B.Sc., Mathematics

Programme Code - UMA

(Aided & SF)

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

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

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

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

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

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

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

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

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

The objectives of this programme is

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

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

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

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

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS
(For those who joined **B.Sc. Mathematics** on or after June 2020)
COURSE STRUCTURE (w.e.f. 2020 batch onwards)

Semester – I

Course	Code No.	Subject	Contact Hours / Week	Credits	Total No. of Hours Allotted	Max. Marks CA	Max. Marks SE	Total
Part I - Tamil	U20P1211	Tamil	6	3	90	25	75	100
Part II - English	U20EN11	English	6	3	90	25	75	100
Core 1	UMA20C11	Calculus	5	4	75	25	75	100
Core 2	UCO20C12	Financial Accounting	5	5	75	25	75	100
Allied(C)-1	UCH20GE11M	General Chemistry - I	4	4	60	25	75	100
Allied (C) - 1 Lab	UCH20GL21 M	Ancillary Chemistry Lab	2	-	30	-	-	-
AECC	U20ES11	Environmental Studies	2	2	30	15	35	50
TOTAL			**30**	**21**				

Semester – II

Course	Code No.	Subject	Contact Hours / Week	Credits	Total No. of Hours Allotted	Max. Marks CA	Max. Marks SE	Total
Part I– Tamil	U20P121	Tamil	6	3	90	25	75	100
Part II –English	U20EN21	English	6	3	90	25	75	100
Core 3	UMA20C21	Algebra and Trigonometry	5	4	75	25	75	100
Core 4	UCO20C22	Cost and Management Accounting	5	5	75	25	75	100
Allied (C) – 1	UCH20GE21M	General Chemistry - II	4	4	60	25	75	100
Allied (C) - 1 Lab	UCH20GL21M	Ancillary Chemistry Lab	2	2	30	40	60	100
AECC	U20VE21	Value Education	2	1	30	15	35	50
TOTAL			**30**	**22**				

Semester – III

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

Semester – IV

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

Semester – V

Course	Code No.	Subject	Contact Hours / Week	Credits	Total No. of Hours Allotted	Max. Marks CA	Max. Marks SE	Total
Core 9	UMA20C51	Linear Algebra	6	5	90	25	75	100
Core 10	UMA20C52	Real Analysis	6	5	90	25	75	100
Core 11	UMA20C53	Linear Programming Problems	6	5	60	25	75	100
Core 12	UMA20C54	Programming in C	5	4	75	25	75	100
Core Elective 1	UMA20CE51 ( )	Options given	5	5	75	25	75	100
SEC 1	UMA20SE51 ( )	Options given	2	2	30	15	35	50
TOTAL			**30**	**26**				
	UMA20IN	**Internship**		**2**				

Self Study Paper* 05 Credits (extra)

Semester – VI

Course	Code No.	Subject	Contact Hours / Week	Credits	Total No. of Hours Allotted	Max. Marks CA	Max. Marks SE	Total
Core 13	UMA20C61	Complex Analysis	6	5	90	25	75	100
Core 14	UMA20C62	Probability and Statistics	6	5	90	25	75	100
Core 15	UMA20C63	Resource Management Techniques	6	5	90	25	75	100
Core 16	UMA20C64	Numerical Methods	5	4	75	25	75	100
Core Elective 2	UMA20CE61 ( )	Options given	5	5	75	25	75	100
SEC2	UMA20SE61 ( )	Options given	2	2	30	15	35	50
Part V		**NCC/NSS/Physical Education**	-	1	-	100	-	100
TOTAL			**30**	**27**				
TOTAL CREDITS FOR SEMESTERS I to VI				**140**				

SEC (2 Hours / week)

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

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

1) Fundamental Principles of Counting
2) Mathematical Logic

Core Electives for Semester V

1) Mechanics
2) Combinatorics
3) Cryptography

Core Electives for Semester VI

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

Self study paper: Soft Skills

A) Consolidation of contact hours and credits: UG

Semester	Contact Hrs/ Week	Credits
I	30 hrs	21
II	30 hrs	22
III	30 hrs	21
IV	30 hrs	23
V	30 hrs	26
VI	30 hrs	26
Part – V	-	01
Total	**180 hrs**	**140**
V	Internship	2
	Additional credit (Self study paper)	5

B) Curriculum Credits: Part wise

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

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

Course Code	Course Title	Category	L	T	P	Credits
UMA20C31	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 of first order and higher order differential equations, systems of differential equations, and partial differentialequations.Laplace transforms and its application in solving ordinary differential equations are studies in detail.

CourseOutcomes

On the completion of the course the student will be ableto

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Classify the differential equations into ordinary, partial and linear	80	70
CO2	Solve differential equations employing various techniques	75	70
CO3	Find Laplace transform of specified functions and solve initial value problems using it	80	70
CO4	Construct differential equations from the given relation and solve them	75	70
CO5	Identify the appropriate tools to solve real world problems in the field of physics and engineering	70	65

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Bloom'staxonomy

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

Contents

UnitI **(12 Hours)**

Differential Equations of First Order: Exact Differential Equations – Integrating Factors – Linear Equations – Bernoulli's Equations – Equations of First Order and Higher Degree.

UnitII **(18 Hours)**

Linear Equations of Higher Order: Introduction - Linear Equations with Constant Coefficients – Methods of finding Complementary Functions – Methods of finding Particular Integrals – Homogeneous Linear Equations – Linear Equations with Variable Coefficients – Simultaneous Linear Differential Equations – Total Differential Equations.

UnitIII **(15 Hours)**

Laplace Transform: Introduction-Inverse Laplace Transform – Solution using Laplace Transform.

UnitIV **(15 Hours)**

Partial Differential Equations: Introduction-Formation of Partial Differential Equations- First Order Partial Differential Equations –Solving First Order Partial Differential Equations – Some Standard Forms – Charpit's Method.

UnitV **(15 Hours)**

Applications of Differential Equations: Introduction-Orthogonal Trajectories–Growth and Decay – Continuous Compound Interest – Simple Electric Circuits – Falling Bodies - Simple Harmonic Motion-Simple Pendulum.

Text Book:

Arumugam S., Thangapandi Isaac A. and Somasundaram A., 2020, Differential Equations and Applications, Yes Dee Publishing Private Limited, India.

Unit	Chapter/Section
I	1 (1.4 – 1.8)
II	2
III	3
IV	4
V	6 (6.1 – 6.4, 6.7 – 6.10)

References:

1.Daniel A. Murray, 2012, Introductory Course in Differential Equations, University Press, New Delhi.

2.Erwin Kreyszig, 2016, Advanced Engineering Mathematics, Wiley, 10th Edition, NewDelhi.

3. Grewal B.S., (Reprint) 2018, Higher Engineering Mathematics, 44th Edition – Khanna Publications.

4.Raisinghania M.D., 2018, Advanced Differential Equations, 19th Edition, S. Chand., NewDelhi.

CourseDesigners:

1. Mrs. K. Ponmari
2. Dr. S. Vijaya

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Course Code	Course Title	Category	L	T	P	Credits
UMA20C32	Analytical Geometry of 3D and Vector Calculus	Core	4	1	-	4

L - Lecture T - Tutorial P– Practical

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

Preamble

The course aims to study the three dimensional geometrical shapes such as Plane, Line, Sphere, Cone and Cylinder and also the vector differentiation and vector integration. It provides an overview about three dimensional shapes. Also it deals the inter connection between the line integral, surface integral and volume integral through the integral theorems.

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Utilize plane concepts in three dimensional spaces	80	70
CO2	Solve the problems related to lines and planes	80	70
CO3	Demonstrate the Sphere, Cone and Cylinder concepts and relate their properties	80	65
CO4	Extend the concepts of differentiation in vector algebra	80	70
CO5	Illustrate line integrals, surface integrals and apply Stokestheorem, Gauss divergence theorem and Green's theorem	80	65

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Bloom's Taxonomy

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

Contents

Unit I **(15 Hours)**

Direction Cosines of a Line: Direction cosines –Direction ratios-The projection of the line joining two points on any other line- Direction cosines of the line joining two points-Angle between the lines-conditions for perpendicularity and parallelism.

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

Unit II **(15 Hours)**

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

Unit III **(20 Hours)**

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

Cone,Cylinder and Central quadrics: The equation ofa surface-cone- **i**ntersection of a straight line and a quadric cone-Tangent plane and normal-Condition for the plane to touch the quadric cone-The angle between the lines in which a plane cuts the cone-Condition that the cone has three mutually perpendicular generators-Cylinder.

Unit IV **(13 Hours)**

Gradient of a scalar point function and divergence and curl of a vector point function: Scalar and vector point functions- Level Surfaces – Directional Derivative of a scalar function- Gradient of a scalar point function – Summation notation for Gradient – Gradient of f(r)- Divergence and Curl of a vector Point function – Summation notation for Divergence and Curl- Laplacian Differential Operator – Other Differential Operators – Divergence and Curl of a Gradient – Divergence and Curl of a Curl – Examples.

Integration of point functions: Line integrals- Independent of Path of Integration – Conservative Field and Scalar potential – Line Integral of a Conservative Vector - Surface integrals-Volume integrals – Cylindrical and Spherical Polar Coordinates- Examples.

Unit V **(12 Hours)**

Integral theorems: Integral theorems- Gauss divergence theorem, Green's theorem in plane, Stoke'stheorem (Problems Only).

Text Books:

1. Duraipandian . P and Kayalal Panchaiyappa,(Reprint)2020,Vector Analysis, S.Chand and Company Limited, New Delhi.
2. ManikavachagamPillay.T.K. and Natarajan. T, 2017, A Text Book of Analytical Geometry(Part II- Three dimension), Ananda Book Depot,Chennai.

Unit	Book	Chapter/ Section
I	2	I(7 to 12),II(full)
II	2	III(1 to 8 & 10,11)

III	2	IV(full) and V(1 to 8)
IV	1	2(full) and 3(full)
V	1	4(4.1&4.8)

References:

1.Arumugam. S. and ThangapandiIsaac.A., 2014, Analytical Geometry of 3D and VectorCalculus,New Gamma publications,Palayamkottai.

2. Pandey. H.D., Dubey. S.K.D. and Pandey. S.N., 2011, A text book of Vector AnalysisandGeometry,Wisdom Press, NewDelhi.

Course Designers:

1. Mrs. R.Latha
2. Mrs. V.Kanchana Devi

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Course Code	Course Title	Category	L	T	P	Credits
UMA20C41	Algebraic Structures	Core	5	1	-	5

L - Lecture T - Tutorial P – Practicals

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

Preamble

The course aims to study the various types of algebraic structures. It provides a thorough discussion of the properties of structure preserving mappings in Groups, Rings, Vector Spaces and Fields. It classifies the various ideals and their characterizations in Rings. Also it explores he concepts of integral domain and unique factorization domain in detail.

Course Outcomes

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

#	Course outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Recall and analyze the fundamental concepts in algebraic structures	85	70
CO2	Summarize and develop the properties of Groups, Rings and Fields	80	70
CO3	Identify and classify the structure preserve mappings in algebraic structures	80	70
CO4	Construct and extend the properties of real numbers	75	75
CO5	Recall and demonstrate algebraic structures in various disciplines	80	75

Mapping of COs withPSOs

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

Mapping of COs with PO

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

Bloom's Taxonomy

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

Contents

Unit I **(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 Principal Integral Domain is a Unique Factorization Domain – Polynomial Rings – Polynomial Rings over Unique Factorization Domain. – Polynomials over Q.

Text Book:

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

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. Kenneth Hoffman and Ray Kunze, 2009, Linear Algebra, PHI Learning Pvt. Ltd., New Delhi.
3. Vijay K Khanna and Bhambri. S.K., 2011, A course in Abstract Algebra, Vikas Publishing House Pvt. Ltd., New Delhi.

Course Designers:

1. Dr. G. Prabakaran
2. Dr. P. Krishnaveni

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**

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Course Code	Course Title	Category	L	T	P	Credits
UMA20C42	**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 aims to study the convergence and divergence of sequences and series. It covers the limit superior and limit inferior of sequences of real numbers. It deals with the operations on convergent and divergent sequences. Also it provides the tests for convergence of series.

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Demonstrate uncountability of the set of real numbers	85	70
CO2	Analyze the convergence and divergence of sequences in real numbers	85	60
CO3	Illustrate the operations on convergent and divergent sequences	85	70
CO4	Find the limit superior, limit inferior of sequences and examine the convergence in real numbers	80	60
CO5	Deduct the summablity of sequences and series of real numbers	80	60

Mapping of COs with PSOs

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

Bloom's Taxonomy

Mapping of COs with POs

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

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

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 sequences and subsequences – 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, Reprint 2019, Methods of Real Analysis, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, ISBN 978-81-204-1757-1.

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. Arumugam, Isaac and Somasundaram, 2019, Sequences and Series, Yes Dee Publishing Pvt. Ltd., India.
2. Bali N.P., 2009, Sequences and Infinite Series, Firewall Media (An imprint of Laxmi Publications Pvt. Ltd., New Delhi, ISBN: 9788131800553.
3. Satish Shirali, Harikrishan L. Vasudeva, 2014, An introduction to Mathematical Analysis, Narosa Publishing House Pvt. Ltd., New Delhi, ISBN: 978-81-8487-323-8.
4. Somasundaram. D. and Choudhary. B., Corrected Edition, Reprint 2018, A first course in

Mathematical Analysis, Narosa Publishing House Pvt. Ltd., New Delhi, ISBN: 978-81-7319-064-3.

Course Designers:

1. Dr. K. Kayathri
2. Mr. K. V. Janarthanan

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS
(For those who joined B.A. / B.Sc. /B.Com. / B.B.A./ B.C.A.on or after June 2020)

Course Code	Course Title	Category	L	T	P	Credits
UMA20NE31	**Fundamental Principles of Counting**	**NME**	**2**	**-**	**-**	**2**

L - Lecture T - Tutorial P–Practicals

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

Preamble

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

Course Outcomes

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

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

B.Sc., Mathematics PSO

Mapping of COs with PSOs

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

Mapping of COs with POs

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

CO4	**M**	**S**	**M**	**L**	**L**	**M**
CO5	**S**	**S**	**M**	**M**	**M**	**M**

B.A. P.O.

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

B.B.A. P.O.

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

B.Com. P.O.

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

Bloom's Taxonomy

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

Contents

Unit I **(15 Hours)**

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 **(15 Hours)**

Permutations and Combinations -Solved Problems on Permutations and Combinations.

Text Book:

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

Unit	Chapter/Sections
I	Chapter 1 (1.1,1.3)
II	Chapter 1(1.2)

References:

1. Alan Tucker, 2012, Applied Combinatorics, 6th Edition, Wiley, New Jersey.
2.

Unit	Topic	Lecture hrs.
1.1	The Sum Rule and the Product Rule	4
1.2	Solved Problems on The Sum Rule and the Product Rule	6
1.3	The Pigeonhole Principle	2
1.4	Solved Problems on The Pigeonhole Principle	3
2.1	Permutations and Combinations	7
2.2	Solved Problems on Permutations and Combinations	8
Total		**30**

Krishnamurthy V., 1985, Combinatorics Theory and Applications, East- West Press Pvt. Ltd.,India.

3. Ralph P. Grimaldi, and RamanaB.V., 2004, Discrete and Combinatorial Mathematics, Pearson Education, Inc., Copyright 2007, Dorling Kindersley (India) Pvt. Ltd.
4. Vasudev C., 2005, Theory and Problems of Combinatorics, New Age international Publishers, New Delhi.

Web Resources:

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

Course Designers:

1. Mrs. S. Shanavas Parvin
2. Mrs. B. Ambika

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined B.A. / B.Sc. /B.Com. / B.B.A. / B.C.A. on or after June 2020)

Course Code	Course Title	Category	L	T	P	Credits
UMA20NE41	**Mathematical Logic**	**NME**	**2**	**-**	**-**	**2**

L-Lecture T-Tutorial P–Practicals

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

Preamble

The course gives an introduction to mathematical logic evolving around the notion of logic. Also it deals with the determination of truth value of new statements build from given statements using connectives. Emphasis is placed on the theory of inference.

CourseOutcomes

On the completion of the course the student will be ableto

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Identify the proposition and argument	80	70
CO2	Illustrate the propositional connectives.	80	70
CO3	Analyze natural language arguments by means of symbolic propositional logic	85	75
CO4	Apply the concepts of theory of inference.	85	70
CO5	Construct the truth table for tautological implications	80	70

B.Sc., Mathematics PSO

Mapping of COs with PSOs

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

Mapping of COs with POs

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

B.A. P.O.

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

B.B.A. P.O.

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

B.Com. P.O.

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

Bloom's Taxonomy

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

Contents:

UnitI(15 Hours)

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

UnitII **(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. Elliott Mendelson, 2015, Introduction to Mathematical Logic, 6th Edition, CRC Press, Taylor and Francis Group.
2. SeymourLipschutz and Marc Lars Lipson, 2007, Discrete Mathematics, Revised third Edition,Tata McGraw- Hill Publishing Company Limited, NewDelhi.

3. Trembley J.P. and Manohar. R.,2017, Discrete Mathematical Structures with Applications to Computer Science,Tata McGraw – Hill Publishing Company Limited, NewDelhi.
4. Veerarajan. T., 2007, Discrete Mathematics with Graph Theory and Combinatorics, Tata McGraw- Hill Publishing Company Limited, New Delhi.

Course Designers:

1. Mr. M. Madhavan
2. Mr. G. Gowtham

Generic Elective
(Allied Papers)

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS
Generic Elective Course Syllabus
For Other Major Students – (w.e.f. June 2020)

Major	Year	Sem.	Code	Title of the Paper	Cont Hrs/W	Credits
Physics	I	I	**UMA20GE11(P)**	**Allied Mathematics - I for Physics**	6	5
		II	**UMA20GE21(P)**	**Allied Mathematics - II for Physics**	6	5
Chemistry	II	III	**UMA20GE31(C)**	**Allied Mathematics - I for Chemistry**	6	5
		IV	**UMA20GE41(C)**	**Allied Mathematics - II for Chemistry**	6	5
Computer Science/Computer Application /Information Technology	I	I	**UMA20GE11(I)**	**Mathematical Foundation for Computer Science**	5	5
		II	**UMA20GE21(I)**	**Probability and Statistics**	5	5
	II	III	**UMA20GE31(I)**	**Computational Methods**	5	5
		IV	**UMA20GE41(I)**	**Operations Research**	5	5
Commerce	I	I	**UMA20GE11(K)**	**Business Mathematics**	5	5
		II	**UMA20GE22(K)**	**Business Statistics**	5	5

Scheme of Examination

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

Minimum Marks required

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

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

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

Course Code	Course Title	Category	L	T	P	Credits
UMA20GE31(C)	**Allied Mathematics - I for Chemistry**	**Generic Elective**	**5**	**1**	**-**	**5**

L - Lecture T - Tutorial P–Practicals

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

Preamble

The course aims to discuss various methods in theory of equations to solve algebraic and transcendental equations. Also it explains the concept of curvature and evolute in detail. Further the course deals with the techniques of interpolation and gives an insight into eigenvalues, eigenvectorsand diagonalization in the theory of matrices.

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Relate the roots and the coefficients of algebraic equations.	80	80
CO2	Transform the given equation and find the roots from it	85	80
CO3	Recall and explain the concepts of curvature and evolute	85	75
CO4	List the difference operators and apply interpolation to real life problems	85	85
CO5	Find the eigenvalues and eigenvectors of a square matrix and extend the idea to diagonalization	90	80

Mapping of COs with PSOs

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

Mapping of COs with POs

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

CO5	**S**	**M**	**L**	**L**	**L**	**L**

Bloom's Taxonomy

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

Contents

Unit I **(15 Hours)**

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

Unit II **(15 Hours)**

Theory of Equations: Reciprocal equation – Transforms 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: Eigenvalues and Eigenvectors – Similar matrices – Cayley-Hamilton theorem – Eigen values for Symmetric matrices

Text Book:

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

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

References:

1. Arumugam S.and Thangapandi Isaac A., July 2011. Algebra: Theory of Equations, Theory of Numbers and Trigonometry, New Gamma Publishing House, Palayamkottai.
2. Balasubrahmanyam P and SubramanianK. G**,** 1996, Ancillary Mathematics, Volume – I, Tata McGraw-Hill Publishing Company Limited, New Delhi.
3. Kandasamy P. and Thilagavathy K., 2013, Allied Mathematics Volume-I, S. Chand & Company Pvt. Ltd, New Delhi.
4. Manicavachagom Pillay T. K, Natarajan T and Ganapathy K. S, 2010, Algebra, Volume – I, S. Viswanathan (Printers & Publishers) Pvt. Ltd., Chennai.

Course Designers:

1. Dr. R. Angeline ChellaRajathi
2. Mrs. D. Murugeswari

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**

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

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

Course Code	Course Title	Category	L	T	P	Credits
UMA20GE41(C)	Allied Mathematics - II for Chemistry	Generic Elective	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 the methods of classifying the integrals and applies the appropriate techniques on integration. It provides the method of solving various types of ordinary and partial differential equations. Also, it deals with the method of solving linear differential equations using Laplace Transforms. Further, it provides knowledge in Group theory.

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Recall and Relate the Analytical Skills in Integration and Differentiation.	80	60
CO2	Solve various problems in ordinary and partial Differential equations.	80	60
CO3	Find the Laplace transform for various functions	85	70
CO4	Recall and analyze Group structure and its properties	85	70
CO5	Formulate Partial Differential Equations	80	60

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Bloom's Taxonomy

	CA		End of Semester
	First	Second	
Knowledge(K1)	40%	40%	40%

Understand(K2)	**40%**	**40%**	**40%**
Apply(K3)	**20%**	**20%**	**20%**

Contents

Unit I **(15 Hours)**

Properties of Definite Integrals – Integration by parts -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)**

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

Unit	Book	Chapter/ Section
I	2	1(11 – 15)
II	2	4(6.1 – 6.4)
III	2	6(1 -3, 5 - 7)
IV	2	7(1 – 6)
V	1	3(3.0, 3.1,3.2, 3.4 - 3.8)

References:

1.Arumugam S.and Thangapandi IsaacA., July 2011. Differential Equations, New Gamma Publishing House, Palayamkottai.

2.Balasubrahmanyam P. and SubramanianK. G., 1996, Ancillary Mathematics, Volume – II, Tata McGraw-Hill Publishing Company Limited, New Delhi.

3. Manicavachagom Pillai T. K., Natarajan T. and Ganapathy K, S., 2010, Calculus, Vol. II, S. Viswanathan (Printers and Publishers), Chennai.

4. Kandasamy P.and ThilagavathyK., 2013, Allied Mathematics Volume-II, S.Chand& Company Pvt. Ltd, New Delhi.

Course Designers:

1. Dr. R. Angeline ChellaRajathi
2. Mrs. S.Karpagam

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

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

Course Code	Course Title	Category	L	T	P	Credits
UMA20GE31(I)	Computational Methods	Generic Elective	5	-	-	5

L - Lecture T - Tutorial P–Practical

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

Preamble

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

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Recall some basic methods to solve Algebraic and Transcendental equations using different algorithms.	80	75
CO2	Solve simultaneous linear equations using different methods	80	75
CO3	Build an interpolating polynomial using appropriate numerical methods	80	75
CO4	Apply numerical methods to evaluate variousintegrals	80	75
CO5	Demonstrate numerical methods to solve Differential equations	80	75

Mapping of COs with PSOs

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

Mapping of COs with POs

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

B.CA. P.O.

#	PO1	PO2	PO3	PO4	PO5	PO6
CO1	M	S	M	L	M	M

CO2	**M**	**S**	**M**	**L**	**M**	**M**
CO3	**M**	**S**	**M**	**M**	**L**	**M**
CO4	**M**	**S**	**M**	**M**	**M**	**M**
CO5	**M**	**S**	**S**	**M**	**M**	**M**

Bloom's Taxonomy

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

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 – Crout's Method - 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)**

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., 2013, 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 6)
III	VI (1 to 5) VIII (1, 3, 4 and 5)
IV	IX (1 to 3, 7 to10)
V	XI (6, 10 to 15, 19 and20)

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 CompanyLtd.,

India.
3.Kandasamy. P., Thilgavathy. K. and Gunavathy. S., 2007, Numerical methods, Chand and Co., NewDelhi.

Course Designers:

1. Dr. B. Arivazhagan
2. Ms. P.Vanmathy

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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 June2020)

CourseCode	Course Title	Category	L	T	P	Credits
UMA20GE41(I)	Operations Research	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 provides scientific approach to aid decision making and improve efficiency of the system by applying analytical methods such as simplex method, Two-phase method and dual simplex method. Also the course deals with the various transshipment techniques using Transportation, Assignment problems.

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Demonstrate operations research approach in decision making	70	65
CO2	Formulate linear programming problems and find their solutions	75	70
CO3	Solve linear programming problems using dualsimplex method	75	65
CO4	Recognize, solve and interpret Transportation and Assignment	80	75
CO5	Convert the given linear programming problems into its dual and	85	75

Mapping of COs with POs

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

Mapping of COs with PSOs

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

B.C.A. P.O.

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

CO3	**M**	**S**	**M**	**M**	**L**	**S**
CO4	**S**	**M**	**M**	**S**	**L**	**M**
CO5	**S**	**M**	**L**	**M**	**M**	**S**

Bloom's Taxonomy

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

Contents

Unit I **(15 Hours)**

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 (Problems only).

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 – Linear Programming (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 (Problems only).

Unit V **(15 Hours)**

Assignment Problem: Introduction – Mathematical formulation of the problem – Solution methods of Assignment problem – Special cases in Assignment Problems – The Travelling Salesman Problem(Problems only).

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, 11.7)

References:

1. Arumugam. S., ThangapandiIssac, 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.

Web Resources:

1.https://www.google.co.in/books/edition/Handbook_of_Operations_Research_in_Natur/jkDT0UZREakC?hl=en&gbpv=1&dq=web+resources+for+operations+research&printsec=frontcover
2.https://www.google.co.in/books/edition/Lecture_Notes_in_Operations_Research_and/oVy_uwEACAAJ?hl=en
3.https://www.google.co.in/books/edition/Operations_Research/ZD0PEAAAQBAJ?hl=en&gbpv=1&dq=operations+research&printsec=frontcover

Course Designers:

1. Mrs. S. Shanavas Parvin
2. Ms. P. Vanmathy

M.Sc., Mathematics

ProgrammeCode: PMA
(Aided & SF)

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

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

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

The objectives of this programmeis

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

Programme Specific Outcomes for M.Sc. Mathematics

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

PSO 1	Formulate Complete, Concise and Correct Mathematical Proofs
PSO 2	Frame Problems Using Multiple Mathematical Structures and Relationships And Solve Using Standard Techniques.
PSO 3	Create Quantitative Models To Solve Real World Problems In Appropriate Contexts
PSO 4	Recognize And Appreciate The Connections Between Theory and applications and Effectively Use Professional Level Technological Tools To Support The Study Of Mathematics
PSO 5	Clearly Communicate Quantitative and Theoretical Ideas In Mathematics

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(For those who joined M.Sc. Mathematics on or after June 2020)
M.Sc. Mathematics
COURSE STRUCTURE (w.e.f. 2020 batch onwards)

Semester – I

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

Semester II

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

Semester – III

Code No.	Subject	Contact Hours / Week	Credits	Total Number of Hours Allotted	Max. Marks		Total
					CA	SE	
Core 9	Linear Algebra	6	5	90	25	75	100
Core 10	Measure and Integration	6	5	90	25	75	100
Core 11	Mathematical Statistics	6	4	90	25	75	100
Core 12	Classical Mechanics	6	4	90	25	75	100
Elective III	Options given	6	5	90	25	75	100
TOTAL		**30**	**23**				

Semester – IV

Code No.	Subject	Contact Hours / Week	Credits	Total Number of Hours Allotted	Max. Marks		Total
					CA	SE	
Core 13	Functional Analysis	6	5	90	25	75	100
Core 14	Differential Geometry	6	5	90	25	75	100
Core 15	Optimization Techniques	6	4	90	25	75	100
Core 16	Stochastic Processes	6	4	90	25	75	100
Project	PJ	6	3	90	25	75	100
	TOTAL	**30**	**21**				

A) Consolidation of Contact Hours and Credits

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

B) Curriculum Credits

Core	75 Credits
Elective	15 Credits
Total	**90 Credits**

Major Electives I to be chosen from the following

1) Number Theory

2) Combinatorics

Major Electives II to be chosen from the following

1) Graph Theory
2) Fuzzy Sets and Fuzzy Logic

Major Elective III to be chosen from the following

1) Calculus of Variations and Integral Equations
2) Fluid Dynamics

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Course Code	Course Title	Category		L	T	P	Credits
PMA20C12	**Real Analysis**	**Core**		**4**	**1**	**-**	**4**

L-Lecture T-Tutorial P–Practical

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

Preamble

The course covers the analysis of integration, uniform convergence of sequence and series of functions**.** It provides a method of finding approximate solutions to theoretical and practical problems through uniform convergence. It gives an insight to study the special functions such as the exponential, logarithmic, trigonometric, gamma and beta functions.

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	Expected Proficiency (%)	Expected Attainment (%)
CO1	Recall and apply the concepts of continuity, discontinuity, compactness and connectedness in metric spaces.	85	75
CO2	Demonstrate the differentiation of functions of real variables.	85	75
CO3	Evaluate the integral of functions of a real variable in the sense of Riemann Stieltjes.	80	70
CO4	Identify and Classify the sequence of functions which are point wise convergence and uniform convergence.	85	70
CO5	Analyze the structure of the exponential and logarithmic functions, the trigonometric functions, the gamma and beta functions.	85	70

Mapping of COs with PSOs

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

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7

CO1	**S**	**S**	**M**	**M**	**S**	**L**	**L**
CO2	**S**	**S**	**S**	**L**	**M**	**L**	**M**
CO3	**S**	**S**	**S**	**S**	**M**	**M**	**M**
CO4	**S**	**M**	**M**	**M**	**L**	**L**	**L**
CO5	**S**	**M**	**S**	**M**	**S**	**M**	**M**

Bloom's 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 **(15 Hours)**

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

Unit II **(15 Hours)**

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

Unit III **(15 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 **(15 Hours)**

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

Unit V **(15 Hours)**

Equicontinuous Families of Functions – The Stone – Weierstrass Theorem – Some Special Functions: Power Series – The Exponential and Logarithmic Functions – The Trigonometric functions The Algebraic Completeness of the Complex Field – The Gamma Function.

Text Book:

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

Unit	**Chapter/Page**
I	4 (Full)
II	5 (Full)
III	6 (Full)
IV	7 (Pages 143 – 154)
V	7 (Pages 155 – 161), 8 (Pages172 – 185 and 192 -195)

References:

1. Karunakaran. V, 2012, Real Analysis, Pearson,Chennai.
2. Stephen Abbott, 2010, Understanding Analysis, Springer Verlag, NewYork.

3. Tom M. Apostol, 1969, Mathematical Analysis, A Modern Approach to Advanced Calculus, Addison-Wesley Publishing Company, United States.

Course Designers:

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

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

(For those who joined M.Sc. Mathematics on or after June 2021)

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

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

Preamble

The course aims to study various arithmetic functions. This provides the basic concepts of numbers such as divisibility and congruences. It gives a method of solving simultaneous congruences through the Chinese Remainder theorem. Also it discusses various Diophantine equations and the characterization of Pythagorean triangles.

Prerequisite

Basic knowledge in classical algebra and theory of numbers

Course Outcomes

On the completion of the course the student will be ableto

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Demonstrate and apply division algorithm in integers and define factorization using primes	85	75
CO2	Classify and Solve the Chinese Reminder problem using congruences	80	75
CO3	Determine Quadratic residues	80	75
CO4	Define and illustrate arithmetic functions and also analyze their properties	80	75
CO5	Recall prime factorization and solve special types of Diophantine equations	85	75

Mapping of COs withPSOs

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

Mapping of COs with POs

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

Bloom'staxonomy

	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 **(15 Hours)**

Divisibility: Introduction – Divisibility – Primes.

Unit II **(15 Hours)**

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

Unit III **(15 Hours)**

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

Unit IV **(15 Hours)**

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

Unit V **(15 Hours)**

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

Text Book:

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

Unit	Chapter/Section
I	1.1 – 1.3
II	2.1 – 2.3
III	3.1 – 3.3
IV	4.1 – 4.3
V	5.1 – 5.3

Reference Books:

1. David M. Burton, 2010, Elementary Number Theory, Tata McGraw-Hill Education Pvt. Ltd., SixthEdition, 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.

CourseDesigners:

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

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POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS
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Course Code	Course Title	Category	L	T	P	Credits
PMA20C31	**Linear Algebra**	**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 aims to study the relation between a linear transformation and its matrix. It explores the fundamental theorem on finitely generated modules. It deals the study of various properties of linear transformations matrices. Also it classifies the nature of characteristic roots of Hermitian, Unitary and Normal transformations.

Prerequisite

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

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Recall and demonstrate the fundamentals of vector spaces, modules and canonical forms of linear transformations	85	75
CO2	Analyze linear transformations and Construct the dual spaces	80	75
CO3	Demonstrate characteristic roots and characteristic vectors of linear transformations	80	75
CO4	Identify Nilpotent, Hermitian, Unitary, Normal transformations and explain their properties	80	75
CO5	Assess and analyze properties of vector spaces and subspaces using linear transformations.	85	75

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Bloom's Taxonomy

	CA		End of Semester
	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:

Herstein. I.N., 2014, Topics in Algebra, Wiley 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 Bhambri S.K, 2012, A course in Abstract Algebra, Vikas Publishing House Pvt. Ltd., Chennai

Course Designers:

1. Dr. G. Prabakaran
2. Mrs. V. Kanchana Devi

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Course Code	Course Title	Category	L	T	P	Credits
PMA20C32	**Measure and Integration**	**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 provides a study of Lebesgue measure. It elaborates the concepts of measurable sets and measurable functions. It gives characterizations of Lebesgue integrable functions. It deals with some decomposition theorems in measurable space.

Prerequisite

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

CourseOutcomes

On the completion of the course the student will be ableto

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Explain the concepts of Lebesgue measure, measurable sets and measurable functions	80	70
CO2	Infer the ideas of measurable functions and explore approximations	75	70
CO3	Evaluate integrals using measures	80	70
CO4	Make use of convergence and Decomposition theory to analyze the structure of Measure theory	85	75
CO5	Explain the decomposition in a Signed measure	80	75

Mapping of COs with PSOs

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

Mapping of COs with POs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**L**	**M**	**M**	**L**	**L**	**S**

CO2	**M**	**S**	**L**	**S**	**L**	**L**	**L**
CO3	**S**	**S**	**M**	**L**	**S**	**L**	**S**
CO4	**S**	**L**	**M**	**M**	**L**	**L**	**S**
CO5	**M**	**L**	**L**	**M**	**L**	**L**	**L**

Bloom's 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 approximation of Lebesgue Measurable sets – Countable additivity, Continuity and the BorelCantelli lemma-Nonmeasurable Sets – The cantor set and the Cantor Lebesgue function.

UnitII (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.

UnitIII (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.

UnitIV (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.

UnitV (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 ameasure.

Integration over General Measure spaces: Integration of Non-negative Measurable functions – Integration of General Measurable functions.

TextBook:

Royden H.L., Fitzpatrick P.M., 2015, 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) 18 (18.2 & 18.3)

References:

1. De Bara. G, 2013, Measure and Integration, Second Edition, Ellis Horwood Ltd.,Chichester.
2. Pawan Kumar Jain, Pawan Gupta V.P., Pankaj Jain, 2012, Lebesgue Measure and Integration, Anshan Ltd., Tunbridgewell , UnitedKingdom.
3. Robert G.Bartle, 2014, The Elements of Integration and Lebesgue Measure, John Wiley&Sons, NewYork.

CourseDesigners:

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

Course Code	Course Title	Category	L	T	P	Credits
PMA20C33	**Mathematical Statistics**	**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 gives an introduction to multivariate distributions of both discrete and continuous types and deals with some important distributions of random variables frequently used in statistics.Also it focus on many tools of inference such as parameter estimation, confidence intervals. Also it discusses some optimal point estimates and tests for certain situations.

Prerequisite

Knowledge in Probability Theory and Calculus.

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Determine the independence of random variables and obtain the distribution of functions of random variables	75	65
CO2	Find the limiting distribution of a sequence of random variables	80	60
CO3	Analyze and Develop statistical inferences	70	60
CO4	Identify the appropriate maximum likelihood methods for a given situation and use it to estimate the parameter	75	60
CO5	Demonstrate optimal testing of hypotheses	75	65

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Bloom's Taxonomy

	CA		End of Semester (Marks)
	First(Marks)	Second(Marks)	
Knowledge– K1	15% (9)	15% (9)	15% (30)
Understand – K2	15% (9)	15% (9)	15% (30)
Apply – K3	30% (18)	30% (18)	30% (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)**

Mutivariate Distributions: Distributions of Two Random Variables, Transformations: Bivariate Random Variables – Conditional Distributions and Expectations –Independent Random Variables – Extension to Several Random Variables – Linear Combinations of Random Variables.

Unit II **(18 Hours)**

Some Special Distributions: The Binomial and Related Distributions – The Poisson Distribution – TheΓ, $\chi^2$and β Distribution – The Normal Distribution – t and F Distribution.

Unit III **(18 Hours)**

Consistency and Limiting Distributions: Convergence in Probability – Convergence in Distribution – Central Limit Theorem. Some Elementary Statistical Inferences: Sampling and Statistics (Exclude 1.1) – Confidence Intervals.

Unit IV **(18 Hours)**

Some Elementary Statistical Inferences: Introduction to Hypothesis Testing – Additional Comments about Statistical Tests. Maximum Likelihood Methods: Maximum Likelihood Estimation – Rao Cramer Lower Bound and Efficiency – Maximum Likelihood Tests.

Unit V **(18 Hours)**

Sufficiency: Measures of Quality of Estimators – A Sufficient Statistic for a Parameter – Properties of a Sufficient Statistic – Optimal Test of Hypothesis: Most Powerful Tests – Uniformly Most Powerful Tests – Likelihood Ratio Tests.

Text Book:

Robert V. Hogg, Joseph Mckean and Alen T.Craig, 7th Edition, Introduction to Mathematical Statistics, Pearson Education, India, Ninth Impression 2020.

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

References:

1. Gupta. S.C. and Kapoor. V.K. , 2020, Fundamentals of Mathematical Statistics, TwelfthEdition, Sultan and Chand Sons publishers, New Delhi.
2. Irwin Miller &Maryless Miller, 2014, John‘s Freund‘s Mathematical Statistics and Applications, Pearson Education, India
3. Kapoor. J.N. and Saxena. H.C., 2010, Mathematical Statistics, S. Chand &Co, New Delhi.

Course Designers:

1. Mrs. K. Ponmari
2. Mrs. D. Princy

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CourseCode	Course Title	Category	L	T	P	Credits
PMA20C34	Classical Mechanics	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 Hamiltonian's Principles and Lagrange's equations. Poisson and Jacobi brackets are classified through canonical transformations. It also deals with solving two body central force problems, equations of canonical transformations and analyzing the holonomic and non holonomic systems.

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	Expected Proficiency (%)	Expected Attainment (%)
CO1	Recall the elementary principles of mechanics	75	70
CO2	Analyze and Demonstrate the Holonomic and non Holonomic systems	75	70
CO3	Solve two body central force problems	85	80
CO4	Explain the Hamilton equations of motion	90	80
CO5	Define and solve the equations of canonical transformations	90	80

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Bloom's Taxonomy

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

Contents

Unit I **(18 Hours)**

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

Unit II **(18 Hours)**

Variational Principles 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 to nonholonomic systems – Conservation theorems and symmetry Properties.

Unit III **(18 Hours)**

The Two Body Central Force Problem : Reduction to the equivalent one body Problem – The equations of motion and first integrals – The equivalent one-dimensional problem, and classification of orbits – The virial theorem– The differential equation for the orbit, and integrable power-law potentials –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 Hamilton equations of motion- Cyclic co-ordinates and conservation theorems -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 – 3.5,3.7-3.9)
IV	8(8.1, 8.2, 8.5, 8.6)
V	9(9.1, 9.2, 9.4)

References:

1. Bhatia V.B, 2001, Classical Mechanics, Narosa Publishing House, Chennai.
2. Gantmacher F, Lectures in Analytic Mechanics,1975, MIR Publishers, Moscow.
3. John Robert Taylor, Classical Mechanics, 2005, University Science Books, Herndon, VA 2019.
4. Mondal. C.R., Classical Mechanics, 2004, PHI Learning Pvt Ltd, New Delhi.

Web Resources:

https://ocw.mit.edu/courses/physics/8-01sc-classical-mechanics-fall-2016/

http://www.astro.caltech.edu/~golwala/ph106ab/ph106ab_notes.pdf

http://galileoandeinstein.physics.virginia.edu/7010/home.html

Course Designers:

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Course Code	Course Title	Category	L	T	P	Credits
PMA20C41	**Functional Analysis**	**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 provides a firm grounding in the theory ofnormed linear space and analyze the ideas of mathematical analysis in it. Also it examines the nature of Banach and Hilbert spaces and elaborates the study of open mapping and closed graph theorems.Further the course deals with finite dimensional spectral theory.

Prerequisite

Knowledge in Mathematical Analysis and Linear Algebra.

CourseOutcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Develop the skills to analyze the structure of normed linear spaces	80	70
CO2	Recall and relate the results in Banach and Hilbert spaces	85	70
CO3	Analyze and applythe ideas of mathematical analysis in normed linear space	80	75
CO4	Demonstrate and examine the fundamentals of functional analysis	85	75
CO5	Assess the ideas on operators in Hilbert space and analyze finite dimensional spectral theory	85	75

Mapping of COs withPSOs

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

Mapping of COs withPOs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**S**	**S**	**S**	**S**	**S**	**S**	**M**
CO2	**S**	**S**	**S**	**S**	**S**	**M**	**L**

CO3	**S**	**S**	**M**	**S**	**M**	**M**	**M**
CO4	**S**	**S**	**M**	**S**	**S**	**S**	**M**
CO5	**S**	**S**	**S**	**S**	**S**	**M**	**M**

Bloom's 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

UnitI

(18Hours)

Banach Spaces -The definition and some examples – Continuous linear transformations –

The Hahn-Banach theorem.

UnitII **(18Hours)**

The natural imbedding of N in N^{**}– The open mapping theorem – The conjugate of anoperator.

UnitIII **(18 Hours)**

Hilbert Spaces-The definition and some simple properties – Orthogonal complements– Orthonormal sets–The conjugate space H^{*}.

UnitIV **(18 Hours)**

The adjoint of an operator – Self-adjoint operators –Normal and unitary operators– Projections.

UnitV **(18 Hours)**

Finite dimensional spectral theory- Matrices – Determinants and the spectrum of an Operator - The spectraltheorem.

TextBook:

Simmons.G.F., 2019, 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, 54,55)
IV	10 (56, 57, 58,59)
V	11 (60, 61, 62)

References:

1. BalmohanVisnu Limaye, 2018, Functional Analysis, New Age International, NewDelhi.
2. Erwin Kreyszig, 2007, Introductory Functional Analysis with Applications, John Wiley&Sons, NewYork.
3. Ponnusamy. S., 2009, Foundations of Functional Analysis, NarosaPublishingHouse, Chennai.
4. Somasundaram D., 2006, A First Course in Functional Analysis, Alpha Science Intl. Ltd.,United Kingdom.

CourseDesigners:

1. Dr. R. Angeline ChellaRajathi
2. Mr. K.V. Janarthanan

Web Resources:

1. www – personal.acfr.usyd.edu.auresources
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

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Course Code	Course Title	Category	L	T	P	Credits
PMA20C42	Differential Geometry	Core	5	1	-	5

Lecture T-Tutorial P–Practicals

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

Preamble

The course aims to study the classical theory of curves and surfaces. It covers the fundamental existence theorem of space curves. It provides the local intrinsic and local non-intrinsic properties of surfaces. Also it deals with the fundamental equations of surface theory.

Prerequisite

Knowledge in Geometry and Vector Calculus.

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Recall and Analyze space curves	85	75
CO2	Demonstrate the metric concepts in surface	85	75
CO3	Find geodesics of curves	85	75
CO4	Apply theory of surfaces to study their intrinsic properties	85	75
CO5	Evaluate Principal curvature and line of curvature	85	75

Mapping of COs with PSOs

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

Mapping of COs with Pos

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

Bloom's 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 **(20 Hours)**

The Theory of space curves: Introduction – Representation of space curves – Unique parametric representation of a space curve – Arc length – Tangent and osculating plane – Principal normal and binormal – Curvature and Torsion – Behavior of a curve near one of its points – The curvature and torsion of a curve as the intersection of two surfaces – Contact between curves and surfaces – Osculating circle and osculating sphere – Locus of centres of spherical curvature – Tangent surfaces, involutes and evolutes – Bertrand Curves - Spherical indicatrix - Intrinsic equations of space curves - Fundamental existence theorem for space curves - Helices.

Unit II **(18 Hours)**

The First Fundamental Form and Local Intrinsic Properties of a Surface: Introduction – Definition of a surface – Nature of points on a surface – Representation of a surface – Curves on surfaces – Tangent plane and surface normal – The general surfaces of revolution – Helicoids – Metric on a surface – The First Fundamental form – Direction coefficients on a surface – Families of curves – Orthogonal trajectories – Double family of curves – Isometric correspondence – Intrinsic properties.

Unit III **(20 Hours)**

Geodesics on a Surface: Introduction – Geodesic and their differential equations – Canonical geodesic equations – Geodesics on surfaces of revolution – Normal property of geodesics – Differential equations of geodesics using normal property – Existence theorems – Geodesic parallels – Geodesic polar coordinates – Geodesic curvature – Gauss–Bonnet Theorem – Gaussian curvature – Surfaces of constant curvature.

Unit IV (20 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 curvatures – Lines of curvature – The Dupin indicatrix– Developable surfaces – Developables associated with space curves – Developables associated with curves on surfaces – Minimal surfaces – Ruled surfaces.

Unit V **(12 Hours)**

The Fundamental Equations of Surface Theory: Introduction – Tensor notations – Gauss equations – Weingarten equations – Mainardi-Codazzi equations – Parallel surfaces.

TextBook:

Somasundaram. D., Reprint 2019, Differential Geometry, Narosa Publishing House, Chennai.

Unit	Chapter/Section
I	1(1.1 - 1.18)
II	2(2.1 - 2.15)
III	3(3.1 – 3.13)

IV	4(4.1 – 4.11)
V	5(5.1 – 5.6)

References:

1. Mittal and Agarwal, 2014, Differential Geometry, Krishna Prakasan Media (P) Ltd., India.
2. Thierry Aubin, 2001, Differential Geometry, American Mathematical Society, Providence,US.
3. Willmore. T.J., 2018, An introduction to Differential Geometry, Oxford University Press, New Delhi.

CourseDesigners:

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Course Code	Course Title	Category	L	T	P	Credits
PMA20C43	Optimization Techniques	Core	4	2	-	4

L - Lecture T - Tutorial P–Practicals

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

Preamble

The Optimization techniques have gained knowledge to solve many design problems by developing linear and nonlinear mathematical models. This course aims to educate the student to develop a mathematical model by defining an objective function and constraints in terms of design variables and then apply a particular mathematical programming techniques. Also it covers classical optimization techniques, linear programming, nonlinear programming and dynamic programming techniques.

Prerequisite

Knowledge in graph theory, probability theory and calculus

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Recall some basic principles of optimization techniques	80	75
CO2	Analyze deterministic and probabilistic inventory models.	80	75
CO3	Summarize decision analysis principles and solve some practical problems.	80	75
CO4	Analyze and Solve different models of Queuing theory problems.	80	75
CO5	Interpret the principle of non-linear problems	80	75

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Bloom's 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: Scope and Definition of Network Models - Minimal Spanning Tree Algorithm- Shortest Route problem - Maximal flow model.

Advanced Linear Programming: Simplex Method Fundamentals - Revised Simplex Method- Bounded Variables Algorithm.

Unit II **(18 Hours)**

Inventory Modeling (with Introduction to Supply Chains) : Inventory problem (A supply chain perspective) - Role of demand in the development of inventory models – Static economic order quantity (EOQ) models – Dynamic EOQ models – Sticky issues in Inventory Modeling.

Probabilistic Inventory Models: Continuous review models – Single- period models – Multiperiod model.

Unit III **(18 Hours)**

Decision Analysis: Decision making under certainty (Analytic Hierarchy Process) – Decision making under risk – Decision under uncertainty.

Deterministic Dynamic Programming: Recursive nature of Dynamic Programming computations-Forward and Backward recursion- Knapsack/Fly – Away Kit / Cargo Loading Model- Workforce Size Model.

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/ ∞/∞) - Pollaczek –Khintchine(P-K) formula – Other Queuing models – Queuing decision models.

Unit V **(18 Hours)**

Nonlinear Programming Algorithms: Unconstrained Algorithms: Direct Search method – Gradient method - Constrained Algorithms : Separable programming – Quadratic programming- Chance constrained programming – Linear Combinations Method- SUMT Algorithm

Text Book:

Hamdy A. Taha, 2019, Operations Research An Introduction, Tenth edition, Pearson education, Chennai.

Unit	Chapter / Section
I	6 (6.1 – 6.4),7 (7.1-7.3)
II	13 & 16
III	15 (15.1- 15.3) & 12 (12.1,12.2,12.3.1,12.3.2)
IV	18
V	21

References:

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

2. SharmaJ.K, 2009, Operations Research Theory and Applications, Third Edition, Macmillan India Limited, Chennai.
3. Wayne L. Winston, 2010, Operations Research Applications and Algorithms, Fourth Edition, Cengage Learning India private Limited, New Delhi.

Course Designers:

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

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

Course Code	Course Title	Category	L	T	P	Credits
PMA20C44	**Stochastic Processes**	**Core**	**4**	**2**	**-**	**4**

L-Lecture T-Tutorial P–Practicals

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

Preamble

Deterministic dynamic systems are usually not well suited for modeling real world dynamics in economics, finance and life sciences. Allowing for random components in dynamic systems leads to stochastic dynamic modeling, which is based on stochastic processes. This course covers models of stochastic processes in discrete and continuous time. This includes Markov Chains, Poisson processes, Renewal processes, Branching and other Random Processes.

Prerequisite

Knowledge in Linear algebra, Differential equations and Probability theory.

Course Outcomes

On the completion of the course the student will be ableto

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Recall and characterize a stochastic process	80	70
CO2	Identify and Analyze the Stochastic models	90	80
CO3	Demonstrate and explain the principles and objectives of model building based on Markov chains, Poisson process and birth-death process	80	75
CO4	Explain the importance of renewal and branching processes	80	70
CO5	Analyze the logical and coherent proofs of important theoretical results	80	70

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Bloom's 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 Gambling Problems: Gambler's ruin -Probability of ruin-Some numerical simulations - Duration of the game - Some variations of gambler's ruin – Problems.

Random Walks: Introduction - Unrestricted random walks - The exact probability distribution of a random walk - First returns of the symmetric random walk – Problems.

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Unit II **(18 Hours)**

Markov Chains : States and transitions - Transition probabilities - General two-state Markov chains - Powers of the general transition matrix - Gambler's ruin as a Markov chain - Classification of states - Classification of chains - A wildlife Markov chain model – Problems.

Unit III **(18 Hours)**

Poisson Processes: Introduction - The Poisson process - Partition theorem approach - Iterative method- The generating function - Arrival times - Summary of the Poisson process – Problems.

Birth and Death Processes: Introduction - The birth process - Birth process: Generating function equation - The death process - The combined birth and death process - General population process– Problems.

.Unit IV (18 Hours)

Reliability and Renewal: Introduction - The reliability function - Exponential distribution and reliability - Mean time to failure - Reliability of series and parallel systems - Renewal processes - Expected number of renewals – Problems.

Unit V **(18 Hours)**

Branching and Other Random Processes – Introduction - Generational growth - Mean and variance - Probability of extinction - Branching processes and martingales - Stopping rules - A continuous time epidemic - A discrete time epidemic model - Deterministic epidemic models - An iterative solution scheme for the simple epidemic – Problems.

TextBook:

Peter W.Jones and Peter Smith,2018, Stochastic Processes - An Introduction, CRC Press, Taylor & Francis Group, LLC, 3rd edition.

Unit	Chapter
I	2& 3
II	4
III	5 & 6
IV	8
V	9

References

1. Basu. A.K., Elements of Stochastic Processes, Narosa Publications, 2002.
2. Karlin, S. and Taylor, H.M. (1975): A First Course in Stochastic Process, Vol. I, Academic Press, Cambridge.

3. Medhi. J, Stochastic Processes, New Age International Publishers, 3rd edition, 2012, New Delhi.
4. Ross S.M., Stochastic Processes, John Wiley &sons, 3rd edition, 2010.

CourseDesigners:

1. Dr. M. Senthilkumaran
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Course Code	Course Title	Category	L	T	P	Credits
PMA20CE31(A)	**Calculus of Variations and Integral Equations**	**Elective**	**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 the variety of applications of variational methods to study various problems in mechanics by learning the fundamentals of the calculus of variations. Also, it deals with the linear integral equations to solve by using Fredholm theory and method of successive approximations.

Prerequisite

Knowledge in calculus and linear algebra.

Course Outcomes

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

#	Course Outcome	Expected Proficiency (%)	Expected Attainment (%)
CO1	Explain the concepts of variation and its properties.	80	70
CO2	Construct the variational problems with fixed and moving boundaries.	80	70
CO3	Examine the different methods to solve variational problems	85	75
CO4	Classify Fredholm , Volterra and singular type integral equations	85	70
CO5	Solve integral equations using Fredholm theorem, Fredholm Alternative theorem and Method of Successive Approximations	85	70

Mapping of COs with PSOs

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

Mapping of COs with POs

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

Bloom's Taxonomy

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

Contents

Unit I **(18 Hours)**

TheMethod of Variations in Problems with Fixed Boundaries: Variation and its Properties – Euler's Equation – Functionals of the form $\int_{x_0}^{x_1} F(x, y_1, y_2, \dots, y_n, y_1', y_2', \dots, y_n')dx$ - Functionals involving Derivatives of Higher order- Functionals Depending on the Functions of Several Independent Variables – Parametric Representation of Variational Problems.

Unit II **(18 Hours)**

Variational Problems with Moving Boundaries and Certain Other Problems: Simple problems with movable Boundaries- Problem with movable boundaries for Functional of the Form $\int_{x_0}^{x_1} F(x, y, z, y', z')dx$ - Problem with movable boundaries for Functional of the Form $\int_{x_0}^{x_1} F(x, y, y', y'')dx$ – Extremals with Cusps – One-Sided Variations .

Sufficient Condition for an Extremum: Field of extremals – The Function E(x, y, p, y') – Problems.

Unit III **(18 Hours)**

Variational Problems of constrained extrema: Constraints of the Form $\varphi(x, y_1, y_2, \dots\dots, y_n) = 0$ – Constraints of the Form $\varphi(x, y_1, y_2, \dots\dots, y_n, y_1', y_2', \dots, y_n') = 0$ – Isoperimetric Problems – Problems.Direct Methods in Variational Problems: Direct Methods – Euler Method of Finite Differences– The Ritz Method.

Unit IV **(18 Hours)**

Introduction: Definition- Regularity conditions – Special kinds of Kernels – Eigenvalues and Eigen Functions – Convolution Integral – The inner and scalar product of two functions – Notation – Reduction to a System of Algebraic equations – Examples – Fredholm Alternative - Examples – An Approximate Method – Fredholm integral equation of the first kind.

Unit V **(18 Hours)**

Method of Successive Approximations: Iterative Scheme – Examples – Volterra Integral equation – Examples – Classical Fredholm Theory: The Method of Solution of Fredholm – Fredholm's First Theorem – Fredholm's Second Theorem – Fredholm's Third theorem.

Text Books:

1. Elsgolts L., 2007, Calculus of variations, Dover Publications, Inc., Mineola, New York.
2. Kanwal. P. Ram, 2013, Linear Integral Equations - Theory &Technique, Birkhauser Publishers.

Unit	Book	Chapter/ Section
I	1	Chapter 1 (1-6)
II	1	Chapter 2 (1 – 5) Chapter 3 (1& 2)
III	1	Chapter 4 (1- 3) Chapter 5 (1 - 3)
IV	2	Chapters 1 and 2
V	2	Chapters 3 (3.1-3.4) and 4

References:

1. Abdul-Majid Wazwaz, 2011, Linear and Nonlinear Integral Equations-Methods and Applications, Springer, New York.
2. Elsgolts Lev., 2003, Differential Equations and the Calculus of variations, University Press of Pacific, USA.
3. Mijanur Rahaman Seikh and Prasun Kumar Nayak, 2021, Integral Equations and Calculus of Variations,
Alpha Science International Limited.
4. Rainer Kress, 2014, Linear Integral Equations, Third Edition, Springer, New York.

Course Designers:

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

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CourseCode	CourseTitle	Category	L	T	P	Credits
PMA20CE31(B)	Fluid Dynamics	Elective	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 the physical properties of fluids and relates the principles of continuity, momentum and energy as applied to fluid motions. It also focuses on the Kinematics of fluid motions, two dimensional flows and three dimensional flows.

Prerequisite

Knowledge in Vector Algebra and Calculus.

CourseOutcomes

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

Mappingof COswithPSOs

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

Mappingof COs withPOs

#	PO1	PO2	PO3	PO4	PO5	PO6	PO7

CO1	**S**	**S**	**S**	**S**	**S**	**S**	**S**
CO2	**S**	**M**	**S**	**M**	**S**	**M**	**M**
CO3	**S**	**M**	**M**	**M**	**S**	**S**	**M**
CO4	**M**	**M**	**S**	**S**	**S**	**M**	**M**
CO5	**S**	**S**	**S**	**M**	**S**	**M**	**M**

Bloom's Taxonomy

	CA		Endof 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)
TotalMarks	**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 orthogonal coordinates–Laplacian in orthogonal coordinates – Curl of a vector function in orthogonal coordinates – worked examples –Some cartesian tensor notation.

UnitI(18 Hours)

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

UnitIII(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 in viscid Immiscible fluids – Euler's equations of motion – Bernoulli's equation – worked examples – discussion of the case of steady motion under conservative body forces– some flows involving axial symmetry – Some special two-dimensional flows–Impulsive motion.

Unit IV **(18 Hours)**

Some Three-Dimensional flows: Introduction– Sources, Sinks and doublets–Images in arigidinfiniteplane–Imagesinsolidspheres–Axi-Symmetricflows, Stoke's Streamfunction.

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,In compressible flow–Complex velocity potentials for standard two-dimensional flows–Some worked examples –Two-Dimensional image systems-The Milne-Thomson circle theorem.

TextBook:

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

Unit	Chapter/Section
I	Chapter1(Section 1.19to 1.20)
II	Chapter2(Section2.1 to2.10)
III	Chapter3(Section 3.1to3.7, 3.9to 3.11)
IV	Chapter4(Section4.1 to4.5)
V	Chapter5(Section5.1 to5.8)

References:

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

CourseDesigners:

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CourseCode	Course Title	Category	L	T	P	Credits
PMA20PJ	**Project**	**Core**	**-**	**-**	**-**	**3**

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.