text Book:

S. Narayanan, R. HanumanthaRao, T. K. ManicavachagomPillay and Dr. P. Kandaswamy, Reprint June 2009, Ancillary Mathematics, Volume I, S. Viswanathan (Printers & Publishers) Pvt. Ltd. Chennai.

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

References:

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

Course Designers:

1. Dr. R. Angeline Chella Rajathi
2. Mrs. K. Ponmari

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Nature of the roots	5
1.2	Relation between the coefficients and the roots of an algebraic equation	5
1.3	Transformations of equations.	5
2.1	Reciprocal equations	4
2.2	Transforms in general	3
2.3	Horner's method	4
2.4	Newton's method	4
3.1	Circle, radius and centre of curvature	5
3.2	Evolute and Involute	5
3.3	p-r equation of a curve	5
4.1	Interpolation	5
4.2	Binomial method	5
4.3	Lagrange's interpolation formula	5
5.1	Eigen values and Eigen vectors	8
5.2	Eigen values for Symmetric matrices	7
Total		**75**

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. Chemistry on or after June 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19GE41C	**Allied Mathematics - II for Chemistry**	**Generic Elective**	**5**	**-**	**-**	**5**

L - Lecture T - Tutorial P–Practicals

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

Preamble

The course deals with the method of solving various ordinary and partial differential equations.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Classify the integrals and apply the appropriate techniques on integration	K2, K3
CO2	Solve ordinary differential equations using various methods	K3
CO3	Formulate partial differential equations and solve it	K3
CO4	Find Laplace transform and solve linear differential equations using Laplace Transforms	K1, K3
CO5	Define group and illustrate its properties	K1,K2

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**				
CO2				**S**	
CO3	**S**		**M**		
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%**
Total Marks	**52**	**52**	**140**

Contents

Unit I **(15 Hours)**

Integration : Reduction formulae - Bernoulli's formula.

Unit II **(15 Hours)**

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

Unit III **(15 Hours)**

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

Unit IV **(15 Hours)**

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

Unit V **(15 Hours)**

Introduction – Definition and examples - Elementary properties of a group – Permutation groups – Subgroups – Cyclic groups – Order of an element – Cosets and Lagrange's theorem.

Text Books:

1. S. Narayanan, R. HanumanthaRao, T. K. Manicavachagom Pillay and Dr. P. Kandaswamy, Reprint June 2009, Ancillary Mathematics, Volume I, S. Viswanathan (Printers & Publishers) Pvt. Ltd., Chennai.
2. S. Arumugam, A. T. Isaac, Reprint, June 2011, Modern Algebra, Scitech Publications(India) Pvt. Ltd., Chennai.

Unit	Book	Chapter/ Section
I	1	1(13 – 15)
II	1	4(6.1 – 6.4)
III	1	6(1 -3, 5 - 7)
IV	1	7(1 – 6)
V	2	3(3.0, 3.1,3.2, 3.4 - 3.8)

References:

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

Course Designers:

1. Dr. R. Angeline Chella Rajathi
2. Mrs. K. Ponmari

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Reduction formulae	8
1.2	Bernoulli's formula	7
2.1	Exact differential equations	8
2.2	Practical rule for solving an exact differential equation	7
3.1	Derivation of partial differential equations	3
3.2	Different integrals of partial differential equations	3
3.3	Standard type of first order equations	3
3.4	Lagrange's equation	3
3.5	Charpit's method	3
4.1	Definition & Problems	5
4.2	Inverse Laplace transform	5
4.3	Solving an ordinary differential equations	5
5.1	Introduction	1
5.2	Definition and examples	2
5.3	Elementary properties of a group	1
5.4	Permutation groups	2
5.5	Subgroups	3
5.6	Cyclic groups	3
5.7	Order of an element	1
5.8	Cosets and Lagrange's theorem	2
Total		**75**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19GE11(CS / CA/ IT)	**Mathematical Foundation for Computer Science**	**Generic Elective**	**5**	**-**	**-**	**5**

L - Lecture T - Tutorial P–Practicals

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

Preamble

Discrete Mathematics introduces the mathematics of networks, social choice, and decision making and the 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 (according to Bloom's Taxonomy)
CO1	Relate set theoretical concepts and analyze simple algorithms	K1,K2,K3
CO2	Recall basic matrix operations and solve problems using matrix theory	K1,K3
CO3	Construct and classify logical sentence in terms of logical connectives, predicates	K2,K3
CO4	Formulate and interpret Boolean logic principles	K2,K3
CO5	Find graphs from matrix and apply graph theoretical ideas in problem solving	K1,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**

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge(K1)	**40%**	**40%**	**40%**
Understand(K2)	**40%**	**40%**	**40%**
Apply(K3)	**20%**	**20%**	**20%**
Total Marks	**52**	**52**	**140**

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.(Proofs of the Theorems are not included – Problems only)

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.(Proofs of the Theorems are not included – Simple problems only)

Unit V **(15 Hours)**

Graph Theory : Basic concepts – Matrix Representation of Graphs

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

Course Designers:

1. Dr. B. Arivazhagan
2. Dr. R. Angeline Chella Rajathi

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Relations and Functions: Cartesian Product of Two Sets – Relations – Representations of a Relation – Operation s on Relations	5
1.2	Equivalence Relations – Closures and Warshall's Algorithm – Partitions and Equivalence Classes	5
1.3	Functions and Operators – one to one and onto functions – Special Types of Functions	3
1.4	Invertible functions -Composition of Functions	2
2.1	Matrix algebra: Introduction – Matrix Opertations	2
2.2	Inverse of a Square Matrix- Elementary Operations and Rank of a Matrix	3
2.3	Simultaneous Linear Equations – Inverse by Partitioning	5
2.4	Eigen Values and Eigen Vectors	5
3.1	Logic: Introduction – TF Statements – Connectives	5
3.2	Tautology- Tautological Implications and Equivalence of Formulae	5
3.3	Replacement Process – Normal Forms	5
4.1	Lattices and Boolean Algebra: Lattices – Some properties of Lattices	5
4.2	New Lattices	5
4.3	Modular and Distributive Lattices	5
5.1	Graph Theory: Basic Concept	8
5.2	Matrix Representation of Graphs	7
Total		**75**

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 on or after June 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19GE21CS	**Statistics**	**Generic Elective**	**5**	**-**	**-**	**5**

L - Lecture T - Tutorial P – Practicals

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 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 (according to Bloom's Taxonomy)
CO1	Improve data handling skills and summarize statistical computations	K2,K3
CO2	Determine the relationship between quantitative variables and extend regression analysis	K2,K3
CO3	Recall and apply a comprehensive set of Probability ideas in generating expectations	K1,K3
CO4	Find, interpret and analyze the measure of central tendencies in distributions	K1,K2,K3
CO5	Relate and Demonstrate the knowledge of using various distributions for statistical analysis	K1,K2

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**

Blooms taxonomy

	CA		End of Semester
	First	Second	
Knowledge(K1)	**40%**	**40%**	**40%**
Understand(K2)	**40%**	**40%**	**40%**
Apply(K3)	**20%**	**20%**	**20%**
Total Marks	**52**	**52**	**140**

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 **(15 Hours)**

Random Variables:Mathematical Expectations – Mathematical Expectation of Continuous Random Variable – Moment Generating Function – Characteristic Function.

Unit IV **(15 Hours)**

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

Unit V **(15 Hours)**

Normal Distribution, Some more continuous distribution (Gamma distribution, Chi-square distribution, Student‘s t -distribution, Snedecor‘s F- distribution, Fischer‘s Z – distribution).

Note: Formula Derivations are not required. Only problems need be dealt with.

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	12(12.4 – 12.6)
IV	13(13.0 – 13.2)
V	13(13.3, 13.4)

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., Kapoor, V.K., 2015, Elements of Mathematical Statistics, Third Edition, Sultan Chand & Sons, Educational Publishers, New Delhi.

Course Designers:

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

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Central Tendencies Introduction	2
1.2	Arithmetic Mean	5
1.3	Measures of Dispersion : Introduction	3
1.4	Measures of Dispersion : Standard deviation	5
2.1	Correlation and Regression: Introduction	2
2.2	Correlation	5
2.3	Rank Correlation	3
2.4	Regression	5
3.1	Random Variables : Mathematical Expectations	5
3.2	Moment Generating function	5
3.3	Characteristic Function	5
4.1	Some Special Distributions: Introduction	5
4.2	Binomial Distribution	5
4.3	Poisson Distribution	5
5.1	Normal Distribution	5
5.2	Fitting of Normal Distribution	5
5.3	Some more Continuous Distribution	5
Total		**75**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19GE31(CS / CA / IT)	**Computational Methods**	**Generic Elective**	**5**	**-**	**-**	**5**

L - Lecture T - Tutorial P–Practicals

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

Preamble

The course introduces fundamental concepts of Numerical methods for handling of mathematical problems frequently encountered in engineering computations. Numerical solutions of Algebraic, transcendental equations and system of simultaneous linear equations have been determined.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Demonstrate common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems	K1, K2
CO2	Adapt numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear equations and the solution of differential equations	K3
CO3	Find the accuracy of common numerical methods.	K1
CO4	Build a function using an appropriate numerical method	K3
CO5	Solve an algebraic or transcendental equations using an appropriate numerical method	K3

Mapping of COs with PSOs

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

Blooms taxonomy

	CA		End of Semester
	First	**Second**	
Knowledge	**40%**	**40%**	**40%**
Understand	**40%**	**40%**	**40%**
Apply	**20%**	**20%**	**20%**
Total Marks	**52**	**52**	**140**

Contents

Unit I **(15 Hours)**

The Solution of Numerical Algebraic and Transcendental Equations : Introduction - The Bisection Method – Method of Successive Approximations – The Method of False Position – Newton-Raphson method – Horner‘s method (Problems only).

Unit II **(15 Hours)**

Simultaneous Linear Algebraic Equations : Introduction - Gauss Elimination Method – Computation of the Inverse of a Matrix using Gauss‘s Elimination Method - Method of Triangularisation –Iterative Methods (problems only).

Unit III **(15 Hours)**

Interpolation:Introduction – Linear interpolation –Gregory-Newton Forward Interpolation Formula – Gregory-Newton Backward Interpolation Formula – Equidistant terms with one or more missing values. Interpolation with Unequal Intervals: Divided differences – Newton‘s interpolation formula for unequal intervals – Lagrange‘s interpolation formula – Inverse interpolation (problems only).

Unit IV **(15 Hours)**

Numerical differentiation and Integration: Introduction - Newton‘s forward difference formula to compute the derivatives - Newton‘s Backward difference formula to compute the derivatives. Numerical Integration -Trapezoidal rule – Truncation Error in the Trapezoidal Formula – Romberg‘s Method - Simpson‘s Rule(problems only).

Unit V **(15 Hours)**

Numerical solution of Ordinary Differential Equations : Solution by Taylor series – Euler‘s method – Improved Euler‘s Method – Modified Euler‘s Method – Runge - Kutta methods – Second order Runge -Kutta method – Higher order Runge - Kutta methods – Predictor - Corrector methods – Milnes‘s Predictor - Corrector formulae(problems only).

Text Book:

Venkataraman. M.K., 2009, Numerical Methods in Science and Engineering, Fifth edition The National publishing company, Chennai.

Unit	Chapter/Section
I	III (1 to 5 and 8 (Horner‘s method))
II	IV (1 to 4 and 6)
III	VI (1 to 5) VIII (1, 3, 4 and 5(Inverse interpolation))
IV	IX (1 to 3, 7 to 10)
V	XI (6, 10 to 15, 19 and 20)

References:

1. Arumugam. S., ThangapandiIssac. A. and Somasundaram. A., 2014,Numerical methods, Second Edition, SciTech Publications(India) Pvt. Ltd., Chennai.
2. Balagurusamy. E., 2002, Numerical methods, Tata McGraw Hill Publishing Company Ltd., India.
3. Kandasamy. P., Thilgavathy. K. and Gunavathy. S., 2007, Numerical methods, Chand and Co., New Delhi.

Course Designers:

1.Mrs. S. Shanavas Parvin
2.Mrs. K. Ponmari

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Introduction	1
1.2	The Bisection Method	2
1.3	Method of Successive Approximations	4
1.4	The Method of False Position	2
1.5	Newton - Raphson method	3
1.6	Horner’s method	3
2.1	Introduction	1
2.2	Gauss Elimination Method	3
2.3	Computation of the Inverse of a Matrix using Gauss Elimination Method	3
2.4	Method of Triangularisation	4
2.5	Iterative Methods	4
3.1	Introduction	1
3.2	Linear interpolation	1
3.3	Gregory-Newton Forward Interpolation Formula	1
3.4	Gregory-Newton Backward Interpolation Formula	2

3.5	Equidistant terms with one or more missing values	3
3.6	Divided differences	1
3.7	Newton's interpolation formula for unequal intervals	2
3.8	Lagrange's interpolation formula	2
3.9	Inverse interpolation	2
4.1	Introduction	1
4.2	Newton's forward difference formulae to compute the derivatives	2
4.3	Newton's Backward difference formulae to compute the derivatives	2
4.4	Numerical Integration	3
4.5	Trapezoidal rule Truncation Error in the Trapezoidal Formula	2
4.6	Romberg Method	3
4.7	Simpson's Rule	2
5.1	Solution by Taylor series	2
5.2	Euler's method	2
5.3	Improved Euler's Method	2
5.4	Modified Euler's Method	2
5.5	Runge -Kutta methods	1
5.6	Second order Runge -Kutta method	1
5.7	Higher order Runge -Kutta methods	2
5.8	Predictor - Corrector methods	1
5.9	Milne's Predictor - Corrector methods	2
Total		**75**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19GE21(CA/IT) **UMA19GE41CS**	**Operations Research**	**Generic Elective**	**5**	**-**	**-**	**5**

L - Lecture T - Tutorial P–Practicals

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

Preamble

The course is a scientific approach to aid decision making and improving efficiency of the system by applying advanced analytical methods such as simplex method, Two-phase method, dual simplex method, etc.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Demonstrate OR approach in decision making	K2
CO2	Formulate mathematical LPP models and find their solutions	K1, K3
CO3	Translate LPP using duality principle and find their solutions	K1, K2
CO4	Recall and apply simplex method and its extensions	K1, K3
CO5	Recognize, solve and interpret transportation and assignment problems	K2, K3

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**M**			
CO2	**S**		**M**		
CO3			**S**		
CO4	**S**			**M**	
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%**
Total Marks	**52**	**52**	**140**

Contents

Unit I **(15 Hours)**

Operations Research(OR) – an overview : Introduction- Origin and development of OR – Applications of OR – Opportunities and shortcomings of OR - Linear Programming Problem(LPP)- Mathematical formulation: Introduction – LPP - Mathematical Formulation of the problem – Illustration of Mathematical Formulation of LPP's – LPP: Graphical Solution and extension: Introduction - Graphical Solution method - Some exceptional cases - General LPP – Canonical and Standard Forms of LPP.

Unit II **(15 Hours)**

LPP Simplex Method: Introduction - Fundamental properties of solutions– The Computational Procedure – Use of Artificial Variables (Problems only).

Unit III **(15 Hours)**

Duality in LPP: Introduction – General primal-dual Pair - Formulating a dual Problem – Primal dual pair in matrix form – Duality and simplex method - Dual simplex method (Problems only).

Unit IV **(15 Hours)**

Transportation Problem (TP): Introduction –LP formulation of the transportation problem – The Transportation Table – Loops in transportation tables – Triangular basis in a TP - Solution of a TP– Finding an initial basic feasible Solution – Test for optimality – Transportation algorithm (MODI Method) – Some exceptional cases.

Unit V **(15 Hours)**

Assignment Problem: Introduction – Mathematical formulation of the problem – Solution methods of Assignment problem – Special cases in Assignment Problems**.**

Text Book:

Kanti Swarup, Gupta. P.K., and Man Mohan, 2014, Operations Research, Seventeenth Edition, Sultan Chand & Sons., New Delhi.

Unit	Chapter/Section
I	1 (1.1, 1.2,1.10 , 1.11), 2 and 3(3.1 to 3.5)
II	4 (4.1 to 4.4)
III	5 (5.1 to 5.4 , 5.7 ,5.9)
IV	10(10.1, 10.2, 10.5 to 10.10,10.13, 10.15)
V	11(11 .1 to 11.4)

References:

1. Arumugam. S., Thangapandi Issac, A., 2010, Topics in Operations Research, New Gamma Publishing House, Palayamkottai.
2. Kalavathy. S., 2013, Operations Research, Fourth edition, Vikas Publishing House Pvt. Ltd, New Delhi.
3. Sharma. J.K.,2013, Operations Research: Theory and Applications, Fourth edition, Macmillan Publishers India Ltd.

Course Designers:

1. Mrs. S. Shanavas Parvin
2. Ms. K. Ponmari

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Introduction	1
1.2	Origin and development of Operations Research(OR)	1
1.3	Applications of OR	1
1.4	Opportunities and shortcomings of OR	1
1.5	Introduction	1
1.6	Linear Programming Problem (LPP)	1
1.7	Mathematical Formulation of the problem	1
1.8	Illustration of Mathematical Formulation of LPP's	2
1.9	Introduction	1
1.10	Graphical Solution method	2
1.11	Some exceptional cases	1
1.12	General LPP	1
1.13	Canonical and Standard Forms of LPP.	1
2.1	Insights into the simplex Method	2
2.2	Introduction	2
2.3	Fundamental properties of solutions	2
2.4	The Computational Procedure	4
2.5	Use of Artificial Variables	5
3.1	Introduction	1

3.2	General primal-dual Pair	2
3.3	Formulating a dual Problem	4
3.4	Primal dual pair in matrix form	1
3.5	Duality and simplex method	4
3.6	Dual simplex method	3
4.1	Introduction	1
4.2	LP formulation of the transportation problem (TP)	1
4.3	The Transportation Table	1
4.4	Loops in transportation table	2
4.5	Triangular basis in a TP	1
4.6	Solution of a TP	1
4.7	Finding an initial basic feasible Solution	1
4.8	Test for optimality	3
4.9	Transportation algorithm (MODI Method)	2
4.10	Some exceptional cases	2
5.1	Introduction	1
5.2	Mathematical formulation of the Assignment problem	4
5.3	Solution methods of Assignment problem	5
5.4	Special cases in Assignment Problems.	5
Total		**75**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19GE12C	**Business Mathematics**	**Generic Elective**	**5**	**-**	**-**	**5**

L - Lecture T - Tutorial P–Practicals

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

Preamble

The course provides an introduction to Business Mathematics. Emphasis is placed on the applications of commercial arithmetic, Permutations and Combinations.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Explain the various mathematical applications	K2
CO2	Solve Problems related to their Business	K3
CO3	Recall the concept of sets	K1
CO4	Develop critical thinking modeling and problem solving skills in a variety of contexts	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**	

CO5			**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%**
Total Marks	**52**	**52**	**140**

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. R. Angeline Chella Rajathi

Lecture Schedule:

Unit	Topic	Lecture hrs.
1.1	Simple Interest and Compound Interest: Calculating simple interest	3
1.2	Finding out missing items	3
1.3	Calculating compound interest	3
1.4	Finding out missing items	3
1.5	Difference between simple interest and compound interest.	3
2.1	Commercial Arithmetic: Discount on Bills	3
2.2	Logarithms – calculation of log values and anti-log values	4
2.3	Ratio – proportions and Percentages	4
2.4	Annuities – Simple problems.	4
3.1	Sets: Basic concepts: Set Operation	4
3.2	Union of set – Intersection of sets – Difference of sets	4
3.3	Venn Diagram – Laws of Sets.	7
4.1	Matrices: Basic concepts – Addition and subtraction of matrices – Multiplication of two matrices	4
4.2	Inverse of a matrix	4
4.3	Solving equation through matrices	4
4.4	Rank of a matrix.	3
5.1	Permutations	7
5.2	Combinations	8
Total		**75**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19C22C	**Business Statistics**	**Core**	**5**	**-**	**-**	**5**

L - Lecture T - Tutorial P–Practicals

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

Preamble

The course provides an introduction to Business Statistics. 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 (according to Bloom's Taxonomy)
CO1	Collect, process, analyze and present the statistical data	K3
CO2	Apply various statistical tools	K3
CO3	Define 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**	
CO5				**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%
Total Marks	52	52	140

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 - Average – Meaning – Characteristics of a typical average – Computation of Mean, Median, Mode, Geometric Mean, Harmonic Mean and Weighted Arithmetic Mean.

Unit II **(15 hours)**

Measures of 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 Analysis: Definition – Types of Correlation – Methods of Studying Correlation – Spearman's Rank Correlation Co-efficient.

Regression Analysis: 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, 2012, Statistics, 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., New Delhi.
2. Sharma J.K.,2014, Fundamentals of Business Statistics, Pearson Education, India.

Course Designers:

1. Mrs. S. Shanavas Parvin
2. Dr. R. Angeline Chella Rajathi

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Classification, Tabulation and Presentation of data	2
1.2	Diagrams – Bar diagram, Frequency polygon, Histogram and Ogive.	4
1.3	Measures of Central Tendency - Average – Meaning – Characteristics of a typical average	3
1.4	Computation of Mean, Median, Mode, Geometric Mean	3
1.5	Harmonic Mean and Weighted Arithmetic Mean.	3
2.1	Measures of Dispersion: Dispersion – Meaning – Properties of a good measure of dispersion – Absolute Vs relative measure of dispersion – Computation of Range	3
2.2	Quartile Deviation, Mean Deviation, Standard Deviation and Co-efficient of Varation.	4
2.3	Skewness – Meaning – Variation Vs Skewness	4
2.4	Measures of Skewness – Karl Person's and Bowley's Co-efficient of Skewness.	4
3.1	Correlation Analysis: Definition – Types of Correlation – Methods of Studying Correlation – Spearman's Rank Correlation Co-efficient.	4
3.2	Regression Analysis: Definition – Correlation Vs Regression	4
3.3	Regression lines and Regression Equations – Regression co-efficients – Computation of correlation co-efficient from regression co-efficients.	7
4.1	Index Numbers: Definition – Characteristics of Index numbers	4
4.2	Uses – Types of Index numbers	4
4.3	Construction of Price Index numbers – Unweighted Index numbers	4
4.4	Weighted Index numbers – Time reversal test and Factor reversal test of Index number.	3
5.1	Analysis of Time Series: Introduction – Uses – Components of time series – Measurement of trend -graphical method	7
5.2	Semi-average method, moving average and method of least square.	8
Total		**75**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
UMA19AE21	**Quantitative Aptitude**	**AECC**	**2**	**-**	**-**	**2**

L - Lecture T - Tutorial P–Practicals

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

Preamble

The course provides various principles involved in solving mathematical problems and develop the mathematical skills.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Find the solutions by using mathematical skills	K1
CO2	Demonstrate various principles involved in solving mathematical problems.	K2
CO3	Evaluate various real life situations by resorting to analysis of key issues and factors	K3
CO4	Formulate the problem quantitatively and use appropriate arithmetical methods to solve the problem.	K3

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**M**	**S**	**M**	**M**
CO2	**S**	**M**		**M**	
CO3		**S**	**M**		**M**
CO4	**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%**
Total Marks	**52**	**52**	**140**

Contents

Unit I **(15 Hours)**

H. C. F and L. C. M of Numbers – Decimal Fractions – Average – Percentage – Profit and Loss – Ratio and Proportion.

Unit II **(15 Hours)**

Time and Distance – Simple interest – Compound interest – True discount – Banker‘s discount

Text Book:

Agarwal. R.S., 2013, Quantitative Aptitude, S. Chand and Co., New Delhi.

Unit	Chapter/section
I	2, 3, 6, 10, 11, 12
II	17, 21, 22, 32, 33

References:

1. Arora. P.N. and Arora. S.,2009, Quantitative Aptitude Mathematics, Volume- 1 S Chand & Company Ltd., New Delhi.
2. Kothari. C.R., 1989, Quantitative Techniques,Vikas Publishing House Pvt. Ltd., New Delhi.
3. Srinivasan. T.M., Perumalswamy. S. and Gopala Krishnan. M.D., 1985, Elements of Quantitative Techniques, Emerald Publishers, Chennai.

Course Designers:

1. Dr. G. Prabakaran
2. Mrs. S. Shanavas Parvin

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	H. C. F and L. C. M of Number	4
1.2	Decimal Fractions	2
1.3	Average	2
1.4	Percentage	2
1.5	Profit and Loss	3
1.6	Ratio and Proportion	2
2.1	Time and Distance	3
2.2	Simple interest	3
2.3	Compound interest	3
2.4	True discount	3
2.5	Banker’s discount	3
Total		**30**

THIAGARAJAR COLLEGE, MADURAI – 9.

(Re-Accredited with 'A' Grade by NAAC)

ENVIRONMENTAL STUDIES

(For those joined B.A., B.Sc., B.Com., B.B.A., B.C.A on or after June 2019)

Course Code	Course Title	Category	L	T	P	Credit
U19EVS11	**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

Blooms taxonomy: Assessment Pattern

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

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 PSOllution – Water PSOllution – Noise PSOllution – Nuclear Hazards. Solid waste management and Waste DisPSOsal 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 PSOllution, 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.
(Re-Accredited with 'A' Grade by NAAC)
VALUE EDUCATION

(For those joined B.A., B.Sc., B.Com., B.B.A., B.C.A on or after June 2019)

Course Code	Course Title	Category	L	T	P	Credit
U19VE51	**Value Education**	AECC1	2	-	-	2

Year	Semester	Int. Marks	Ext.Marks	Total
Third	Fifth	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

Blooms taxonomy: Assessment Pattern

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

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

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

விழுமியக் கல்வி

கூறு - 1

சுய முன்னேற்றம்

அறிமுகம் - விழுமியங்களின் விளக்கம் மற்றும் வகைகள் - சுயமதிப்பீடு - சுய முன்னேற்றத்திற்கு விழுமியங்களின் தேவை - குடும்ப வாழ்க்கைக்கு விழுமியங்களின் தேவை - மகிழ்ச்சியான வாழ்க்கைக்கான கொள்கைகள்

பண்பு வளர்ச்சி

நற்பண்பு - நல்லுறவு - உயரிய பண்புகளால் உயர்ந்த பெருமக்களாதல் - பண்புகளைத் தேடல் - பண்புகளை வளர்த்தல் - நற்பண்புகளுக்கான திறவுகோல்.

கூறு - 2

சுயமரியாதையும் நேர்மறைச் சிந்தனையும்

சிந்தனையின் வகைகள் - சிந்தனைப் பகுதிகள் - சிந்தனையை வளர்க்கும் முறை - சிந்தனையில் புறத்தாக்கங்கள் - நேர்மறைப் பண்பை வெளித்தோற்றத்தில் காட்டும்முறை - சுயமரியாதையின் பொருள் - சுய அதிகாரமளித்தல்

அழுத்தமில்லா வாழ்க்கை

பிரமைகளும் காரணங்களும் - அழுத்த நிலைகளுக்கான அறிகுறிகள் - தன்னம்பிக்கை - தலைமைப் பண்பில் முன்னுதாரணங்கள் - விமர்சனச் சிந்தனை - தொடர்புத் திறன்கள் - மகிழ்ச்சி மற்றும் வெற்றிகரமான வாழ்க்கை

Reference

Study material / Course material

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

Self Study Paper

Thiagarajar College (Autonomous) :: Madurai – 625 009
SELF STUDY PAPER
(For those joined UG on or after June 2019)

Course Code	Course Title	Category	L	T	P	Credit
U19SS51	**Soft Skills**	Self Study Paper	-	-	-	5

Year	Semester	Int. Marks	Ext.Marks	Total
Third	Fifth	----	100	100

*** Carries Extra 5 credits that do not form part mandatory credits (140) required for completion of the course. Optional paper not compulsory for all UG students.**

Preamble

Prepare the students to develop skills, provide training to face interview .prepare themselves with the right skill-sets and attitude

Course Outcomes

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

	Course outcomes	Knowledge Level
CO1	Possess a basic idea on the understanding of nature, cause, effect and ways to deal with critical challenges in everyday life	K1,K2
CO2	Overcome the aspects such as Communication barriers, Stress management, Emotions.	K3
CO3	Gain insights into high-in-demand soft skills and prepare themselves with the right skill-sets and attitude	K1,K2
CO4	Develop or take part inteam work, Thinking skills, Creativity and time management.	K3
CO5	Prepare themselves to face different levels of interviews. Develop skills to manage an organization	K3

K1: Knowledge K2: Understand K3: Apply

Blooms taxonomy: Assessment Pattern

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

Unit - 1

Self Awareness (Concept of Self-esteem, Positive and Negative self esteem) Motivation (Nature and types, Factors enhancing and affecting Motivation, Needs and Drives) (Creativity Introduction, Nature of Creativity, Stages of Creativity, Enhancing Creativity, Verbal and Non Verbal Creativity) Values and Ethics (Nature and Significance, Values, Ethics, Work Ethics, Character building, Manners and Ethics)

Self Management (Self management skills and Social Competency, Social Competency Behaviour, Value Orientation, Life goals)

Unit 2

Communication and Thinking Communication (Definition, Types, Styles, Culture and Communication); Thinking (Nature, Types, Problem Solving, Proactive thinking, Positive Thinking, Assertiveness)

Unit 3

Emotions (Nature of emotions, Emotional Intelligence and its strategies, Attachment, Love, Happiness, Introduction to Anger – Causes, Types, Functions and Consequences, Anger management)

Stress (Nature of stress, Relation between Demands and Coping, Types and Causes, Effects and Indicators, Management of Stress, Time management and Stress reduction) Empathy (Definition, Nature and Factors enhancing empathy)

Unit4

Excelling through a placement process(Resume writing; Taking a written test; Group discussion – Need, Types, Tips and techniques; Interview handling – Tips and Techniques)

Unit 5

Being effective in an organisation

50 rules of work, Professional Etiquettes and Mannerism, Building relationship within an organisation, Communication skills, Working in teams, Managing conflicts, Effective negotiation skills, Problem solving using creativity.

Text book

1. Life Skills for Success – AlkaWadkar – 2016 Edition SAGE | TEXTS Sagepublishing.com

2. Campus to Corporate – Roadmap to Employability – Gangadhar Joshi – 2015 Edition SAGE | TEXTS Sagepublishing.com

Reference textbook

1 ACE of Soft skills – Gopalaswamy Ramesh and Mahadevan Ramesh, Pearson Publication

2 Bridging the soft skills gap – Bruce Tulgan – 2015 Edition – Wiley Publication

B.Sc. Mathematics

Assessment values of course learning outcomes and their mapping with program specific outcomes (PSOs)

Major papers

Title of the courses	PSO1	PSO2	PSO3	PSO4	PSO5
Calculus	5	3	8	3	4
Financial Accounting					
Algebra and Trigonometry	7	3	1	9	4
Cost and Management Accounting					
Differential Equations and Laplace Transform	6	3	4	3	5
Analytical Geometry of 3D and Vector calculus	6	8	3	4	3
Sequences and Series	3	11	6	3	2
C Programming	6	3	8	1	2
C Programming Lab	6	3	6	2	2
Algebraic structures	3	3	10	5	2
Real Analysis	3	3	7	6	2
Probability and Statistics	3	5	6	5	4
Linear programming problem	6	11	2	5	5
Elective (List enclosed)					
Soft Skills					
Complex Analysis	3	3	3	3	3
Linear Algebra	3	9	4	2	3
Discrete Mathematics	3	3	6	4	5
Resource management techniques	3	3	11	4	11
Elective (List enclosed)					

NME / SBE papers

Title of the courses	PSO1	PSO2	PSO3	PSO4	PSO5
Environmental Studies					
Quantitative Aptitude	8	7	8	4	4
Mathematical Aptitude for Competitive Examinations	3	3	4	8	2
Skill Enhanced Course (List enclosed)					
Mathematical Logic	3	3	7	2	3
Value Education					
Skill Enhanced Course (List enclosed)					

Allied / Ancillary papers

Title of the courses	PSO1	PSO2	PSO3	PSO4	PSO5
General Chemistry - I					
Ancillary Chemistry Lab					
General Chemistry – II					
Ancillary Chemistry Lab					
Physics - I					
Allied Practicals					
Basic Electronics					
Allied Practicals					

Skill Enhanced Course Papers

Title of the courses	PSO1	PSO2	PSO3	PSO4	PSO5
Theory of Numbers	3	11	2	6	1
Statistical Test of Significance	3	3	5	5	4
Web Designing with HTML – Practical	3	3	3	6	4
Theory of Lattices	6	3	2	5	2
Numerical Methods – Practical	3	2	3	3	3

Core Electives for Semester V

Title of the courses	PSO1	PSO2	PSO3	PSO4	PSO5
Mechanics	3	3	3	6	2
Combinatorics	6	9	4	2	3
Cryptography	6	3	2	4	6

Core Electives for Semester VI

Title of the courses	PSO1	PSO2	PSO3	PSO4	PSO5
Fuzzy sets	3	5	8	6	3
Fundamentals of Computer Algorithms	3	2	5	5	7
Numerical Methods	3	6	2	2	5

Generic Elective Papers for Physics and Chemistry

#	Title of the courses	PSO1	PSO2	PSO3	PSO4	PSO5
1	Allied Mathematics I for Physics	3	6	3	3	2
2	Allied Mathematics II for Physics	6	3	2	3	3
3	Allied Mathematics I for Chemistry	3	3	3	3	3
4	Allied Mathematics II for Chemistry	6	3	2	3	3

Generic Elective Papers for B.Sc.(CS), BCA, B.Sc.(IT)

Title of the courses	PSO1	PSO2	PSO3	PSO4	PSO5
Mathematical Foundation for Computer Science	3	6	6	6	4
Statistics	6	6	5	4	6
Computational Methods	6	3	2	2	3
Operations Research	9	2	5	2	3

Core Papers for B.Com (Aided)

Title of the courses	PSO1	PSO2	PSO3	PSO4	PSO5
Business Mathematics	3	3	4	6	5
Business Statistics	3	5	2	5	6

Certificate course

Title of the courses	PSO1	PSO2	PSO3	PSO4	PSO5
Certificate course in Latex	3	2	3	3	3

M.Sc., MATHEMATICS

Programme Code : PMA

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 2019)

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

The objectives of this programme is to equip/prepare the students

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	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 2019)

M.Sc. Mathematics

COURSE STRUCTURE (w.e.f. 2019 batch onwards)

Semester – I

Code No.	Subject	Contact Hrs / Week	Credits	Total No of Hrs Allotted	Max Marks		Total
					CA	SE	
PMA19C11	Groups and Rings	6	5	90	25	75	100
PMA19C12	Real Analysis	6	5	90	25	75	100
PMA19C13	Ordinary Differential Equations	6	5	90	25	75	100
PMA19C14	Number Theory	4	3	60	25	75	100
PMA19C15	Applied Numerical Analysis	4	3	60	25	75	100
PMA19CL11	Lab in Numerical Analysis	3	2	45	40	60	100
	Flip Class	1	-	15	-	-	-
Total		**30**	**23**				

Semester – II

Code No.	Subject	Contact Hrs / Week	Credits	Total No of Hrs Allotted	Max Marks		Total
					CA	SE	
PMA19C21	Theory of Fields	6	5	90	25	75	100
PMA19C22	Complex Analysis	6	5	90	25	75	100
PMA19C23	Topology	6	5	90	25	75	100
PMA19C24	Partial Differential Equations	6	5	90	25	75	100
PMA19C25	Graph Theory	6	4	90	25	75	100
Total		**30**	**24**				

Semester – III

Code No.	Subject	Contact Hrs / Week	Credits	Total No of Hrs Allotted	Max. Marks		Total
					CA	SE	
PMA19C31	Linear Algebra	6	4	90	25	75	100
PMA19C32	Mechanics	6	5	90	25	75	100
PMA19C33	Functional Analysis	6	4	90	25	75	100
PMA19CE31	Elective - I (List enclosed)	6	4	90	25	75	100
PMA19CE32	Elective - II (List enclosed)	6	4	90	25	75	100
Total		**30**	**21**				

Semester – IV

Code No.	Subject	Contact Hrs / Week	Credits	Total No of Hrs Allotted	Max Marks		Total
					CA	SE	
PMA19C41	Mathematical Statistics	6	4	90	25	75	100
PMA19C42	Measure and Integration	6	5	90	25	75	100
PMA19C43	Optimization Techniques	6	4	90	25	75	100
PMA19CE41	Elective - III (List enclosed)	6	4	90	25	75	100
PMA19PJ41	Project work	6	5	90	40	60	100
Total		**30**	**22**				

Major Electives I to be chosen from the following

1) Combinatorics
2) Fluid Dynamics
3) Differential Geometry

Major Electives II to be chosen from the following

1) Theory of Computation
2) Non linear differential equations
3) Fuzzy Sets and Fuzzy Logic

Major Elective III to be chosen from the following

1) Difference Equations
2) Stochastic Processes
3) Dynamical Systems

A) Consolidation of Contact Hours and Credits : PG

Semester	Contact Hrs / Week	Credits
I	30	23
II	30	24
III	30	21
IV	30	22
Total	120	90

B) Curriculum Credits

Core	78 Credits
Elective	12 Credits
Total	**90 Credits**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
PMA19C11	**Groups and Rings**	**Core**	**5**	**1**	**0**	**5**

L - Lecture T - Tutorial P–Practical

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

Preamble

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

Prerequisite

Students must possess basic knowledge in abstract algebra.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Find the number of subgroups in a group	K1
CO2	Demonstrate and analyze the concepts of solvability of group	K2, K4
CO3	Examine advanced ideas in the algebraic structures	K3
CO4	Solve the irreducibility of polynomials	K3
CO5	Explain chain conditions in Rings	K2,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**

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.

Unit IV **(18 Hours)**

Generators of a subgroup – Derived subgroups – Normal series – Solvable groups – Composition series – Zassenhaus lemma - Schrier's Refinement theorem – Jordan-Holder theorem.

Unit V **(18 Hours)**

Noetherian Rings - Artinian Rings.

Text Books:

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	2.5 – 2.10
II	1	2.11 – 2.14
III	1	3.7 – 3.11
IV	2	5
V	2	15

References:

1. Vijay K Khanna and S.K. Bhambri , 2015, A course in Abstract Algebra, Vikas Publishing House Pvt. Ltd., New Delhi.

2. Richard M. Foote and David S. Dummit , 2011, Abstract Algebra, John Wiley Publications, New York.

3. Joseph A Gallian, 1999, Contemporary Abstract Algebra, Narosa Publication, New Delhi, 1999

Course Designers:

1. Dr. G. Prabakaran
2. Dr. M. Senthilkumaran

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	A counting principle	3
1.2	Normal subgroups and Quotient groups	4
1.3	Homomorphisms	2
1.4	Automorphisms	3
1.5	Cayley's theorem	2
1.6	Permutation groups	4
2.1	Another counting principle	4
2.2	Sylow's theorem	4
2.3	Direct products	5
2.4	Finite Abelian groups	5
3.1	Euclidean Ring	4
3.2	A particular Euclidean Ring	5
3.3	Polynomial Rings	4
3.4	Polynomials over the Rational field	5
4.1	Generators of a subgroup	2
4.2	Derived subgroups	2
4.3	Normal series	2
4.4	Solvable groups	2
4.5	Composition series	3
4.6	Zassenhaus lemma	2
4.7	Schrier's Refinement theorem	2
4.8	Jordan-Holder theorem	3
5.1	Noetherian Rings	9
5.2	Artinian Rings	9
Total		**90**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
PMA19C12	**Real Analysis**	**Core**	**5**	**1**	**-**	**5**

L - Lecture T - Tutorial P–Practicals

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 (according to Bloom's Taxonomy)
CO1	Recall and apply the concepts of continuity, discontinuity, compactness and connectedness in metric spaces.	K1, K3
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.	K2, 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	PSO2	PSO3	PSO4	PSO5
CO1	**S**				
CO2				**S**	
CO3			**S**	**M**	
CO4	**S**				
CO5		**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 **(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 , 2013, 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, New York.
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. G. Prabakaran

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Limits of functions	3
1.2	Continuous Functions	3
1.3	Continuity and Compactness	3
1.4	Continuity and Connectedness	3
1.5	Discontinuities	2
1.6	Monotonic Functions	2
1.7	Infinite Limits and Limits at Infinity	2
2.1	The Derivative of a Real Function	3
2.2	Mean Value Theorems	3
2.3	The Continuity of Derivatives	2
2.4	L' Hospital's Rule	3
2.6	Derivatives of Higher Order	1
2.7	Taylor's Theorem	2
2.8	Differentiation of vector –valued functions	4
3.1	Definition and Existence of the Integral	4
3.2	Properties of the Integral	5
3.3	Integration and Differentiation	5
3.4	Integration of vector - valued functions	2
3.5	Rectifiable Curves	2
4.1	Discussion of Main Problem	5
4.2	Uniform Convergence	3
4.3	Uniform Convergence and Continuity	3
4.4	Uniform Convergence and Integration	3
4.5	Uniform Convergence and Differentiation.	4
5.1	Equicontinuous Families of Functions	3
5.2	The Stone – Weierstrass Theorem	2
5.3	Power Series	3
5.4	The Exponential and Logarithmic Functions	3
5.5	The TrigonometFunctions	3
5.6	The Algebraic Completeness of the Complex Field	1
5.7	The Gamma Function	3
Total		**90**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
PMA19C13	**Ordinary Differential Equations**	**Core**	**5**	**1**	**-**	**5**

L - Lecture T - Tutorial P – Practicals

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 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 (according to Bloom's Taxonomy)
CO1	Apply concept of power series solution, special function, existence and uniqueness of solutions of ODE's	K3
CO2	Explain Nonlinear differential equations and stability by Liapunov's Direct Method	K2, K5
CO3	Analyze and solve a variable separable differential equation,homogeneous differential equation,an exact differential equation,	K3, K4
CO4	Find the series solutions of the ordinary differential equations	K1
CO5	Demonstrate ordinary points, singular points and Regular singular points.	K2

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1				**S**	**M**
CO2		**S**			
CO3			**S**	**M**	
CO4	**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, 2008, Differential Equations with Applications and Historical Notes, Tata McGraw-Hill Publishing Company Limited, Second Edition, New Delhi.

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. Dr. D. Pandiaraja

Lecture Schedule

Unit	Topic	No. of lecture hrs.
1.1	Introduction - The General Solution of the Homogeneous Equation	3
1.2	The use of a known solution to find another	3
1.3	The Homogeneous Equation with constant co-efficients	4
1.4	The method of Undetermined co-efficients	4
1.5	The method of variation of Parameters.	4
2.1	Introduction – A Review of Power series- Series solutions of First Order Equations	4
2.2	Second Order Linear Equations	3

	(Ordinary Points)	
2.3	Regular Singular Points - Regular Singular Points (Continued)	4
2.4	Gauss's Hypergeometric Equation	4
2.5	The point at Infinity	3
3.1	Legendre Polynomials	6
3.2	Properties of Legendre Polynomials	4
3.3	Bessel Functions (The Gamma Function)	5
3.4	Properties of Bessel functions.	3
4.1	General Remarks on systems – Linear systems	4
4.2	Homogeneous Linear systems with constant co-efficients	4
4.3	The Existence and Uniqueness of solutions: The method of Successive Approximations	5
4.4	Picard's Theorem	5
5.1	Autonomous Systems (The Phase Plane and its phenomena	2
5.2	Types of Critical Points (Stability)	5
5.3	Critical Points and stability of Linear Systems	5
5.4	Stability by Liapunov's Direct Method	3
5.5	Simple Critical Points of Nonlinear Systems	3
Total		**90**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
PMA19C14	**Number Theory**	**Core**	**3**	**1**	**-**	**3**

L - Lecture T - Tutorial P - Practicals

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

Preamble

The course provides the basic concepts of Numbers such as Divisibility, Congruences, Quadratic residues and some arithmetic functions.

Prerequisite

Basic concepts in classical algebra.

Course Outcomes

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

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

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**M**	**S**		**S**
CO2	**S**		**S**		**M**
CO3		**S**		**S**	
CO4	**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 **(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 equation – 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 – 3.3
IV	4.1 – 4.3
V	5.1 – 5.3

References:

1. David M. Burton. 2010. Elementary Number Theory, Tata McGraw-Hill Education Pvt. Ltd., Sixth Edition, New Delhi.
2. George E. Andrews . 1992. Number Theory, Hindustan Publishing Corporation, New Delhi.
3. Martin Erickson and Anthony Vazzana. 2009. Introduction to Analytic Number Theory, Chapman and Hall /CRC publications, New Delhi.

Course Designers:

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

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Introduction	4
1.2	Divisibility	4
1.3	Primes	4
2.1	Congruences	4
2.2	Solutions of congruences	4
2.3	The Chinese remainder theorem	4
3.1	Quadratic residues	4
3.2	Quadratic reciprocity	4
3.3	The Jacobian symbol	4
4.1	Greatest integer function	4
4.2	Arithmetic functions	4
4.3	The Mobius inversion formula	4
5.1	The equation ax + by = c	4
5.2	Simultaneous linear equations	4
5.3	Pythagorean triangles	4
Total		**60**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
PMA19C15	**Applied Numerical Analysis**	**Core**	**3**	**1**	**-**	**3**

L - Lecture T - Tutorial P – Practicals

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

Preamble

The course deals with the methods of solving linear algebraic equations , evaluation of definite integrals ,solving ordinary differential equations with boundary conditions.

Prerequisite

Knowledge in solving system of equations, interpolation and various difference operators

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

#	Course outcomes	Knowledge Level (according to Bloom's Taxonomy)
CO1	Solve system of linear algebraic equations	K3
CO2	Explain Gaussian rules for Numerical integration	K2
CO3	Make use of numerical techniques to find the derivative at a point and evaluate definite integrals	K3,K5
CO4	Demonstrate and match mathematical preliminaries to solve ordinary differential equations	K1,K2
CO5	Illustrate the numerical solutions of boundary value problems	K2

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**M**	**S**			
CO2			**S**		
CO3				**S**	
CO4				**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 **(12 Hours)**

Systems of Equations and unconstrained optimization: Optimization and Steepest Descent – Newton's Method – Fixed Point Iteration and Relaxation Methods.

Unit II **(12 Hours)**

Approximation: Uniform approximation by polynomials – Data Fitting – Orthogonal polynomials – Least Squares Approximation by polynomials.

Unit III **(12 Hours)**

Differentiation and Integration: Numerical Differentiation – Numerical Integration: Some Basic rules – Numerical Integration: Gaussian rules and Composite rules

Unit IV **(12 Hours)**

The solution of Differential Equations: Mathematical preliminaries – Simple Difference equations – Numerical Integration by Taylor Series – Error estimates and convergence of Euler's method – Runge – Kutta methods – Multi step formulas – Predictor – Corrector methods

Unit V **(12 Hours)**

Boundary value Problems in Ordinary Differential Equations: Finite Difference methods – Shooting methods

Text Book:

Elementary Numerical Analysis An Algorithmic Approach, Samuel D.Conte and Carl De Boor , Third Edition, 2009, Tata McGraw- Hill Edition, New Delhi.

Unit	Chapter / Section
I	5 (5.1 – 5.3)
II	6 (6.1- 6.4)
III	7 (7.1 -7.4)
IV	8 (8.1 – 8.5, 8.7,8.8)
V	9 (9.1,9.2)

References:

1. An Introduction to Numerical Analysis , Third Edition , Devi Prasad, 2009, Narosa Publishing House , New Delhi.
2. Numerical Methods for Scientific and Engineering Computaion , Sixth Edition, M.K.Jain , S.R.K,. Iyengar, R.K. Jain, 2012, New Age International Publishers, New Delhi.
3. Numerical Methods in Engineering and Science with Programs in C, C++ & MATLAB, B.S.Grewal, Khanna Publishers, New Delhi, 2015.

Course Designer:

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

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Optimization and Steepest Descent	3
1.2	Newton's Method	3
1.3	Fixed Point Iteration and Relaxation Methods	3
1.4	Seminar	3
2.1	Uniform approximation by polynomials	3
2.2	Data Fitting	2
2.3	Orthogonal polynomials	2
2.4	Least Squares Approximation by polynomials.	2
2.5	Seminar	3
3.1	Numerical Differentiation	3
3.2	Numerical Integration: Some basic rules	3
3.3	Numerical Integration: Gaussian rules and Composite rules	3

3.4	Seminar	3
4.1	Mathematical preliminaries	2
4.2	Simple Difference equatioins	2
4.3	Numerical Integration by Taylor Series	2
4.4	Error estimates and convergence of Euler's method	2
4.5	Runge- Kutta methods	2
4.6	Multi step formulas	1
4.7	Predictor – Corrector methods	1
5.1	Finite Difference methods	3
5.2	Shooting methods	3
5.3	Seminar	3
5.4	Revision	3
Total		**60**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
PMA19CL11	**Lab in Numerical Analysis**	**Core**	**-**	**-**	**3**	**2**

L - Lecture T - Tutorial P – Practicals

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

Preamble

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

Prerequisite

Fundamental knowledge in C-Programme.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Develop C programs to solve linear algebraic equations using Gauss Jacobi's iteration method and Gauss Seidal method	K3
CO2	Find the derivative of a function using Newton's forward and interpret backward interpolation formulas	K1,K2
CO3	Evaluate integrals using Trapezoidal, Simpson's and Weddle's rules and develop C programs	K3, K5
CO4	Solve the given ordinary differential equations using C programs	K3

Mapping of COs with PSOs

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

Contents

1. Solving system of linear algebraic equations using Gauss Jacobi's iteration method.
2. Solving system of linear algebraic equations using Gauss seidal iteration method.
3. Finding the derivative at the initial point of a tabulated function by Newton's forward interpolation formula.
4. Finding the derivative of a tabulated function at the final point, by Newton's backward interpolation formula.
5. Evaluating integrals using Trapezoidal, Simpson's and Weddle's rules.
6. Solving the given differential equation by using Euler's method .
7. Solving the given differential equation by using Modified Euler's method.
8. Solving the given differential equation by using Runge- Kutta method.
9. Solving the given differential equation by using Predictor and Corrector method.
10. Solving boundary value problems in ordinary differential equations

References:

1. Numerical Methods for Scientific and Engineering Computaion , Sixth Edition, M.K.Jain , S.R.K,. Iyengar, R.K. Jain, 2012, New Age International Publishers, New Delhi
2. Numerical Methods in Engineering and Science with Programs in C, C++ & MATLAB, B.S.Grewal, Khanna Publishers, 2015, New Delhi.
3. Numerical Methods with programs in C , Second Edition, T.Veerarajan, T. Ramachandran,2006, Tata McGraw – Hiill Publishing Company Limited, New Delhi

Course Designers:

1. Dr. B. Arivazhagan
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.Sc. Mathematics on or after June 2019)

Course Code	Course Title	Category	L	T	P	Credit
PMA19C21	**Theory of Fields**	**Core**	**5**	**1**	**-**	**5**

L - Lecture T - Tutorial P – Practicals

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 (according to Bloom's Taxonomy)
CO1	Recall and construct extensions of a given field	K1, K3
CO2	Find the degree of the splitting field of a polynomial	K1
CO3	Demonstrate the constructability of algebraic numbers	K2
CO4	List and identify the extensions such as finite, algebraic, simple and normal	K1,K3, K4
CO5	Explain the properties of finite fields	K2, 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**

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 – 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 – Galois group over the rationals.

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, New Delhi.

Unit	Chapter/Section
I	5.1,5.3
II	5.4,5.5
III	5.6,5.7,5.8
IV	7.1,7.2
V	7.3,7.4

References:

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

Course Designers:

1. Dr. G. Prabakaran
2. Dr. M. Senthilkumaran

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Extension Fields	10
1.2	Roots of polynomials	10
2.1	Construction with straight edge and compass	8
2.2	More about roots	8
3.1	The elements of Galois theory	7
3.2	Solvability by radicals	6
3.3	Galois group over the rationals	7
4.1	Finite fields	8
4.2	Wedderburn's theorem on finite division rings	8
5.1	A theorem of Frobenius	9
5.2	Integral Quaternions and the Four-Square theorem	9
Total		**90**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
PMA19C22	**Complex Analysis**	**Core**	**5**	**1**	**-**	**5**

L - Lecture T - Tutorial P–Practicals

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

Preamble

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

Prerequisite

A first course in calculus of complex numbers.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Recall and Analyze the concepts in complex analysis	K1, K4
CO2	Define and Evaluate complex integration	K1,K5
CO3	Determine and Analyze the calculus of residues	K4,K5
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, 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**			

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 ρ function – The function ς(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 and 3)
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.

Course Designers:

1. Mrs. S. Shanavas Parvin
2. Mrs. R. Latha

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Complex Functions:Introduction to the concept of analytic functions : Limits and Continuity	2
1.2	Analytic functions	2
1.3	Polynomials	1
1.4	Rational functions	2
1.5	Elementary theory of Power series : Sequences	1
1.6	Series.	1
1.7	Uniform Convergence	1
1.8	Power Series	1
1.9	Abel's Limit theorem	2
1.10	The Exponential Functions	1
1.11	The Trigonometric Functions	1
1.12	The Periodicity	1
1.13	The Logarithm	2
2.1	Complex Integration : Fundamental Theorems ,	1
2.2	Rectifiable arcs	1
2.3	Line Integrals as Functions of arcs	2
2.4	Cauchy's theorem for a rectangle.	2

2.5	Cauchy's theorem in a disk	2
2.6	Cauchy's Integral formula: Index of a point	2
2.7	The Integral Formula	2
2.8	Higher derivatives	2
2.9	Local Properties of Analytic Functions : Removable singularities- Taylor's theorem	1
2.10	Zeros and poles	1
2.11	The Local mapping	1
2.12	The Maximum Principle	1
3.1	Complex Integration: The Calculus of Residues The Residue theorem	5
3.2	The Argument Principle,	2
3.3	Evaluation of definite Integrals	2
3.4	Harmonic Functions: Definition and Basic properties	4
3.5	Mean- value Property	3
3.6	Poisson's Formula	2
4.1	Series and Product Development : Power Series Expansions: Weierstrass's Theorem	2
4.2	The Taylor Series	2
4.3	The Laurent Series	2
4.4	Partial Fractions and Factorization: Partial Fractions	2
4.5	Infinite Products	2
4.6	Canonical Products,	2
4.7	The Gamma Function	2
4.8	Entire functions : Jensen's Formula	2
4.9	Hadamard's theorem.	2
5.1	Elliptic functions: Doubly Periodic Functions The Period Module	2
5.2	Unimodular Transformations	2
5.3	The Canonical basis	3
5.4	General Properties of Elliptic Functions Weierstrass Theory	3
5.5	The Weierstrass ρ function	2
5.6	The function $\varsigma(z)$ and $\sigma(z)$,	3
5.7	The Differential Equation.	3
Total		**90**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
PMA19C23	**Topology**	**Core**	**5**	**1**	**-**	**5**

L - Lecture T - Tutorial P–Practicals

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

Preamble

Topology developed as a field of study out of geometry and set theory, through analysis of concepts as space, dimension, and transformation the course emphasize an introduction to theory of topological spaces and focus on selected types of topological spaces.

Prerequisite

Knowledge in first course of Real and Complex analysis.

Course Outcomes

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

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

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**			**M**	
CO2	**M**		**S**		
CO3		**S**		**M**	
CO4		**S**		**M**	
CO5			**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 **(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. G. Prabakaran
2. Ms. K. Ponmari

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Topological Spaces	2
1.2	Basis for a topology	2
1.3	The order topology	2
1.4	The product topology on X x Y	2
1.5	The subspace topology	2
1.6	Closed sets and limit points	3
1.7	Continuous functions	3
1.8	The product topology	2
1.9	The metric topology	4
2.1	Connected Spaces	6
2.2	Connected Subspaces of the Real line	6
2.3	Components and local connectedness	5
3.1	Compact Spaces	6
3.2	Compact Subspaces of the Real line	6
3.3	Limit point compactness	5
4.1	The Countability axioms	4
4.2	The Separation axioms	3
4.3	Normal spaces	5
4.4	The Urysohn lemma	5
5.1	The Urysohn Metrization theorem	6
5.2	The Tietze extension theorem	6
5.3	TheTychonoff theorem	5
Total		**90**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
PMA19C24	**Partial Differential Equations**	**Core**	**5**	**1**	**-**	**5**

L - Lecture T - Tutorial P - Practicals

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 various solutions of elliptic, parabolic and hyperbolic partial differential equations.

Prerequisite

Knowledge in multivariable calculus, linear algebra and Ordinary Differential Equations.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
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, K3
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	K3, 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**		

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)**

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 – Problem with Axial Symmetry.

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– The use of Integral Transforms.

Text Book:

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

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

References:

1. Sankara Rao. K., 2016, Introduction to Partial Differential Equations, PHI Learning Private Limited, New Delhi.

2. Aslak Tveito & Ragnar Winther, 2010, Introduction to Partial Differential Equations: A Computational Approach, Springer – Verleg.

3. K. S. Bhamra, 2010, Partial Differential Equations: An Introductory Treatment with Applications, PHI Learning Private Limited, New Delhi.

Course Designers:

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

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Linear Equations of the first order	3
1.2	Integral Surfaces Passing Through a Given Curve	2
1.3	Surfaces Orthogonal to a Given System of Surfaces	2
1.4	Non-linear Equations of the first Order	2
1.5	Cauchy's Method of Characteristics	2
1.6	Compatible Systems of First Order Equations	2
1.7	Charpit's Method	3
1.8	Special types of First order Equations	2
2.1	The Origin of Second Order Equations	3
2.2	Second Order Equations in Physics	3
2.3	Linear Partial Differential Equations with	4

	Constant Coefficients	
2.4	Equations with Variable Coefficients	4
2.5	Characteristic Curves of Second Order Equations.	4
3.1	The Occurrence of Laplace's Equations in Physics	3
3.2	Elementary Solutions of Laplace's Equation	3
3.3	Families of Equipotential Surfaces	3
3.4	Boundary Value Problems	3
3.5	Separation of Variables	3
3.6	Problem with Axial Symmetry	3
4.1	The Occurrence of the Wave Equation in Physics	4
4.2	Elementary Solutions of the One-dimensional Wave Equation	4
4.3	Vibrating Membranes: Application of the Calculus of Variations	5
4.4	Three dimensional Problems.	5
5.1	The Occurrence of the Diffusion Equation in Physics	3
5.2	The Resolution of Boundary Value Problems for the Diffusion Equation	4
5.3	Elementary Solutions of the Diffusion Equation	4
5.4	Separation of Variables	3
5.5	The use of Integral Transforms	4
Total		**90**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
PMA19C25	**Graph Theory**	**Core**	**4**	**2**	**-**	**4**

L - Lecture T - Tutorial P - Practicals

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

Preamble

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

Prerequisite

Knowledge in basic definitions and properties in graph theory is needed.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Relate connectivity concepts in the theory of network flow problems	K1,K2
CO2	Analyze and Apply planarity concepts in computer graphics	K3, K4
CO3	Apply the distance concepts in channel assignment	K3
CO4	Explain matching concepts in job assignment problems	K5
CO5	Develop mathematical models of real life problems using domination	K3

Mapping of COs with PSOs

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

Connectivity: Cut–Vertices – Blocks – Connectivity – Menger'S Theorem.

Unit II **(18 Hours)**

Matchings and Factorization: Matchings – Factorization – Decompositions and Graceful Labelings.

Unit III **(18 Hours)**

Planarity: Planar Graphs – Embedding Graphs on Surfaces.

Unit IV **(18 Hours)**

Coloring: The Four Color Problem – Vertex Coloring – Edge Coloring

Unit V **(18 Hours)**

Distance: The Center of a Graph – Distant Vertices – Channel Assignment.
Domination: The domination number of a graph.

Text Book:

Gary Chartrand and Ping Zhang, 2006. Introduction to Graph Theory, Tata McGraw – Hill, New Delhi.

Unit	Chapter/ Sections
I	5(5.1-5.4)
II	8(8.1-8.3)
III	9(9.1,9.2)
IV	10(10.1 – 10.3)
V	12(12.1,12.2,12.5) 13(13.1)

References:

1. Balakrishnan, R. and Ranganathan, K., 2012, A Textbook of Graph Theory, 2nd Edition, Springer-Verlag, New York.
2. Bondy, J.A. and Murthy, U.S.R., 2008, Graph Theory, Springer-Verlag, London.
3. Douglas B. West, 2001, Introduction to Graph Theory –Prentice – Hall of India, Singapore
4. Harary, 1989, Graph Theory, Narosa Publishing House, New Delhi.

Web Resources:

1. http://diestel-graph-theory.com/basic.html

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

Course Designers:

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

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Connectivity : Cut-Vertices	5
1.2	Blocks	5
1.3	Connectivity	5
1.4	Menger's Theorem	3
2.1	Matchings and Factorization: Matchings	5
2.2	Factorization	3
2.3	Decompositions	5
2.4	Graceful Labelings	5
3.1	Planarity: Planar Graphs – Embedding Graphs on Surfaces	10
3.2	Embedding Graphs on Surfaces	8
4.1	Coloring: The Four Color Problem	4
4.2	Vertex Coloring	7
4.3	Edge Coloring	7
5.1	Distance: The Center of a Graph – Distant Vertices – Channel Assignment	9
5.2	Domination: The domination number of a graph	9
Total		**90**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
PMA19C31	**Linear Algebra**	**Core**	**4**	**2**	**-**	**4**

L - Lecture T - Tutorial P - Practicals

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

Preamble

The course deals with the relation between a linear transformation and its matrix. Various properties of transformations is discussed through matrices.

Prerequisite

Knowledge in basis of a vector spaces, dual spaces and linear transformations.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Recall and demonstrate the concepts of vector spaces, subspaces and inner product spaces.	K1, K2
CO2	Analyze and Construct the dual spaces and modules	K3,K4
CO3	Apply principles of matrix algebra to find properties of linear transformations.	K1, K3
CO4	Determine canonical forms and nilpotent transformations	K5
CO5	Demonstrate the Hermitian, Unitary and normal transformations	K2

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**	**M**			**S**
CO2	**S**				**M**
CO3				**S**	
CO4			**S**		
CO5	**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 **(18 Hours)**

Elementary Basic Concepts – Linear independence and bases– Inner product spaces

Unit II **(16 Hours)**

Dual spaces - Modules

Unit III **(18 Hours)**

The algebra of linear transformations - Characteristic roots

Unit IV **(20 Hours)**

Matrices - Canonical forms - Triangular forms – Nilpotent transformations

Unit V **(18 Hours)**

Hermitian, Unitary and Normal transformations – Real Quadratic forms

Text Book:

I.N. Herstein, 2014, Topics in Algebra Wiely India Pvt. Ltd., New Delhi.

Unit	Chapter/ Section
I	4(4.1,4.2,4.4)
II	4(4.3, 4.5)
III	6(6.1, 6.2)
IV	6(6.3,6.4,6.5)
V	6(6.10, 6.11)

References:

1. Joseph A Gallian, 1999, Contemporary Abstract Algebra, Narosa Publication, New Delhi.
2. Kenneth Hoffman and Ray Kunze Linear Algebra, 2009, PHI Learning Pvt. Ltd., New Delhi.
3. Vijay K Khanna and S.K. Bhambri, 2012, A course in Abstract Algebra Vikas Publishing House Pvt. Ltd., Chennai.

Course Designers:

1. Dr. G. Prabakaran
2. Dr. M. Senthilkumaran

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Elementary basic concepts	6
1.2	Linear independence and bases	6
1.3	Inner product spaces	6
2.1	Dual spaces	8
2.2	Modules	8
3.1	The algebra of linear transformations	9
3.2	Characteristic roots	9
4.1	Matrices	6
4.2	Canonical forms - Triangular forms	7
4.3	Nilpotent transformation	7
5.1	Hermitian, unitary and normal transformations	12
5.2	Real quadratic forms	6
Total		**90**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
PMA19C32	**Mechanics**	**Core**	**5**	**1**	**-**	**5**

L - Lecture T - Tutorial P - Practicals

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

Preamble

The course deals with Hamiltonian's Principles and Lagrange's equations. Poisson and Jacobi brackets are classified through canonical transformations.

Prerequisite

Knowledge in multivariable calculus and basics of physics.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Recall the elementary principles of mechanics	K1
CO2	Analyze and Demonstrate the Holonomic and non Holonomic systems	K2, K4
CO3	Solve two body central force problems	K3
CO4	Explain the Hamilton equations of motion	K5
CO5	Define and solve the equations of canonical transformations	K1, K3

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**				
CO2		**S**	**M**		
CO3	**S**			**M**	
CO4		**S**		**M**	
CO5			**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 **(18 Hours)**

Survey of Elementary Principles : Mechanics of a particle - Mechanics of a system of particles – D'Alembert's Principle and Lagrange's equation – Velocity-dependent Potential and dissipation function – Simple application of the Lagrangian formulation.

Unit II **(18 Hours)**

Variational Principle and Lagrange's Equations: Hamilton's Principle – some Techniques of the calculus of variation – Derivation of Lagrange's Equation from Hamilton's principle – Extension of Hamilton's principle through nonholonomic systems – Conservation theorems and symmetry Properties.

Unit III **(18 Hours)**

Two Body Central Force Problem : Reduction to one body Problem – The equations of motion and first integrals – The equivalent one-dimensional problem – The virial theorem– The differential equation for the orbit, and integrable power-law potentials – Conditions for closed orbits – The Kepler problem: Inverse square law of force – The motion in time in the Kepler problem – The Laplace- Runge- Lenz vector

Unit IV **(18 Hours)**

The Hamilton equations of motion:Legendre transformations and the Hamiltonequations of motion- Cyclic co-ordinates and conservation theorem-Derivation of Hamilton's equations from a variational principle-The principle of least action.

Unit V **(18 Hours)**

Canonical transformations: The equations of canonical transformation-Examples of canonical transformations-Poisson brackets and other canonical invariants.

Text Book:

Herbert Goldstein, 2002, Classical Mechanics, Second Edition, Narosa Publishing House. Chennai.

Unit	Chapter/Section
I	1
II	2(2.1 – 2.4, 2.6)
III	3(3.1 – 3.9)
IV	8(8.1, 8.2, 8.5, 8.6)
V	9(9.1, 9.2, 9.4)

References:

1. V.B. Bhatia, 2001, Classical Mechanics, Narosa Publishing House, Chennai.
2. John Robert Taylor, Classical Mechanics, 2005, University Science Books, Herndon, VA 20192.
3. Mondal. C.R., Classical Mechanics, 2004, PHI Learning Pvt Ltd, New Delhi.

Course Designers:

1. Dr. G. Prabakaran
2. Mrs. S. Shanavas Parvin

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Mechanics of a particle	5
1.2	Mechanics of a system of particles	2
1.3	D'Alembert's Principle and Lagrange's equation	5
1.4	Velocity-dependent potential and dissipation function	4
1.5	Simple application of the Lagrangian formulation.	2
2.1	Hamilton's Principle	4
2.2	Some Techniques of the calculus of variation	3
2.3	Derivation of Lagrange's Equation from Hamilton's principle	4
2.4	Extension of Hamilton's principle through nonholonomic systems	3
2.5	Conservation theorems and symmetry Properties	4
3.1	Reduction to one body Problem	2
3.2	The equations of motion and first integrals	2
3.3	The equivalent one-dimensional problem	2
3.4	The virial theorem	2
3.5	The differential equation for the orbit, and integrable power-law potentials	3

3.6	The Kepler problem: Inverse square law of force	2
3.7	The motion in time in the Kepler problem	2
3.8	The Laplace- Runge- Lenz vector	3
4.1	Legendre transformations and the Hamilton equations of motion	5
4.2	Cyclic co-ordinates and conservation theorem	4
4.3	Derivation of Hamilton's equations from a variational principle	5
4.4	The principle of least action.	4
5.1	The equations of canonical transformation	6
5.2	Examples of canonical transformations	6
5.3	Poisson brackets and other canonical invariants	6
Total		**90**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
PMA19C33	**Functional Analysis**	**Core**	**4**	**2**	**-**	**4**

L - Lecture T - Tutorial P–Practicals

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

Preamble

The course provides a firm grounding in the theory and techniques of functional analysis.

Prerequisite

Knowledge in linear algebra, analysis, basic topology and linear and non - linear operators on spaces.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Develop the skills in analyzing the basic structure of Banach spaces	K3, K4
CO2	Recall the results in Banach spaces and Hilbert spaces	K1
CO3	Apply Normed space theory to prove Hahn-Banach theorem	K3
CO4	Demonstrate the fundamentals of functional analysis	K2
CO5	Explain the operators and find the spectrum of operators	K5,K1

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**M**			**M**	**S**
CO2	**S**	**M**			
CO3	**S**				**M**
CO4		**S**			
CO5			**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 **(18 Hours)**

Banach Spaces: The definition and some examples – Continuous linear transformations – The Hahn-Banach theorem.

Unit II **(18 Hours)**

Banach Spaces: The natural imbedding of N in N^{**} – The open mapping theorem – The conjugate of an operator.

Unit III **(18 Hours)**

Hilbert Spaces: The definition and some simple properties – Orthogonal complements – Orthonormal sets.

Unit IV **(18 Hours)**

Hilbert Spaces: The conjugate space H^{*} – The adjoint of an operator – Self-adjoint operators – Normal and unitary operators.

Unit V **(18 Hours)**

Finite-Dimensional Spectral Theory: Matrices – Determinants and the spectrum of an operator – The spectral theorem.

Text Book:

Simmons.G.F., 2016, Introduction to Topology and Modern Analysis, Tata McGraw Hill, New Delhi.

Unit	Chapter/Sections
I	9 (46, 47, 48)
II	9 (49, 50, 51)
III	10 (52, 53, 54)
IV	10 (55, 56, 57, 58)
V	11 (60, 61, 62)

References:

1. Balmohan Visnu Limaye, 2012, Functional Analysis, New Age International, New Delhi.
2. D. Somasundaram, 2006, A First Course in Functional Analysis, Alpha Science Intl Ltd., United Kingdom.
3. Erwin Kreyszig, 2007, Introductory Functional Analysis with Applications, John Wiley& Sons, New York.
4. Ponnusamy. S., 2009, Foundations of Functional Analysis, Narosa Publishing House, Chennai.

Course Designers:

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

Web Resources:

1. www – personal.acfr.usyd.edu.au resources
2. https://people.math.ethz.ah > funcana
3. www. math. nsc.ru > English > ssk > fa_e
4. https://www.mat.univie.ac.at > book-fa

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Banach Spaces: The definition and some examples	6
1.2	Continuous linear transformations	6
1.3	The Hahn-Banach theorem	6
2.1	Banach Spaces: The natural imbedding of N in N^{**}	6
2.2	The open mapping theorem	6
2.3	The conjugate of an operator	6
3.1	Hilbert Spaces: The definition and some simple	6
3.2	Orthogonal complements	6
3.3	Orthonormal sets	6
4.1	Hilbert Spaces: The conjugate space H^*	4
4.2	The adjoint of an operator	5
4.3	Self-adjoint operators	4
4.4	Normal and unitary operators	5
5.1	Finite-Dimensional Spectral Theory: Matrices	6
5.2	Determinants and the spectrum of an operator	6
5.3	The spectral theorem	6
Total		**90**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
PMA19C41	**Mathematical Statistics**	**Core**	**4**	**2**	**-**	**4**

L - Lecture T - Tutorial P–Practicals

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

Preamble

The course deals with various distributions of discrete and continuous types. Estimation of parameters and testing of hypotheses are studied in detail.

Prerequisite

Knowledge in probability theory and integration is needed.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Recall and interpret different types of distributions	K1, K2, K5
CO2	Find the limiting distribution of a sequence of random variables	K1
CO3	Analyze and Develop statistical inferences	K3, K4
CO4	Identify the appropriate maximum likelihood methods for a given situation and use it to estimate the parameter	K3
CO5	Demonstrate optimal testing of hypotheses	K2

Mapping of COs with PSOs

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

Some special distributions The Binomial and related distributions - Poisson distribution – The Gamma, Chi-square and Beta distributions – The Normal distribution – The multivariate normal distribution.

Unit II **(18 Hours)**

Some special distribution, unbiasedness, consistency and limiting distribution -The t and F distributions – Expectations of functions – Convergence in probability –Convergence in distributions – Central limit theorem.

Unit III **(18 Hours)**

Some elementary statistical inference, Sampling and statistics– Order statistics – More on confidence interval – Introduction to hypothesis testing – Additional comments about statistical tests.

Unit IV **(18 Hours)**

Maximum likelihood methods, sufficiency: Maximum likelihood estimation – Rao-Cramer lower boundand efficiency - Maximum likelihood tests – Measures of quality of estimators – A sufficient statistics for a parameter – Properties of a sufficient statistic**.**

Unit V **(18 Hours)**

Optimal test of Hypotheses, Most powerful tests – Uniformly most powerful tests – Likelihood Ratio tests – The sequential probability ratio test.

Text Book:

Hogg, R.V. Craig. A.T. and J.W. Mckean, 2005, Introduction to Mathematical Statistics, Pearson Education, India.

Unit	Chapter/ Sections
I	3(3.1-3.5)
II	3(3.6), 4(4.1 – 4.4)
III	5(5.1, 5.2, 5.4 – 5.6)
IV	6(6.1 – 6.3), 7(7.1 – 7.3)
V	8(8.1-8.4)

References:

1. Gupta. S.C. and Kapoor. V.K., Mathematical Statistics, 2000, Sultan and Chand sons publishers, New Delhi.
2. Kapoor. J.N. and Saxena. H.C., 2009, Mathematical Statistics, 25thEdition, S. Chand & Co, New Delhi.
3. Irwin Miller & Maryless Miller, 2004, John‘s Freund‘s Mathematical Statistics, 2004, Pearson Education, India

Course Designers:

1. Dr. G. Prabakaran
2. Mrs. K. Ponmari

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Some special distributions The Binomial and related distributions	5
1.2	Poisson distribution	3
1.3	The Gamma, Chi-square and Beta distributions	5
1.4	The Normal distribution – The multivariate normal distribution	5
2.1	Some special distribution, unbiasedness, consistency and limiting distribution	7
2.2	The t and F distributions – Expectations of functions	5
2.3	Convergence in probability –Convergence in distributions	5
2.4	Central limit theorem	1
3.1	Some elementary statistical inference, Sampling and statistics	7
3.2	Order statistics – More on confidence interval	3
3.3	Introduction to hypothesis testing – Additional comments about statistical tests	8
4.1	Maximum likelihood methods, sufficiency : Maximum likelihood estimation – Rao-Cramer lower boundand efficiency	8
4.2	Maximum likelihood tests – Measures of quality of estimators	5
4.3	A sufficient statistics for a parameter – Properties of a sufficient statistic	5
5.1	Optimal test of Hypotheses, Most powerful tests – Uniformly most powerful tests	9
5.2	Likelihood Ratio tests – The sequential probability ratio test	9
Total		**90**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
PMA19C42	**Measure and Integration**	**Core**	**5**	**1**	**-**	**5**

L - Lecture T - Tutorial P–Practicals

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

Preamble

The course deals with Lebesque measure, Lebesque integral on bounded sets, General measure spaces and Decomposition theorems

Prerequisite

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

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Define Lebesgue measure, Lebesgue measurable sets and measureable functions.	K1
CO2	Infer measurable functions by simple functions and continuous functions.	K2
CO3	Evaluate integrals using measures	K5
CO4	Analyze and make use of convergence and Decomposition theorems	K3,K4
CO5	List the properties of Signed measures	K1, K4

Mapping of COs with PSOs

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

Lebesgue Measure : Introduction – Lebesgue Outer Measure – The algebra of Lebesgue Measurable Sets- Outer and inner approxjmation of Lebesgue Measurable sets – Countable additivity, Continuity and the Borel Cantelli lemma-Nonmeasurable Sets – The cantor set and the Cantor Lebesgue function.

Unit II **(18 Hours)**

Lebesgue Measurable Functions:Sums,Products and compositions – Sequential Pointwise limits and simple approximation - Littlewood‘s three principles,Egonoff‘s theorem and Lusin‘s theorem.

Unit III **(18 Hours)**

Lebesgue Integration: The Riemann Integral – The Lebesgue Integral of a Bounded measurable function over a set of finite measure – The Lebesgue Integral of a nonnegative function – The general Lebesgue Integral- Countable additivity and continuity of integration – Uniform integrability: The Vitali convergence theorem.

Unit IV **(18 Hours)**

Differentiation and Integration : Continuity of monotone functions - Differentiability of Monotone functions: Lebesgue theorem - Functions of Bounded Variation: Jordan theorem – Absolutely continuous function: Intergrating derivatives: Differentiating indefinity integrals : Convex functions.

Unit V **(18 Hours)**

General Measure spaces: Their properties and construction: Measures and Measurable Sets - Signed Measures:The Hahn and Jordan decompositions – The Caratheodory measure induced by an outer measure -.The construction of Outer Measures - The Caratheodory-Hahn theorem: The Extension of a premeasured to a measure.

Text Book:

Royden H.L., Fitzpatrick P.M., 2014, Real Analysis, Fourth Edition - PHI Learning Private Limited, Delhi.

Unit	Chapter
I	2 (full)
II	3 (full)
III	4(full)
IV	6 (full)
V	17 (full)

References:

1. Robert G.Bartle, 2014, The Elements of Integration and Lebesgue Measure, John Wiley &Sons, New York.
2. de Bara. G, 2013, Measure and Integration, Second Edition, Ellis Horwood Ltd., Chichester.
3. Pawan Kumar Jain, Pawan Gupta V.P., Pankaj Jain, 2012, Lebesgue Measure and Integration, Anshan Ltd., Tunbridge well , United Kingdom.

Course Designers:

1. Mrs. R. Latha
2. Dr. G. Prabakaran

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Introduction	2
1.2	Lebesgue Outer Measure	3
1.3	The σ algebra of Lebesgue Measurable Sets	3
1.4	Outer and inner approxjmation of Lebesgue Measurable sets	4
1.5	Countable additivity, Continuity and the Borel Cantelli lemma	2
1.6	Nonmeasurable Sets	2
1.7	The cantor set and the Cantor Lebesgue function	2
2.1	Sums,Products and compositions	6
2.2	Sequential Pointwise limits and simple approximation	6
2.3	Littlewood's three principles,Egonoff's theorem and Lusin's theorem	6
3.1	The Riemann Integral	2
3.2	The Lebesgue Integral of a Bounded measurable function over a set of finite measure	4
3.3	The Lebesgue Integral of a nonnegative function	4
3.4	The general Lebesgue Integral	3
3.5	Countable additivity and continuity of integration	3
3.6	The Vitali convergence theorem	2
4.1	Continuity of monotone functions	2
4.2	Lebesgue theorem	2
4.3	Functions of Bounded Variation: Jordan theorem	5
4.4	Absolutely continuous function	3
4.5	Differentiating indefinity integrals	4
4.6	Convex functions	2
5.1	Measures and Measurable Sets	4
5.2	Signed measures	5
5.3	The Caratheodory measure	3
5.4	The construction of Outer Measures	3
5.5	The Caratheodory-Hahn theorem	3
Total		**90**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
PMA19C43	**Optimization Techniques**	**Core**	**4**	**2**	**-**	**4**

L - Lecture T - Tutorial P – Practicals

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

Preamble

The course deals with the application of analytical methods such as Inventory models, shortest path problems, Queueing models and help to solve decision making problems.

Prerequisite

Knowledge of basic graph theory, differentiation and integration concepts.

Course Outcomes

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

#	Course outcomes	Knowledge Level (according to Bloom's Taxonomy)
CO1	Recall some basic principles of optimization techniques and solve shortest path problems, Maximal flow problems, CPM and PERT problems.	K1,K3
CO2	Analyze deterministic and probabilistic inventory models	K4
CO3	Summarize game theory and decision analysis principles and solve some practical problems.	K2,K3
CO4	Analyze and Solve different models of queueing theory problems.	K3,K4
CO5	Interpret the principle of non-linear problems.	K2,K5

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**				
CO2		**S**	**M**		
CO3		**S**	**M**	**M**	
CO4					**S**
CO5			**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 **(18 Hours)**

Network Models: Shortest route problem - Maximal flow model - CPM and PERT

Unit II **(18 Hours)**

Deterministic Inventory Models: General Inventory model – Role of demand in the development of inventory models – Static economic order quantity (EOQ) models – Dynamic EOQ models ; Probabilistic Inventory Models: Continuous review models – Single- period models – Multiperiod model

Unit III **(18 Hours)**

Decision Analysis and Games: Decision making under certainty – Decision making under risk – Decision under uncertainty – Game theory

Unit IV **(18 Hours)**

Queuing Systems:Why study queues? – Elements of a Queuing model – Role of exponential distribution – Pure birth and death models - Generalized Poisson Queuing model – Specialized Poisson Queues – (M/G/1):$(GD/\infty/\infty)$- Pollaczek –Khintchine(P-K) formula – Other Queuing models – Queuing decision models

Unit V **(18 Hours)**

Nonlinear Programming Algorithms:Unconstrained Algorithms:Direct search method – Gradient methodConstrained Algorithms: Separable programming - Quadratic programming- Chance – Constrained programming

Text Book:

Hamdy A. Taha, 2012 , Operations Research , Ninth edition , Pearson education , New Delhi.

Unit	Chapter / Section
I	6 (6.3 – 6.5)
II	13 & 16
III	15
IV	18
V	21

References:

1. Kanti swarup, P.K.Gupta and Man Mohan, 2014, Operations Research , Sultan Chand & Sons, New Delhi.
2. Wayne L.Winston, 2010, Operations Research Applications and Algorithms , Fourth Edition, Cengage Learning India private Limited , New Delhi
3. J.K.Sharma, 2009, Operations Research Theory and Applications , Third Edition , Macmillan India Limited , Chennai

Course Designers:

1. Dr. B. Arivazhagan
2. Dr. G. Prabakaran

Lecture Schedule

Unit	Topic	Lecture
1.1	Shortest route problem	6
1.2	Maximal flow model	6
1.3	CPM and PERT	6
2.1	General Inventory model	4
2.2	Role of demand in the development of inventory models	4
2.3	Static economic order quantity (EOQ) models	3
2.4	Dynamic EOQ models	2
2.5	Continuous review models	2
2.6	Single- period models	2
2.7	Multi period model	1
3.1	Decision making under certainty	5
3.2	Decision making under risk	5
3.3	Decision under uncertainty	5
3.4	Game theory	3
4.1	Elements of a Queuing model	2
4.2	Role of exponential distribution	2
4.3	Pure birth and death models	2
4.4	Generalized Poisson Queuing model	2
4.5	Specialized Poisson Queues	2
4.6	$(M/G/1):(GD/\infty/\infty)$	1
4.7	Pollaczek –Khintchine(P-K) formula	2
4.8	Other Queuing models	3
4.9	Queuing decision models	2
5.1	Unconstrained Algorithms :Direct search method	4
5.2	Gradient method	4
5.3	Separable programming	4
5.4	Quadratic programming	3
5.5	Constrained programming	3
Total		**90**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
PMA19CE31(A)	**Combinatorics**	**Elective**	**4**	**2**	**-**	**4**

L - Lecture T - Tutorial P–Practicals

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 (according to Bloom's Taxonomy)
CO1	Classify the concepts of arrangements and selections.	K2,K4
CO2	Determine the recurrence relations and solve with generating functions	K3,K5
CO3	Recall Polya's formula and solve enumeration problems	K1, K3
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**

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)**

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

Unit II **(18 Hours)**

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

Unit III **(18 Hours)**

Recurrence Relations: Recurrence Relation Models – Divide-and-Conquer Relations – Solution of Linear Recurrence Relations – Solution of Inhomogeneous Recurrence Relations – Solutions with Generating Functions.

Unit IV **(18 Hours)**

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

Unit V **(18 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 – 5.5)
II	6(6.1 – 6.5)
III	7(7.1 – 7.5)
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.

Web Resources:

1. https://people.math.gatech.edu/~trotter/book.pdf
2. http://jwilson.coe.uga.edu/emt725/References/Polya_HowToSolveIt.pdf
3. http://www.freetechbooks.com/discrete-structures-for-computer-science- counting-recursion-and-probability-t967.html

Course Designers:

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

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Two basic counting principles	3
1.2	Simple arrangements and selections	3
1.3	Arrangements and selections with repetitions	4
1.4	Distributions	4
1.5	Binomial identities	4
2.1	Generating function models	3
2.2	Calculating Coefficients of Generating Functions	5
2.3	Partitions	4
2.4	Exponential Generating functions	3
2.5	A summation Method	3
3.1	Recurrence Relation Models	6
3.2	Divide-and-Conquer Relations	3
3.3	Solutions of Linear Recurrence Relations	3
3.4	Solution of Inhomogeneous Recurrence Relations	2
3.5	Solutions with Generating Functions	4
4.1	Counting with Venn diagrams	4

4.2	Inclusion-Exclusion Formula	7
4.3	Restricted Positions and Rook Polynomials	7
5.1	Equivalence and symmetry Groups	4
5.2	Burnside's Theorem	5
5.3	The Cycle Index	4
5.4	Polya's Formula	5
Total		**90**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
PMA19CE31(B)	**Fluid Dynamics**	**Elective**	**4**	**2**	**-**	**4**

L - Lecture T - Tutorial P - Practicals

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

Preamble

The course identifies and obtain the values of fluid properties and relates the principles of continuity, momentum, and energy as applied to fluid motions.

Prerequisite

Knowledge in Vector Algebra, Jacobian, Kinematics and Differential Equations.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Recall the curvilinear coordinates	K1
CO2	Demonstrate the properties of fluids	K2
CO3	Solve the equations of motion of a fluid when it is at rest and in motion	K3
CO4	Analyze three dimensional flow and explain Stoke's stream function	K2, K4,K5
CO5	Find complex velocity potentials for standard two dimensional flows	K1

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**				
CO2	**S**	**M**			
CO3		**S**	**M**		
CO4				**S**	**M**
CO5	**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 **(18 Hours)**

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

Unit II **(18 Hours)**

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

Unit III **(18 Hours)**

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

Unit IV **(18 Hours)**

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

Unit V **(18 Hours)**

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

Text Book:

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

Unit	Chapter/Section
I	Chapter 1(Section 1.19 to 1.20)
II	Chapter 2(Section 2.1 to 2.10)
III	Chapter 3(Section 3.1 to 3.7, 3.9 to 3.11)
IV	Chapter 4(Section 4.1 to 4.5)
V	Chapter 5(Section 5.1 to 5.8)

References:

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

Course Designers:

1. Mrs. S. Shanavas Parvin
2. Dr. M. Senthilkumaran

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	General orthogonal curvilinear coordinates Arc length in Orthogonal coordinates	2
1.2	Gradient in orthogonal coordinates	3
1.3	Divergence in orghogonal coordinates	2
1.4	Laplacian in orthogonal coordinates	2
1.5	Curl of a vector function in orthogonal coordinates	2
1.6	worked examples ,	4
1.7	Some cartesian tensor notation	3
2.1	Kinematics of fluids in Motion :Real fluids and Ideal fluids	2
2.2	Velocity of a fluid at a point	2
2.3	Streamlines and Pathlines : steady an unsteady flows	2
2.4	The velocity potential	2
2.5	The vorticity vector	2
2.6	Local and particle rates of change ,	2
2.7	The equation of continuity	1
2.8	worked examples ,	3
2.9	Acceleration of a fluid ,	1
2.10	Conditions at a rigid boundary	1

3.1	Equations of Motion of a Fluid :Pressure at a point in a fluid at rest	1
3.2	Pressure at a point in a moving fluid	1
3.3	Conditions at a boundary of two Inviscid Immiscible fluids	1
3.4	Euler's equations of motion	1
3.5	Bernoulli's equation	1
3.6	worked examples	4
3.7	Discussion of the case of steady motion under conservative body forces	3
3.8	some flows involving axial symmetry	2
3.9	Some special two-dimensional flows	2
3.10	Impulsive motion.	2
4.1	Some Three-Dimensional flows : Introduction	1
4.2	Sources, Sinks and doublets	2
4.3	Images in a rigid infinite plane	5
4.4	Images in solid spheres	5
4.5	Axi-Symmetric flows : Stoke's Stream function	5
5.1	Some Two-Dimensional flows :Meaning of Two-Dimensional Flow	1
5.2	Use of Cylindrical Polar coordinates	2
5.3	The stream function,	2
5.4	The complex potential for Two – Dimensional , Irrotational, Incompressible flow	3
5.5	Complex velocity potentials for standard two-dimensional flows	2
5.6	Some worked examples ,	4
5.7	Two-Dimensional image systems	2
5.8	The Milne-Thomson circle theorem.	2
Total		**90**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
PMA19CE31(C)	**Differential Geometry**	**Elective**	**4**	**2**	**-**	**4**

Lecture T - Tutorial P–Practicals

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

Preamble

The course emphasizes concrete aspects of geometry centred on the notion of curvature.

Prerequisite

Knowledge in multivariable calculus and analytical geometry of 2D and 3D.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Recall and Analyze knowledge in space curves	K1, K4
CO2	Demonstrate the metric concepts in surface	K2
CO3	Find geodesics on curves	K1
CO4	Apply surfaces of revolution	K3
CO5	Evaluate Principal curvature and line of curvature	K5

Mapping of COs with PSOs

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

The Theory of space curves: Arc length – Tangent, normal and binormal – Curvature and Torsion – The curvature and torsion of a curve as the intersection of two surfaces - Contact between curves and surfaces – Osculating circle and osculating sphere - Tangent surface, involutes and evolutes – Intrinsic equations of space curves – Fundamental existence theorem for space curves - Helices.

Unit II **(18 Hours)**

The First Fundamental Form: Introduction – Definition of a surface – Nature of points on a surface – Curves on surfaces – Tangent plane and surface normal – The general surfaces of revolution – Helicoids – Metric on a surface – First Fundamental form – Direction Coefficients on a surface – Families of curves – Orthogonal trajectories -Isometric correspondence – Intrinsic properties.

Unit III **(18 Hours)**

Geodesics on a Surface: Introduction – Geodesic and their differential equations - Canonical geodesic equations –Geodesics on surfaces of revolution - Existence theorem – Geodesic parallels – Geodesics polar coordinates - Geodesic curvature – Gauss–Bonnet theorem.

Unit IV **(18 Hours)**

The Second Fundamental Form and local Non-intrinsic Properties of a Surface: Introduction – The second fundamental form – Classification of points on a surface – Principal curvature – Lines of curvature – The Dupin indicatrix.

Unit V **(18 Hours)**

The Second Fundamental Form and local Non-intrinsic Properties of a Surface: Developable surfaces – Developables associated with associated with space curves - Developables associated with associated with curves on surfaces- Minimal surface – Ruled surface.

Text Book:

Somasundaram. D., 2014, Differential Geometry Narosa Publishing House, Chennai.

Unit	Chapter/Section
I	1(1.4 - 1.7, 1.9 – 1.11, 1.13, 1.16 – 1.18)
II	2(2.1 – 2.3, 2.5 – 2.12, 2.14, 2.15)
III	3(3.1 – 3.4, 3.7 – 3.11)
IV	4(4.1 – 4.6)
V	5(4.7 – 4.11)

References:

1. Mittal and Agarwal, 1998, Differential Geometry Krishna prakasam Publishers, Uttar Pradesh.
2. Willmore. T.J., 2010, An introduction to Differential Geometry, Oxford university press, New Delhi.
3.Thierry Aubin, 2001, Differential Geometry, American Mathematical Society, Providence, US.

Course Designers:

1. Mr. M. Madhavan
2. Dr. G. Prabakaran

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Arc length	2
1.2	Tangent, normal and binormal	2
1.3	Curvature and Torsion	2
1.4	The curvature and torsion of a curve as the intersection of two surfaces	2
1.5	Contact between curves and surfaces	2
1.6	Osculating circle and osculating sphere	2
1.7	Tangent surface, involutes and evolutes	2
1.8	Intrinsic equations of space curve	1
1.9	Fundamental existence theorem for space curves	1
1.10	Helices	2
2.1	Introduction – Definition of a surface	1
2.2	Nature of points on a surface	1
2.3	Curves on surfaces	1
2.4	Tangent plane and surface normal	2
2.5	The general surfaces of revolution	1
2.6	Helicoids	2
2.7	Metric on a surface	2
2.8	First Fundamental form	1
2.9	Direction Coefficients on a surface	1
2.10	Families of curves	2

2.11	Orthogonal trajectories	1
2.12	Isometric correspondence	2
2.13	Intrinsic properties	1
3.1	Geodesics	1
3.2	Canonical geodesic equations	2
3.3	Existence theorem	1
3.4	Geodesic parallel	1
3.5	Geodesic curvature	1
3.6	Gauss–Bonnet theorem	1
3.7	Introduction – Geodesic and their differential equations	2
3.8	Canonical geodesic equations	1
3.9	Geodesics on surfaces of revolution	1
3.10	Existence theorem	1
3.11	Geodesic parallels	1
3.12	Geodesics polar coordinates	2
3.13	Geodesic curvature	1
3.14	Gauss–Bonnet theorem	2
4.1	Introduction	3
4.2	The second fundamental form –	3
4.3	Classification of points on a surface	3
4.4	Principal curvature	3
4.5	Lines of curvature	3
4.6	The Dupin indicatrix	3
5.1	Developable surfaces	3
5.2	Developables associated with associated with space curves	4
5.3	Developables associated with associated with curves on surfaces	4
5.4	Minimal surface	4
5.5	Ruled surface	3
Total		**90**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
PMA19CE32(A)	**Theory of Computation**	**Elective**	**4**	**2**	**-**	**4**

L - Lecture T - Tutorial P–Practicals

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

Preamble

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

Prerequisite

Knowledge in computer fundamentals

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Classify deterministic and non- deterministic finite automatons	K2,K4
CO2	Explain the properties of regular sets	K2,K5
CO3	Demonstrate derivation trees	K2
CO4	Define and construct Pushdown Automaton.	K1, K3
CO5	Develop a Turing machine	K3

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S**				**M**
CO2		**S**			
CO3		**S**	**M**		
CO4				**S**	**M**
CO5				**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 **(18 Hours)**

Finite Automata and Regular Expressions: Finite state systems – Basic definitions – Nondeterministic finite automata – Finite automata with Є moves – Regular expressions – Finite Automata with output.

Unit II **(18 Hours)**

Properties of Regular Sets: The pumping lemma for regular sets – Closure properties of regular sets – Decision algorithm for regular sets – The Myhill-Nerode theorem and minimization of finite automata.

Unit III **(18 Hours)**

Context-Free grammars: Context free grammars – Derivation trees – Simplification of context free grammars – Chomsky normal form – Greibach normal form.

Unit IV **(18 Hours)**

Pushdown Automata: Definitions – pushdown automata and context free languages – The pumping lemma for CFL‘s – Closure properties of CFL‘s.

Unit V **(18 Hours)**

Turing Machines: Introduction – The Turing machine model – Computable languages and functions. Undecidability- Problems, properties of recursive and recursively enumerable languages, Universal Turing Machines and an undecidable problem, Rice‘s theorem and some more undecidable problems.

Text Book:

John E. Hopcroft and Jeffery D. Ullman, 2002, Introduction to Automata Theory, Languages, and Computation, Narosa. Chennai.

Unit	Chapter/Section
I	Chapter 2 : 2.1 to 2.5, 2.7
II	Chapter 3 : 3.1 to 3.4
III	Chapter 4 : 4.2 to 4.6
IV	Chapter 5 : 5.2,5.3 Chapter 6: 6.1,6.2
V	Chapter 7 : 7.1,7.2,7.3 Chapter 8: 8.1 to 8.4

References:

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

Course Designers:

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

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Finite state systems and basic definitions	6
1.2	Nondeterministic finite automata	3
1.3	Finite automata with Є moves	4
1.4	Regular expressions	2
1.5	Finite Automata with output	3
2.1	The pumping lemma for regular sets	3
2.2	Closure properties of regular sets	5
2.3	Decision algorithm for regular sets	5
2.4	The Myhill-Nerode theorem and minimization of finite automata.	5
3.1	Context free grammars	3
3.2	Derivation trees	2

3.3	Simplification of context free grammars	3
3.4	Chomsky normal form	5
3.5	Greibach normal form	5
4.1	Definitions	4
4.2	Pushdown automata and context free languages	4
4.3	The pumping lemma for CFL‘s	5
4.4	Closure properties of CFL‘s	5
5.1	Introduction and The Turing machine model	4
5.2	Computable languages and functions	2
5.3	Undecidability- Problems, properties of recursive and recursively enumerable languages	5
5.4	Universal Turing Machines and an undecidable problem	4
5.5	Rice‘s theorem and some more undecidable problems	3
Total		**90**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
PMA19CE32(B)	**Non linear Differential Equations**	**Elective**	**4**	**2**	**-**	**4**

L - Lecture T - Tutorial P - Practicals

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

Preamble

The course deals with system of differential equations, Averaging methods and Perturbation method to solve systems and stability analysis of system of differential equations.

Prerequisite

Knowledge in Ordinary differential equations, Partial differential equations and linear systems of differential equations.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Model plane autonomous systems	K3
CO2	Find spiral phase paths using averaging methods	K1
CO3	Choose Perturbation Method to solve non-linear differential equations	K1, K3, K5
CO4	Classify Poincaré stability and Liapunov stability	K2,K4
CO5	Identify the structure of n-dimensional inhomogeneous system of differential equations	K3

Mapping of COs with PSOs

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

looms 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)**

Plane autonomous systems and linearization: The general phase plane-some population models – Linear approximation at equilibrium points – The general solution of linear autonomous plane systems.

Unit II **(18 Hours)**

Averaging Methods: An energy balance method for limit cycles – Amplitude and frequency estimates:Polar Coordinates – An averaging method for spiral phase paths - Periodic solutions: harmonic– The equivalent linear equation by harmonic balance problems.

Unit III **(18 Hours)**

Perturbation Methods: Non autonomous systems: forced oscillations - The direct perturbation method for the undamped Duffing‘s equation - Forced oscillations far from resonance - Forced oscillations near resonance with weak excitation - The amplitude equation for the undamped pendulum - The amplitude equation for a damped pendulum - Periodic solutions of autonomous equations (Lindstedt‘s method) - Forced oscillation of a self-excited equation - The perturbation method and Fourier series.

Unit IV **(18 Hours)**

Stability: Poincaré stability (stability of paths) - Paths and solution curves for general systems - Stability of time solutions: Liapunov stability - Liapunov stability of plane autonomous linear systems - Structure of the solutions of n-dimensional linear systems.

Unit V **(18 Hours)**

Structure of n-dimensional inhomogeneous linear systems - Stability and boundedness for linear systems - Stability of linear systems with constant coefficients - Linear approximation at equilibrium points for first-order systems in n variables - Stability of a class of non-autonomous linear systems in n dimensions - Stability of the zero solutions of nearly linear systems - Problems.

Text Book:

Jordan. D.W. and Smith. P., 2007, Nonlinear Ordinary Differential Equations: An Introduction for Scientists and Engineers, Oxford University Press, New York, US.

Unit	Chapter/Section
I	Chapter 2(Section 2.1 to 2.4)
II	Chapter 4(Section 4.1 to 4.5)
III	Chapter 5(Section 5.1 to 5.6, 5.9 to 5.11)
IV	Chapter 8(Section 8.1 to 8.5)
V	Chapter 8(Section 8.6 to 8.11)

References:

1. Simmons. G.F., Differential Equations, 1979, Tata McGraw Hill, New York, US.
2. Sanchez. D.A. and Freeman, 1968, Ordinary Differential Equations and Stability Theory, Dover Publications, New York, US.
3. Grimzhiaw. R., Nonlinear Ordinary Differential Equations, 1993, CRC Press, Florida, US.

Course Designers:

1. Dr. D. Pandiaraja
2. Dr. M. Senthilkumaran

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	The general phase plane-some	4
1.2	population models	4
1.3	Linear approximation at equilibrium points	5
1.4	The general solution of linear autonomous plane systems	5
2.1	An energy balance method for limit cycles	3
2.2	Amplitude and frequency estimates:Polar Coordinates	5
2.3	An averaging method for spiral phase paths	4
2.4	Periodic solutions: harmonic	3
2.5	The equivalent linear equation by harmonic balance problems.	3
3.1	Nonautonomous systems: forced oscillations -	3
3.2	The direct perturbation method for the undamped Duffing's equation	3
3.3	Forced oscillations far from resonance - Forced oscillations near resonance with weak excitation	3
3.4	The amplitude equation for the undamped pendulum - The amplitude equation for a damped pendulum	3
3.5	Periodic solutions of autonomous equations (Lindstedt's method) - Forced oscillation of a self-excited equation	2

3.6	The perturbation method and Fourier series	4
4.1	Poincaré stability (stability of paths)	4
4.2	Paths and solution curves for general systems	4
4.3	Stability of time solutions: Liapunov stability	3
4.4	Liapunov stability of plane autonomous linear systems	3
4.5	Structure of the solutions of *n*-dimensional linear systems.	4
5.1	Stability and boundedness for linear systems	4
5.2	Stability of linear systems with constant coefficients	2
5.3	Linear approximation at equilibrium points for first-order systems in *n* variables	4
5.4	Linear approximation at equilibrium points for first-order systems in *n* variables	4
5.5	Stability of a class of non-autonomous linear systems in *n* dimensions- Stability of the zero solutions of nearly linear systems - Problems.	4
Total		**90**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
PMA19CE32(C)	**Fuzzy Sets and Fuzzy Logic**	**Elective**	**4**	**2**	**-**	**4**

L - Lecture T - Tutorial P – Practicals

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

Preamble

Fuzzy sets and Fuzzy logic introduce the concept of uncertainty and fuzziness and deals with the 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 Level (according to Bloom's Taxonomy)
CO1	Define and illustrate the concept of fuzzy sets and crisp sets	K1,K2
CO2	Analyze the axioms and build operations on fuzzy sets	K4,K3
CO3	Apply rules of inference and infer from various types of fuzzy propositions	K3, K4
CO4	Develop fuzzy controllers for real life problems and implement it in appropriate hardware	K3
CO5	Apply and assess multistage decision making in dynamic systems	K3,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**	

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 Principle 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 on Fuzzy numbers.

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/Sections
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

References:

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

Web Resources:

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

Course Designers:

1. Dr. K. Kayathri
2. Dr. M. Senthilkumaran

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Fuzzy Set: Introduction	1
1.2	Crisp Sets: an overview	1
1.3	Fuzzy sets: basic types	2
1.4	Fuzzy sets: basic concepts	3
1.5	Additional properties of α – Cuts	3
1.6	Representation of Fuzzy sets	3
1.7	Extension Principle for fuzzy sets	3
2.1	Types of Operations	1
2.2	Fuzzy Complements	3
2.3	Fuzzy intersections: t-Norms	4
2.4	Fuzzy Unions: t-Conorms	3
2.5	Combinations of operations	3
2.6	Fuzzy Arithmetic - Fuzzy numbers	2

2.7	Linguistic variables	1
2.8	Arithmetic operations on intervals	1
2.9	Arithmetic operations on Fuzzy numbers	2
3.1	Fuzzy Logic – Fuzzy Propositions	4
3.2	Fuzzy quantifiers	3
3.3	Linguistic Hedges	2
3.4	Inference from Conditional Fuzzy Propositions	3
3.5	Inference from Conditional and Qualified Propositions	3
3.6	Inference from Quantified Propositions	3
4.1	Fuzzy Systems – General discussion	1
4.2	Fuzzy Controllers: an overview	5
4.3	Fuzzy Controllers: an example	3
4.4	Fuzzy systems and Neural Networks –	2
4.5	Fuzzy Neural Networks	2
4.6	Fuzzy Automata	4
4.7	Fuzzy Dynamic systems	1
5.1	Fuzzy Decision Making – General Discussion	1
5.2	Individual Decision Making	3
5.3	Multiperson Decision Making	3
5.4	Multicriteria Decision Making	2
5.5	Multistage Decision Making	4
5.6	Fuzzy ranking methods	2
5.7	Fuzzy linear programming	3
Total		90

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 joined M.Sc. Mathematics on or after June 2019)

Course Code	Course Title	Category	L	T	P	Credit
PMA19CE41(A)	**Difference Equations**	**Elective**	**4**	**2**	**-**	**4**

L - Lecture T - Tutorial P – Practicals

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

Preamble

This course present an overview of the various facets of difference equations that can be studied by elementary mathematical methods.

Prerequisite

Knowledge in elementary analysis and Linear algebra.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Define difference operator and demonstrate generating functions and approximate summation.	K1, K2
CO2	Build solutions to linear difference equations and explain the applications of difference equations.	K2,K3,K5
CO3	Find the Z transform of a function.	K1
CO4	Analyze the stability of linear systems.	K4
CO5	Find approximations of solutions that are accurate for large t.	K1

Mapping of COs with PSOs

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

Difference calculus: Difference Operator – Summation - Generating function and Approximate Summation.

Unit II **(18 Hours)**

Linear Difference Equations: First order equations – General results for linear equations – Solving Linear Equations - Applications.

Unit III **(18 Hours)**

Equations with variable coefficients – The Z-Transform.

Unit IV **(18 Hours)**

Stability Theory: Initial Value Problems for linear Systems – Stability of linear systems – Phase Plane Analysis of Linear systems.

Unit V **(18 Hours)**

Asymptotic Methods: Introduction – Asymptotic analysis of sums – Linear equations.

Text Book:

Kelley W.G. and Peterson A.C., Difference Equations, 2nd edition, Academic Press, New York, 1991.

Unit	Chapter/ Section
I	2(2.1 - 2.3)
II	3(3.1- 3.4)
III	3(3.5 and 3.7)
IV	4(4.1 - 4.3)
V	5(5.1 to 5.3)

References:

1. Elaydi S.N., An Introduction to Difference Equations, Springer Verlag, New York, 1995.
2. Agarwal R.P., Difference Equations and Inequalities, Marcel Dekkar, New York, 1992.

Course Designers:

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

Lecture Schedule:

Unit	Topic	Lecture hrs.
1.1	Difference Operator	6
1.2	Summation	6
1.3	Generating function and Approximate Summation.	6
2.1	First order equations	5
2.2	General results for linear equations	4
2.3	Solving Linear Equations	5
2.4	Applications	4
3.1	Equations with variable coefficients	9
3.2	The Z-Transform	9
4.1	Initial Value Problems for linear Systems	6
4.2	Stability of linear systems	6
4.3	Phase Plane Analysis of Linear systems	6
5.1	Introduction	1
5.2	Asymptotic analysis of sums	8
5.3	Linear equations	9
Total		**90**

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 joined M.Sc. Mathematics on or after June 2019)

Course Code	Course Title	Category	L	T	P	Credit
PMA19CE41(B)	**Stochastic Processes**	**Elective**	**4**	**2**	**-**	**4**

L - Lecture T - Tutorial P – Practicals

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

Preamble

The course deals with the generating functions, Markov Chains, Poisson processes, Renewal processes and Queuing models.

Prerequisite

Knowledge in Probability concepts and Queuing theory.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Recall Markov chains and explain the generalization of independent Bernoulli trails.	K1, K2, K5
CO2	Classify states and chains and analyze stability of a Markov system	K2, K4
CO3	Demonstrate and apply renewal theorems.	K2, K3
CO4	List and illustrate renewal processes in continuous time using Wald's equation	K1, K3
CO5	Analyze transient behaviour of Queuing models	K4

Mapping of COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**M**	**S**			
CO2	**S**				
CO3		**S**		**S**	
CO4	**S**				
CO5				**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 **(18 Hours)**

Stochastic Processes: An introduction – Specification of Stochastic processes – Definitions and examples of Markov chains – Higher Transition probabilities – Generalization of Independent Bernoulli trails : Sequence of chain-Dependent trails.

Unit II **(18 Hours)**

Classification of states and chains – Determination of higher transition probabilities – stability of a Markov system – Reducible chains – Markov chains with continuous state space.

Unit III **(18 Hours)**

Poisson process – Poisson process and related distributions – Generalization of Poisson process – Birth and Death process – Markov processes with discrete state space (continuous time Markov Chains)

Unit IV **(18 Hours)**

Renewal processes – Renewal processes in continuous time – Renewal equation – Stopping time : Wald's equation – Renewal theorems.

Unit V **(18 Hours)**

Queueing systems and models – Birth and death processes – Non-Markovian queueing models.

Text Book:

Medhi. J, Stochastic Processes, New Age International Publishers, 3rd edition, 2012, New Delhi.

Unit	Chapter / Section
I	1.5, 2.1 – 2.3
II	2.4 – 2.6, 2.9, 2.11
III	3.1 – 3.5
IV	6.1 – 6.5
V	10.1 – 10.3(omit 10.2.2 and 10.2.3)

References:

1. 1. Karlin, S. and Taylor, H.M. (1975) :A First Course in Stochastic Process, Vol.I, Academic Press, Cambridge.
2. Box, G.E.P. and Jenkins, G.M. (1976) : Time Series Analysis - Forecasting and Control. Holden-Day, San Francisco.
3. Makridakis,Wheelwright&Hndman(2005):Forecasting – Methods and Applications, Third edition, Wiley, NY.
4.Shenoy,Srivastav&Sharma(2009).:Business Statistics,1st edition, New age International Publisher, New Delhi.
5. Granger, C.W.J. and Newbold, (1984) :Forecasting Econometric Time Series, Third Edition, Academic. 2.Anderson, T.W. (1971) :The Statistical Analysis of Time Series, Wiley, NY.
6.Kendall, M.G. and Stuart, A. (1966) :The advanced Theory of Statistics, Vol.3, Charles Griffin, London.

Course Designers:

1. Dr. G. Prabakaran
2. Dr. M. Senthilkumaran

Lecture Schedule:

Unit	Topic	Lecture Hours
1.1	Introduction	3
1.2	Specification of Stochastic processes	3
1.3	Definitions and examples of Markov chains	3
1.4	Higher Transition probabilities	3
1.5	Generalization of Independent Bernoulli trails	3
1.6	Sequence of chain-Dependent trails	3
2.1	Classification of states and chains	3
2.2	Determination of higher transition probabilities	4
2.3	Stability of a Markov system	4
2.4	Reducible chains	3
2.5	Markov chains with continuous state space	4
3.1	Poisson process and related distributions	5
3.2	Generalization of Poisson process	5
3.3	Birth and Death process	4
3.4	Markov processes with discrete state space	4
4.1	Renewal processes in continuous time	4
4.2	Renewal equation	5
4.3	Wald's equation	5
4.4	– Renewal theorems.	4
5.1	Queueing systems and models	6
5.2	Birth and death processes	6
5.3	Non-Markovian queueing models.	6
Total		**90**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
PMA19CE41(C)	**Dynamical Systems**	**Elective**	**4**	**2**	**-**	**4**

L - Lecture T - Tutorial P–Practicals

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

Preamble

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

Prerequisite

Knowledge in basic linear algebra and familiarity with differential equations.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	List the basic existence and uniqueness theorem for initial value problems.	K1
CO2	Develop the knowledge to analyze the dynamical behavior of systems using differential equations.	K3,K4
CO3	Interpret the concept of nonlinear systems, global existence theorem, Periodic orbits and The Poincare map.	K2,K5
CO4	Improve their problem solving skills in nonlinear dynamical systems.	K3
CO5	Build a mathematical models of relevant real-world problems based on differential equations.	K3

Mapping of COs with PSOs

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

Blooms taxonomy

	CA		End of Semester
	First(Marks)	Second(Marks)	(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)**

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

Unit II **(18 Hours)**

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

Unit III **(18 Hours)**

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

Unit IV **(18 Hours)**

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

Unit V **(18 Hours)**

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

Text Book:

Lawrence Perko, 2001, Differential Equations and Dynamical Systems, 3rd Edition, Springer, New York, US.

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

References:

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

Course Designers:

1. Dr. M. Senthilkumaran
2. Dr. D. Pandiaraja

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Uncoupled linear systems	3
1.2	Diagonalization	3
1.3	Exponential of Operators	4
1.4	The Fundamental theorem for linear systems	4
1.5	Linear System in R^2	4
2.1	Complex Eigenvalues	3
2.2	Multiple Eigen values	5
2.3	Jordan forms	4
2.4	Stability theory	3
2.5	Nonhomogeneous Linear Systems.	3
3.1	Some preliminary Concepts and Definitions	4
3.2	The fundamental Existense-Uniqueness theorem	5
3.3	Dependence on initial conditions and parameters	4
3.4	The maximal Interval of Existence	5
4.1	The flow defined by a Differential equation	4
4.2	Linearization - The stable manifold theorem	4
4.3	The Hartman-Grogman theorem – Stability and Liapunov Functions	6
4.4	Saddles, Nodes, Foci and Centers.	4
5.1	Dynamical Systems and Global Existence Theorem	4
5.2	Limit sets And Attractors	5
5.3	Periodic Orbits, Limit Cycles and Separatrix Cycles	4
5.4	The Poincare map	5
Total		**90**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
PMA19PJ41	**Project**	**Core**	**-**	**-**	**-**	**5**

L - Lecture T - Tutorial P–Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
Second	Fourth	40	60	100

The students who pass out of postgraduate course in Mathematics must be capable of first-hand experience and independent judgment. To achieve these goals the project at the end of the course is expected to provide the tools necessary to develop these essential skills, which will help them later in their career as research scholars and teachers.

The choice of the topic for the project can be from a wide range of subjects, but a text or topic prescribed for study should be strictly avoided.

The length of the project report will be 30 - 60 pages in the standard format.

M.Sc. Mathematics

Assessment values of course learning outcomes and their mapping with program specific outcomes (PSOs)

Major papers

Title of the courses	PSO1	PSO2	PSO3	PSO4	PSO5
Groups and Rings	9	7	4	3	4
Real Analysis	6	2	3	5	3
Ordinary Differential Equations	6	3	3	5	2
Number Theory	9	5	9	3	5
Applied Numerical Analysis	2	3	3	6	3
Lab in Numerical Analysis	3	3	3	2	3
Flip Class					
Theory of Fields	12	6	3	4	7
Complex Analysis	9	10	2	4	6
Topology	5	6	6	6	3
Partial Differential Equations	3	3	8	5	5
Graph Theory	5	6	7	9	2
Linear Algebra	9	4	3	3	5
Mechanics	6	6	5	4	2
Functional Analysis	8	5	2	2	8
Elective – I(List enclosed)					
Elective – II(List enclosed)					
Mathematical Statistics	6	2	3	6	2
Measure and Integration	9	2	3	7	2
Optimization Techniques	3	6	7	2	5
Elective – III(List enclosed)					
Project work					

Major Electives I and II Papers

Title of the courses	PSO1	PSO2	PSO3	PSO4	PSO5
Combinatorics	6	3	8	4	5
Fluid Dynamics	8	8	2	3	2
Differential Geometry	6	3	2	6	3
Theory of Computation	3	6	2	6	6
Non linear differential equations	3	5	3	3	5
Fuzzy Sets and Fuzzy Logic	2	9	8	10	3

Major Elective III Papers

Title of the courses	PSO1	PSO2	PSO3	PSO4	PSO5
Difference Equations	**2**	**8**	**3**	**5**	**3**
Stochastic Processes	**8**	**6**	**0**	**5**	**3**
Dynamical Systems	**3**	**9**	**7**	**5**	**5**

Diploma Course

Title of the courses	PSO1	PSO2	PSO3	PSO4	PSO5
Diploma in Mathematica	**3**	**3**	**3**	**3**	**4**

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 2019)

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

The objectives of this programme is to equip/prepare the students

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 2019)

M. Phil. MATHEMATICS
COURSE STRUCTURE (w.e.f. 2019 – 2020 batch onwards)

Semester – I

Code No	Subject	Contact Hrs / Week	Credits	Total No of Hrs Allotted	Max Marks CA	Max Marks SE	Total
MMA19C11	Research Methodology and Module Theory	6	6	90	100	100	200
MMA19C12	Advanced Analysis	6	6	90	100	100	200
MMA19CE11	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
MMA19D21	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 2019)

Course Code	Course Title	Category	L	T	P	Credit
MMA19C11	**Research Methodology and Module Theory**	**Core**	**6**	**-**	**-**	**6**

L - Lecture T - Tutorial P–Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	100	100	200

Preamble

The course deals with the methodology of research, theory of modules and document preparation system using LATEX.

Prerequisite

Fundamental knowledge in commutative algebra and computer programming is required.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Develop abstract mathematical thinking	K3,K6
CO2	Design mathematical documents using LATEX software	K6
CO3	List and Explain fundamentals of abstract algebra	K1, K2, K5
CO4	Analyze Modules, submodules, quotient modules and local properties of fractions	K4
CO5	Explain Noetherian and Artin Rings in research level	K2,K5

Mapping of COs with PSOs

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

Blooms taxonomy

	CA		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge – K1	20	20	-
Understand – K2	20	20	40
Apply – K3	20	20	40
Analyze –K4	20	20	40
Evaluate- K5	20	20	40
Create – K6	20	20	40

Contents

Unit I

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

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

Unit III

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

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

Unit V

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

Text Books:

1. C.R. Kothari 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. M.F. Atiyah 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. R. Panneerselvam, 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

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Meaning of Research – Objectives of Research – Motivation in Research	3
1.2	Types of Research – Research Approaches – Significance of Research	3
1.3	Research Methods versus Methodology – Research and Scientific Method – Importance of Knowing How Research is Done	3
1.4	Research Process – Criteria of Good Research – Problems- Encountered by Researchers in India – What is a Research Problem? – Selecting the Problem	3
1.5	Necessity of Defining the problem – Techniques	3

	Involved in Defining a Problem – Meaning of Research Design – Need for Research Design	
1.6	Features of a Good Design – Important Concepts Relating to Research Design – Different Research Designs – Basic Principles of Experimental Designs.	3
2.1	The Basics – The Document	3
2.2	Bibliography – Bibliographic Databases	3
2.3	Table of contents , Index and Glossary	3
2.4	Displayed Text – Rows and Columns	4
2.5	Typesetting Mathematics	5
3.1	Modules and module homomorphisms - Submodules and quotient modules	3
3.2	Operations and submodules – Direct sum and product	3
3.3	Finitely generated modules – Exact sequences	3
3.4	Tensor product of modules –Restriction and extension of scalars	3
3.5	Exactness properties of the tensor product	2
3.6	Algebras – Tensor product of algebras	4
4.1	Local properties	9
4.2	Extended and contracted ideals in rings of Fractions	9
5.1	Noetherian rings	6
5.2	Primary Decomposition in Noetherian rings	6
5.3	Artin rings	6
Total		**90**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
MMA19C12	**Advanced Analysis**	**Core**	**6**	**-**	**-**	**6**

L - Lecture T - Tutorial P - Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	100	100	200

Preamble

The course provides advance knowledge in the Analysis of measure theory, Banach Algebra, Topology and Vector spaces.

Prerequisite

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 (according to Bloom's Taxonomy)
CO1	Recall and identify regular and singular elements in a Banach Algebra	K1, K3
CO2	Find the spectral radius and Develop Gelfand mappings on commutative Banach algebra	K1,K3, K6
CO3	Recall and Illustrate integration as a Linear functional corresponding to finite positive Borel measure	K1,K2
CO4	Classify and analyze various properties of topological vector spaces	K2,K4
CO5	Define and apply Seminorms and Prove various properties on function spaces	K1,K3,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**

Blooms taxonomy

	CA		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge – K1	20	20	-
Understand – K2	20	20	40
Apply – K3	20	20	40
Analyze –K4	20	20	40
Evaluate- K5	20	20	40
Create – K6	20	20	40

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

Lecture Schedule

Unit	Topic	Lecture hrs.
1.1	Definition and examples – Regular and singular elements	6
1.2	Topological divisors of zero	3
1.3	The spectrum – The formula for the spectral radius	6
1.4	The radial and semi-simplicity	3
2.1	The Gelfand mapping – Application of the formula r(x) = lim ||xn||	6
2.2	Involution in Banach algebras	3
2.3	The Gelfand Neumark theorem	3
2.4	Ideals in and the Banach-Stone theorem	6
3.1	Positive Borel Measures	3
3.2	:The Riesz representation theorem	6
3.3	Regularity Properties of Borel Measures-Lebesgue measure	3
3.4	Continuity properties of measurable functions	6
4.1	Toplogical vector spaces	3
4.2	Separation properties – Linear mappings	6
4.3	Finite Dimensional spaces- Metrization	6
4.4	Boundedness and continuity- Bounded linear transformations	3
5.1	Seminorms and local convexity	3
5.2	Quotient spaces	3
5.3	Seminorms and quotient spaces	6
5.4	The spaces L^p with $(0 < p < 1.)$	6
Total		**90**

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
MMA19CE11(A)	**Stochastic Differential Equations and Applications**	**Elective**	**-**	**-**	**-**	**6**

L - Lecture T - Tutorial P - Practicals

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

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 (according to Bloom's Taxonomy)
CO1	Explain the Ito Stochastic integral	K2,K5
CO2	Discuss the theory of existence and uniqueness of the solutions to Stochastic differential equations	K6
CO3	Define stability properties of Stochastically differential equation	K1
CO4	Develop Stochastic simulations in their respective field of interest	K3,K6
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**

Blooms taxonomy

	CA		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge – K1	20	20	-
Understand – K2	20	20	40
Apply – K3	20	20	40
Analyze –K4	20	20	40
Evaluate- K5	20	20	40
Create – K6	20	20	40

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:

1. 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. Bernt Oksendal, Reprint 2011, Stochastic Differential Equations, Springer, 6th Edition, New York.

2.Avner Friedman, 2004, Stochastic Differential Equations and Applications, Dover Publications, New York.

Course Designers:

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

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
MMA19CE11(B)	**Magic Labelings of Graphs**	**Elective**	**-**	**-**	**-**	**6**

L - Lecture T - Tutorial P - Practicals

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

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 (according to Bloom's Taxonomy)
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.	K2
CO4	Recall the forbidden configurations for totally magic labelings and determine the totally magic graphs.	K1,K5
CO5	Develop research skills by analyzing the properties of super edge-magic graceful graphs.	K3,K4, K6

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**

Blooms taxonomy

	CA		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge – K1	20	20	-
Understand – K2	20	20	40
Apply – K3	20	20	40
Analyze –K4	20	20	40
Evaluate- K5	20	20	40
Create – K6	20	20	40

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:

1. 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. P. Jeyanthi, Studies in Graph Theory – Magic labeling and related concepts, LAP lambert Academic Publishing, Germany, 2012.

2. Susana C. López and Francesc A. Muntaner-Batle, Graceful, Harmonious and Magic TypeLabelings - Relations and Techniques, Springer, New York, 2019.

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
MMA19CE11(C)	**Transform Theory on Function Spaces**	**Elective**	**-**	**-**	**-**	**6**

L - Lecture T - Tutorial P - Practicals

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

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 (according to Bloom's Taxonomy)
CO1	Define and analyze Fourier Transform on L^p space	K1,K4
CO2	Demonstrate and develop Fourier Transform on L^1 space	K2,K6
CO3	Find, illustrate and compare the relationship between L^p space and continuous function	K1,K2,K5
CO4	Recall and extend the Gelfand Theory of Commutative Banach algebras	K1,K2
CO5	Identify and Classify Maximal ideal space of Bounded Holomorphic functions.	K2,K3,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**

Blooms taxonomy

	CA		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge – K1	20	20	-
Understand – K2	20	20	40
Apply – K3	20	20	40
Analyze –K4	20	20	40
Evaluate- K5	20	20	40
Create – K6	20	20	40

Contents

Unit I **(18 hours)**

Convex functions and inequalities - The L^p Spaces – Approximation by continuous functions.

Unit II **(18 hours)**

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

Unit III **(18 hours)**

Fourier transforms on L^p (R).

Unit IV **(18 hours)**

Ideals and homomophism – Homomorphisms and quotient algebras - Gelfand transforms .

Unit V **(18 hours)**

On Maximal Ideal space of Bounded Holomorphic functions.

Text Books:

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

Web Resources:

1. Devendra Kumar and Dimple Singh, Fourier Transform in L^p (R) Spaces, $p \geq 1$ Gen. Math. Notes, Vol. 3, No. 1, March 2011, pp.14-25 ISSN 2219-7184.
2. Hermann Render , The Maximal Ideal Space Of H∞(D) With Respect To The Hadamard Product, Proceedings Of The American Mathematical Society Volume 127, Number 5, Pages 1409–1411 S 0002-9939(99)04697-3 Article electronically published on January 29, 1999.

Course Designers:

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

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
MMA19CE11(D)	**Theory of Domination in Graphs**	**Elective**	**6**	**-**	**-**	**6**

L - Lecture T - Tutorial P – Practicals

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

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 (according to Bloom's Taxonomy)
CO1	Find and illustrate the relation among domination, independence and covering	K1, K2
CO2	Define and develop new domination parameters	K1, K3, K6
CO3	Build advanced ideas in domination	K3,K6
CO4	Identify and classify the properties of domination through polynomials	K2, K3, 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**

Blooms taxonomy

	CA		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge – K1	20	20	-
Understand – K2	20	20	40
Apply – K3	20	20	40
Analyze –K4	20	20	40
Evaluate- K5	20	20	40
Create – K6	20	20	40

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. T. W. Haynes, S. T. Hedetniemi and Peter J. Slater, 1998. Fundamentals of domination in Graphs, Marcel Dekker Inc, New York.

Research Articles:

1. Saeid Alikhani 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. V. R. Kulli, 2010, Theory of domination in graphs, Vishwa International Publications, Gulbarga
2. Martin Baca and Mirka Miller, 2008, Super Edge-Antimagic Graphs-A Wealth of Problems and Some Solutions, Brown Walker Press, USA

Course Designers:

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

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
MMA19CE11(E)	**Algorithmic Graph Theory**	**Elective**	**-**	**-**	**-**	**6**

L - Lecture T - Tutorial P – Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	100	100	200

Preamble

The course deals with basic principles of algorithm design techniques, some of the graph theoretical algorithms and the theory of NP completeness

Prerequisite

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 (according to Bloom's Taxonomy)
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,K4
CO3	Develop minimal spanning tree algorithms and analyze the algorithms	K3,K6
CO4	Explain the theory of NP – completeness	K2, K5
CO5	Design some new Graph coloring algorithms and analyze the complexity.	K4,K6

Mapping of COs with PSOs

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

Blooms taxonomy

	CA		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge – K1	20	20	-
Understand – K2	20	20	40
Apply – K3	20	20	40
Analyze –K4	20	20	40
Evaluate- K5	20	20	40
Create – K6	20	20	40

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 Books:

1. Thomas H.Corman, Charles E.Leiserson, Ronald L.Rivest, Clifford Stein , 2010, Introduction to Algorithms , Third Edition, PHI Learning Private Limited, New Delhi.

Units I – IV - Text Book

Unit	Chapters/Sections
I	Chapter I : Sections 1 -3
II	Chapter VI :Section 22
III	Chapter VI : Sections 23
IV	Chapter VII :Section 34
V	Journal

References:

1. Ellis Horowitz, Sartaj Sahni, 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. R.C.T. Lee, S.S.Tseng, R.C.Chang, Y.T.Tsai,2013, Introduction to Design and Analysis of Algorithms A Strategic Approach, McGraw Hill Education (India) Private Limited, New Delhi
4. William Kocky, Donald L.Kreher, "Graphs, Algorithms,, and Optimization, 2005, CRC Press.

Course Designer:

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

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
MMA19CE11(F)	**Delay Differential Equations and Applications**	**Elective**	**6**	**-**	**-**	**6**

L - Lecture T - Tutorial P - Practicals

Year	Semester	Int. Marks	Ext. Marks	Total
First	First	100	100	200

Preamble

Delay differential equations(DDEs) are a type of differential equation in which the derivative of the unknown function at a certain time is given in terms of the values of the function at previous times. This course provides an introduction to DDEs that discusses the fundamental concepts and properties of DDEs and present stability properties of HIV model.

Prerequisite

Post Graduate students should have taken a first course in Ordinary Differential equations and have a familiarity with Complex analysis. A course in Dynamical Systems would be helpful.

Course Outcomes

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

#	Course Outcome	Knowledge Level (according to Bloom's Taxonomy)
CO1	Recall the basic concepts of delay differential equation	K1
CO2	Explain the stability concepts in various problems	K2, K5
CO3	Construct the Liapunov functions for delay differential equations	K3, K6
CO4	Analyze and Find Hopf bifurcation for delay differential equation	K1,K4
CO5	Explain stability and Hopf bifurcation in a delayed model for HIV	K2,K5

Mapping of COs with PSOs

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

Blooms taxonomy

	CA		End of Semester Marks
	I Internal Marks	II Internal Marks	
Knowledge – K1	20	20	-
Understand – K2	20	20	40
Apply – K3	20	20	40
Analyze –K4	20	20	40
Evaluate- K5	20	20	40
Create – K6	20	20	40

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:

1. 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. Applied Delay Differential Equations, Thomas Erneux, Springer, 2009.
2. Delay Differential Equations with Applications in Population Dynamics, Yang Kuang, Academic press, 1993.
3. Stability and Oscillation of Delay Differential equations of Population Dynamics, Gobalsamy. K, Springer, 2013.

Course Designers:

1. Dr. M. Senthilkumaran
2. Dr. D. Pandiaraja

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 2019)

Course Code	Course Title	Category	L	T	P	Credit
MMA19D21	**Dissertation**	**Core**	**-**	**-**	**-**	**6**

L - Lecture T - Tutorial P–Practicals

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.

M.Phil. Mathematics

Assessment values of course learning outcomes and their mapping with program specific outcomes (PSOs)

Title of the courses	PSO1	PSO2	PSO3	PSO4	PSO5
Research Methodology and Module Theory	**3**	**5**	**6**	**7**	**2**
Advanced Analysis	**3**	**8**	**8**	**4**	**2**
Elective (In depth study)(List enclosed)					
Dissertation					

Elective Papers (In depth study)

Title of the courses	PSO1	PSO2	PSO3	PSO4	PSO5
Stochastic Differential Equations and Applications	**6**	**5**	**6**	**2**	**4**
Magic Labelings of Graphs	**6**	**5**	**3**	**9**	**6**
Transform Theory on Function Spaces	**9**	**4**	**8**	**7**	**6**
Theory of Domination in Graphs	**6**	**5**	**7**	**5**	**4**
Algorithmic Graph Theory	**3**	**6**	**3**	**5**	**7**
Delay Differential Equations and Applications	**6**	**3**	**3**	**5**	**4**