CURRICULUM AND SYLLABUS FOR M.Sc. (MATHEMATICS) - MASTER OF SCIENCE
(TWO YEAR - FULL TIME) REGULATION - 2022

(Applicable to the students admitted from the academic year 2022-2023 onwards)

Semester	Course Code	Course Name	L	T	P	H	C
I	YMA101	Algebra - I	4	1	0	5	5
	YMA102	Real Analysis - I	4	1	0	5	5
	YMA103	Graph Theory	4	1	0	5	5
	YMA104	Ordinary Differential Equations	4	1	0	5	5
	YMA105	Optimization Techniques	4	1	0	5	5
	YMA1E*	One among the list of electives (1E)	3	0	0	3	3
		Total	**23**	**5**	**0**	**28**	**28**

***List of Electives (1E)**

Elective Code	Course Name	L	T	P	C
1	Fuzzy sets and Fuzzy logic	3	0	0	3
2	Coding Theory	3	0	0	3
3	Neural Networks	3	0	0	3

Semester	Course Code	Course Name	L	T	P	H	C
II	YMA201	Algebra -II	4	1	0	5	5
	YMA202	Real Analysis -II	4	1	0	5	5
	YMA203	Partial Differential Equations	4	1	0	5	5
	YMA204	Classical Dynamics	4	1	0	5	5
	YMA2E*	One among the list of electives (2E)	3	0	0	3	3
NME	YMA205	Computer Programming (c++ Theory and Lab)	3	0	2	5	5
		Total	**22**	**4**	**2**	**28**	**28**

***List of Electives (2E)**

Elective Code	Course Name	L	T	P	C
1	Fluid Dynamics	3	0	0	3
2	Combinatorics	3	0	0	3
3	Cryptography	3	0	0	3

Semester	Course Code	Course Name	L	T	P	H	C
III	YMA301	Topology	4	1	0	5	5
	YMA302	Integral Equations, Calculus of Variations and Transforms	4	1	0	5	5
	YMA303	Functional Analysis	4	1	0	5	5
	YMA304	Differential Geometry	4	1	0	5	5
	YMA305	Complex Analysis	4	1	0	5	5
	YMA3E*	One among the list of Electives (3E)	3	0	0	3	3
		Total	**23**	**5**	**0**	**28**	**28**

***List of Electives (3E)**

Elective code	Course Name	L	T	P	C
1	Elements of Stochastic Processes	3	0	0	3
2	Mathematical Modeling	3	0	0	3
3	Data Analysis using SPSS	3	0	0	3

Semester	Course Code	Course Name	L	T	P	H	C
IV	YMA401	Project	0	0	0	30	8
		Total				**30**	**8**

Total Number of Credits: 92

SEMESTER I

COURSE NAME			ALGEBRA - I	L	T	P	C
COURSE CODE			YMA101	4	1	0	5
C	P	A		L	T	P	H
5	0	0		4	1	0	5

PREREQUISITE	Basics of sets, relations and functions

On successful completion of this course, the students will be able to:

	COURSE OUTCOMES	DOMAIN	LEVEL
CO 1	**Construct** Cayley table for the given symmetric group of degree 2 and 3	Cognitive	Applying
CO 2	**Extend** group structure to finite permutation groups	Cognitive	Understanding
CO 3	**Classify** groups of finite order upto 120 using Sylow's theorems	Cognitive	Analyzing
CO 4	**Identify** the quotient field of the given integral domain	Cognitive	Applying
CO 5	**Categorize** the factorization of polynomials over a field	Cognitive	Analyzing

UNIT 1		12+3
Binary Operations – Groups - Subgroups – Permutations I – Permutations II – Cyclic Groups		
UNIT 2		**12+3**
Isomorphisms – Direct Products – Finitely Generated Abelian groups - Groups of Cosets - Normal subgroups and factor groups- Homomorphisms		
UNIT 3		**12+3**
Series of Groups – Isomorphism theorems- Proof of the Jordan Holder theorem—Group action on a set- Applications of G-sets to counting - Sylow's theorems –Applications of Sylow's theorems		
UNIT 4		**12+3**
Rings – Integral Domains - Some non-commutative examples –The Field of quotients – Quotient rings and Ideal.		
UNIT 5		**12+3**
Homomorphism of Rings – Rings of polynomials – Factorization of Polynomials oveer a field – Euclidean domains-Gaussian integers and norms		

LECTURE	60	TUTORIAL	15	PRACTICAL	0	TOTAL	75

TEXT BOOK

1.John B. Fraleigh, A First Course in Abstract Algebra, Narosa Publishing House, Third edition, 1992.

UNIT – I Chapter 1, 2, 3,4,5,6

UNIT – II Chapter 7,8,9,11,12,13

UNIT – III Chapter 14,15,16,17,18,19

UNIT – IV Chapter 23,24,25,26,27,28

UNIT – V Chapter 29,30,31,33,34

REFERENCES

1.P.B. Bhattacharya et al., Basic Abstract Algebra, 2nd edition, Cambridge University Press, 1995

2.I.N.Herstein, Topics in Algebra, John Wiley, 2nd Edition, 1975.

3.R. Solomon, Abstract Algebra, AMS Indian edition, 2010.

CO Vs PO

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO 1	3	3	3	2	3	1	1	1	1
CO 2	3	3	2	1	3	1	0	1	1
CO 3	3	3	3	1	3	1	1	1	1
CO 4	3	3	3	1	3	1	1	1	1
CO 5	3	3	3	1	3	1	1	1	1
TOTAL	**15**	**15**	**14**	**6**	**15**	**5**	**4**	1	**5**
SCALED VALUE	**3**	**3**	**3**	**2**	**3**	1	**1**	1	**1**
0 - No Relation, 1 – Low Relation, 2- Medium Relation, 3- High Relation									
1-5→1, 6-10→2, 11-15→3									

COURSE NAME			REAL ANALYSIS - I	L	T	P	C
COURSE CODE			YMA102	4	1	0	5
C	P	A		L	T	P	H
5	0	0		4	1	0	5
PREREQUISITE			Basic concepts of real numbers				

On successful completion of this course, the students will be able to:

COURSE OUTCOMES		DOMAIN	LEVEL
CO 1	**Explain** the concepts of real number system and its algebraic properties	Cognitive	Understanding
CO 2	**Explain** the concepts of metric space and its properties	Cognitive	Understanding
CO 3	**Apply** convergence sequence in metric space	Cognitive	Applying
CO 4	**Classify** the characterization of compact metric space geometrically	Cognitive	Analyzing
CO 5	**Utilize** the Banach contraction principle in formulating and solving given problems	Cognitive	Applying

UNIT 1		12+3

Sets and Functions, Mathematical Induction, Finite and Infinite sets. Real Number system: Algebraic and Order properties: Infimum, Supremum, LUB Axiom. Countable and uncountable sets.

UNIT 2		12+3

Metric spaces – Definition and examples - open balls and open sets

UNIT 3		12+3

Sequences and Series of real numbers – limit theorems – monotone sequences – Cauchy criterion – lim sup, lim inf - Convergent sequences in metric spaces – limit and cluster points – Cauchy sequences – Bounded sets – Dense sets.

UNIT 4		12+3

Continuous functions – Equivalent Definitions of Continuity – Uniform Continuity - Limit of a function – Discontinuities of a Real Valued function - Compact spaces and their properties – Continuous functions on Compact spaces- Characterization of Compact Metric spaces.

UNIT 5		12+3

Connectedness: Connected spaces – Complete metric spaces – Examples- Baire Category Theorem – Banach Contraction Principle.

LECTURE	60	TUTORIAL	15	PRACTICAL	0	TOTAL	75

TEXT BOOKS

1. R.G. Bartle and D.R. Sherbert, Introduction to Real Analysis 3rdEdn, John Wiley &Sons, 2000.
2. S.Kumaresan,Topology of Metric Spaces, Narosa Publishing House, New Delhi,2005.

UNIT–I- Chapters 1 and 2from [1]
UNIT–II -Chapter1from [2]
UNIT–III-Chapter3from [1]and Chapter2sections 2.1to2.5 from[2]
UNIT–IV-Chapter3, Chapter4 from [2](sections3.3and 3.6omitted)and Chapter5 from [1]
UNIT-V-Chapter 5 section 5.1and Chapter 6 sections 6.1,6.3 and 6.4(section6.2,6.3.16 and6.3.17 omitted) from [2]

REFERENCES

1. Edward D.Gaughan,Introduction to Analysis,AMS,Indian edition,2010.
2. KennethA. Ross,Elementary Analysis:The Theory of Calculus,Springer Verlag,2004.
3. Walter Rudin,Principles of Mathematical Analysis,Third Edition,McGraw Hill,1976.

COs VS POs

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO 1	3	3	2	1	3	1	0	1	1
CO 2	3	3	2	1	3	1	0	1	1
CO 3	3	3	3	2	3	1	1	1	1
CO 4	3	3	3	3	3	1	2	1	1
CO 5	3	3	3	2	3	1	1	1	1
TOTAL	**15**	**15**	**13**	**9**	**15**	**5**	**4**	**5**	**5**
SCALED VALUE	**3**	**3**	**3**	**2**	**3**	**1**	**1**	**1**	**1**

0 - No Relation, 1 – Low Relation, 2- Medium Relation, 3- High Relation

1-5→1, 6-10→2, 11-15→3

COURSE NAME			GRAPH THEORY	L	T	P	C
COURSE CODE			YMA103	4	1	0	5
C	P	A		L	T	P	H
5	0	0		4	1	0	5
PREREQUISITE			Basic concepts of Graphs				

On successful completion of this course, the students will be able to:

	COURSE OUTCOMES	DOMAIN	LEVEL
CO 1	**Explain** basic concepts of **graphs**	Cognitive	Understanding
CO 2	**Explain** vertex connectivity and edge connectivity in graphs	Cognitive	Understanding
CO 3	**Explain** Eulerian Graphs and Hamiltonian Graphs	Cognitive	Understanding
CO 4	**Apply** colouring principle for solving problems in Vertex colourings and Edge coloring	Cognitive	Applying
CO 5	**Demonstrate** planar graphs	Cognitive	Understanding

UNIT 1	**Basic Results**	12+3

Basic Concepts - Subgraphs - Degrees of Vertices - Paths and Connectedness Operations on Graphs - Directed Graphs: Basic Concepts - Tournaments.

UNIT 2	**Connectivity**	12+3

Vertex Cuts and Edge Cuts - Connectivity and Edge - Connectivity, Trees:Definitions, Characterization and Simple Properties - Counting the Number of Spanning Trees - Cayley's Formula.

UNIT 3	**Independent Sets and Matchings**	12+3

Vertex Independent Sets and Vertex Coverings - Edge Independent Sets -Matchings and Factors - Eulerian Graphs - Hamiltonian Graphs.

UNIT 4	**Graph Colourings**	12+3

Vertex Colouring - Critical Graphs - Triangle - Free Graphs - Edge Colourings of Graphs - Chromatic Polynomials.

UNIT 5	**Planarity**	12+3

Planar and Nonplanar Graphs - Euler Formula and its Consequences - K5 and K3,3 are Nonplanar Graphs - Dual of a Plane Graph - The Four-Colour Theorem and the Heawood Five-Colour Theorem- Kuratowski's Theorem.

LECTURE	60	TUTORIAL	15	PRACTICAL	0	TOTAL	75

TEXT BOOK
1.Douglas B. West, “Introduction to Graph Theory”, Prentice Hall of India, Second Edition, 2002.
REFERENCES
1. Bondy J. A, and Murty U. S. R., “Graph Theory”, Springer, 2008. 2. Balakrishnan R. and Ranganathan K., “A textbook of Graph Theory”, Springer, 2012. 3. Graham R.L., Rothschild B.L and Spencer J.H., “Ramsey Theory”, Wiley Publishers, Second Edition, 1990. 4. Biggs N., “Algebraic Graph Theory”, Cambridge Tracts in Mathematics 67, Cambridge University Press, 1994. MX8003 Algebraic Theory of Semigroups.

COs VS POs

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO 1	3	3	2	1	3	1	0	1	1
CO 2	3	3	3	2	3	1	1	1	1
CO 3	3	3	2	1	3	1	0	1	1
CO 4	3	3	3	2	3	1	1	1	1
CO 5	3	3	2	1	3	1	0	1	1
TOTAL	**15**	**15**	**12**	**7**	**15**	**5**	**2**	**5**	**5**
SCALED VALUE	**3**	**3**	**3**	**2**	**3**	**1**	**1**	**1**	**1**
0 - No Relation, 1 – Low Relation, 2- Medium Relation, 3- High Relation									
1-5→1, 6-10→2, 11-15→3									

COURSE NAME			ORDINARY DIFFERENTIAL EQUATIONS	L	T	P	C
COURSE CODE			YMA104	4	1	0	5
C	P	A		L	T	P	H
5	0	0		4	1	0	5
PREREQUISITE			Knowledge in differentiation				

On successful completion of this course, the students will be able to:

	COURSE OUTCOMES	DOMAIN	LEVEL
CO 1	**Utilize** the theory of power series when solving second order differential equations	Cognitive	Applying
CO 2	**Solve** the problems arises in mathematical physics using properties of Bessel functions	Cognitive	Applying
CO 3	**Apply** Picard's theorem for calculating exact solution for a given initial value problem	Cognitive	Applying
CO 4	**Examine** the classical vibrating string problem through eigenvalues and eigen functions with given boundary conditions	Cognitive	Analyzing
CO 5	**Identify** critical points and phase portrait of nonlinear equations	Cognitive	Applying

UNIT 1		12+3

The general solution of the homogeneous equation – The use of one known solution to find another – The method of variation of parameters – Power Series solutions. A review of power series – Series solutions of first order equations – Second order linear equations; Ordinary points.

UNIT 2		12+3

Regular Singular Points – Gauss's hypergeometric equation – The Point at infinity - Legendre Polynomials – Bessel functions – Properties of Legendre Polynomials and Bessel functions.

UNIT 3		12+3

Linear Systems of First Order Equations – Homogeneous Equations with Constant Coefficients – The Existence and Uniqueness of Solutions of Initial Value Problem for First Order Ordinary Differential Equations – The Method of Solutions of Successive Approximations and Picard's Theorem.

UNIT 4		12+3

Oscillation Theory and Boundary value problems – Qualitative Properties of Solutions– Sturm Comparison Theorems – Eigen values, Eigen functions and the Vibrating String.

UNIT 5		**12+3**

Nonlinear equations:Autonomous Systems; the phase plane and its phenomena–Types of critical points;Stability – critical points and stability for linear systems – Stability by Liapunov's direct method – Simple critical points of nonlinear systems.

LECTURE	**60**	**TUTORIAL**	**15**	**PRACTICAL**	**0**	**TOTAL**	**75**

TEXT BOOK

1.G.F. Simmons, Differential Equations with Applications and Historical Notes, TMH, New Delhi, 1974.

UNIT – I -Chapter 3: Sections 15, 16, 19 and Chapter 5: Sections 25 to 27

UNIT – II -Chapter 5 : Sections 28 to 31 and Chapter 6: Sections 32 to 35

UNIT – III -Chapter 7: Sections 37, 38 and Chapter 11: Sections 55, 56

UNIT – IV -Chapter 4: Sections 22 to 24

UNIT – V -Chapter 8: Sections 40 to 44

REFERENCES

1. M.E. Taylor, Introduction to Differential Equations, AMS Indian Edition, 2011.
2. M. Braun, Differential Equations and Their Applications, Springer, 1992.
3. E.A. Coddington and N. Levinson, Theory of Ordinary Differential Equations, McGraw Hill, 1955.

COs VS POs

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO 1	3	3	3	2	3	1	1	1	1
CO 2	3	3	3	2	3	1	1	1	1
CO 3	3	3	3	2	3	1	1	1	1
CO 4	3	3	3	3	3	1	2	1	1
CO 5	3	3	3	2	3	1	1	1	1
TOTAL	15	15	15	11	15	5	6	5	5
SCALED VALUE	3	3	3	3	3	1	2	1	1

0 - No Relation, 1 – Low Relation, 2- Medium Relation, 3- High Relation

1-5→1, 6-10→2, 11-15→3

COURSE NAME			OPTIMIZATION TECHNIQUES	L	T	P	C
COURSE CODE			YMA105	4	1	0	5
C	P	A		L	T	P	H
5	0	0		4	1	0	5

PREREQUISITE	Probability and random process

On successful completion of this course, the students will be able to:

	COURSE OUTCOMES	DOMAIN	LEVEL
CO 1	**Explain** the systematic way of approaching a decision theory to get desired outcome of where the possibility of occurrence of different outcomes are evaluated in advance.	Cognitive	Understanding
CO 2	**Solve** the abilities in project evaluation techniques using PERT, CPM	Cognitive	Applying
CO 3	**Explain** the dynamics of inventory management's principles, concepts, and techniques	Cognitive	Understanding
CO 4	**Solve** fourth order polynomial function using Newton Raphson Method	Cognitive	Applying
CO 5	**Apply** the direct search method and gradient method for obtaining optimal solutions for the given function	Cognitive	Applying

UNIT 1	DECISION THEORY	12+3

Steps in Decision theory Approach - Types of Decision-Making Environments - Decision Making Under Uncertainty - Decision Making under Risk - Posterior Probabilities and Bayesian Analysis - Decision Tree Analysis - Decision Making with Utilities

UNIT 2	PROJECT MANAGEMENT: PERT AND CPM	12+3

Basic Differences between PERT and CPM - Steps in PERT/CPM Techniques - PERT/CPM Network Components and Precedence Relationships - Critical Path Analysis - Probability in PERT Analysis - Project time-cost Trade Off - Updating the Project - Resource Allocation

UNIT 3	DETERMINISTIC INVENTORY CONTROLMODELS	12+3

Meaning of Inventory Control - Functional Classification - Advantage of Carrying Inventory - Features of Inventory System - Inventory Model building - Deterministic Inventory Models with no shortage - Deterministic Inventory with Shortages Probabilistic Inventory Control Models:Single Period Probabilistic Models without Setup cost - Single Period Probabilities Model with Setup cost.

UNIT 4	CLASSICAL OPTIMIZATION THEORY	12+3

Unconstrained Problems-Necessary and Sufficient Conditions- The Newton-Raphson Method- Constrained Problems- Equality Constraints- Inequality Constraints.

UNIT 5	NONLINEAR PROGRAMMING ALGORITHMS	12+3

Unconstrained Algorithms- Direct Search Method- Gradient Method- Constrained Algorithms- Quadratic Programming- Chance-Constrained Programming

LECTURE	60	TUTORIAL	15	PRACTICAL	0	TOTAL	75

TEXT BOOKS:

1. J.K.Sharma, "Operations Research Theory and Applications", Third Edition, Macmillan India Ltd., 2007

Unit I - Chapter-11 (Section 11.1 - 11.8)

Unit II - Chapter-13 (Section 13.1 - 13.9)

Unit III - Chapter-14 (Section 14.1 - 14.8); Chapter-15 : (Section15.1 - 15.4)

2. Hamdy A Taha, Operations Research: An Introduction, Eighth Edition,. University of Arkansas, Fayetteville, PEARSON Prentice Hall. © 2007 by Pearson Education, Inc.

Unit IV-Chapter 18 – Section 18.1.1, 18.1.2, 18.2.1, 18.2.2

Unit V-Chapter 19 – Section 19.1.1, 19.1.2, 19.2.2 and 19.2.3

REFERENCES

1. Hillier F.S. and J.Lieberman, "Introduction to Operations Research" (8th Edition), Tata McGraw Hill Publishing Company, New Delhi, 2006.
2. Beightler. C, D.Phillips, B. Wilde, "Foundations of Optimization" (2nd Edition) Prentice Hall Pvt Ltd., New York,1979
3. Bazaraa, M.S; J.J.Jarvis, H.D.Sharall, "Linear Programming and Network flow", John Wiley and sons, New York,1990.
4. Gross, D and C.M.Harris, "Fundamentals of Queueing Theory", (3rd Edition), Wiley and Sons, New York, 1998.
5. Hamdy A. Taha , "Operations Research" (sixth edition), Prentice - Hall of India Private Limited, New Delhi.2007

COs VS POs

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO 1	3	3	2	1	3	1	0	1	1
CO 2	3	3	3	2	3	1	1	1	1
CO 3	3	3	2	1	3	1	0	1	1
CO 4	3	3	2	1	3	1	0	1	1
CO 5	3	3	2	1	3	1	0	1	1
TOTAL	**15**	**15**	**11**	**6**	**15**	**5**	**1**	**5**	**5**
SCALED VALUE	**3**	**3**	**3**	**2**	**3**	**1**	**1**	**1**	**1**
0 - No Relation, 1 – Low Relation, 2- Medium Relation, 3- High Relation									
1-5→1, 6-10→2, 11-15→3									

COURSE NAME			FUZZY SETS AND FUZZY LOGIC	L	T	P	C
COURSE CODE			YMA1E1	3	0	0	3
C	P	A		L	T	P	H
3	0	0		3	0	0	3

PREREQUISITE	Basic concepts of sets

On successful completion of this course, the students will be able to:

	COURSE OUTCOMES	DOMAIN	LEVEL
CO 1	**Compare** the relationship between Crisp sets and Fuzzy sets	Cognitive	Applying
CO 2	**Explain** operation on Fuzzy Sets	Cognitive	Understanding
CO 3	**Compare** Fuzzy Relations and crisp relations	Cognitive	Applying
CO 4	**Demonstrate** the propositional calculus	Cognitive	Understanding
CO 5	**Explain** the concepts of fuzzy logic	Cognitive	Understanding

UNIT 1	**Crisp Sets and Fuzzy Sets**	9

Crisp sets basic definitions - the notion of fuzzy sets - basic concepts of fuzzy sets

UNIT 2	**Operation on Fuzzy Sets**	9

Fuzzy complement - fuzzy union - fuzzy intersection - combination and general aggregation operations

UNIT 3	**Fuzzy Relations**	9

Crisp and fuzzy relations - binary relation - equivalence and similarity relations - tolerance relations- orderings

UNIT 4	**Classical Logic**	9

Tautologies - contradictions - equivalence - exclusive OR and exclusive NOR - logical proofs

UNIT 5	**Fuzzy Logic**	9

Fuzzy logic - approximate reasoning - fuzzy tautologies - contradictions - equivalence and logical proofs

LECTURE	45	TUTORIAL	0	PRACTICAL	0	TOTAL	45

TEXT BOOKS

1. George J. Klir & Tina A. Folger, “Fuzzy Sets, Uncertainty, and Information”, Prentice Hall of India Pvt. Ltd., New Delhi, 1988
2. Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, 3rd edition, McGraw-Hill. Inc, 2010.

REFERENCES

1. Zimmermann. H.J, “Fuzzy Set Theory and Its Applications”, 4th edition, Springer, Netherlands,2015.
2. Bart Kosko, “Neural Networks and Fuzzy Systems”, Prentice-Hall International,1992.

COs VS POs

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO 1	3	3	3	2	3	1	1	1	1
CO 2	3	3	2	1	3	1	0	1	1
CO 3	3	3	3	2	3	1	1	1	1
CO 4	3	3	2	1	3	1	0	1	1
CO 5	3	3	2	1	3	1	0	1	1
TOTAL	**15**	**15**	**12**	**7**	**15**	**5**	**2**	**5**	**5**
SCALED VALUE	**3**	**3**	**3**	**2**	**3**	**1**	**1**	**1**	**1**
0 - No Relation, 1 – Low Relation, 2- Medium Relation, 3- High Relation									
1-5→1, 6-10→2, 11-15→3									

COURSE NAME			CODING THEORY	L	T	P	C
COURSE CODE			YMA1E2	3	0	0	3
C	P	A		L	T	P	H
3	0	0		3	0	0	3
PREREQUISITE			Linear algebra				

On successful completion of this course, the students will be able to:

COURSE OUTCOMES		DOMAIN	LEVEL
CO 1	**Utilize** the maximum likelihood decoding rule to decode the received words	Cognitive	Applying
CO 2	**Identify** a generator matrix and parity check matrix for the given binary linear code	Cognitive	Applying
CO 3	**Explain** various bounds involved in coding theory	Cognitive	Understanding
CO 4	**Construct** the generator polynomial for all binary cyclic codes of given length	Cognitive	Applying
CO 5	**Examine** the decoding of narrow-sense binary BCH codes	Cognitive	Analyzing

UNIT 1		9

Error detection, Correction and decoding: Communication channels – Maximum likelihood decoding – Hamming distance – Nearest neighborhood minimum distance decoding – Distance of a code

UNIT 2		9

Linear codes: Linear codes – Self orthogonal codes – Self dual codes – Bases for linear codes – Generator matrix and parity check matrix – Encoding with a linear code – Decoding of linear codes – Syndrome decoding.

UNIT 3		9

Bounds in coding theory: The main coding theory problem – lower bounds -Sphere covering bound – Gilbert Varshamov bound – Binary Hamming codes – q-ary Hamming codes – Golay codes – Singleton bound and MDS codes – Plotkin bound

UNIT 4		9

Cyclic codes: Definitions – Generator polynomials – Generator matrix and parity check matrix – Decoding of Cyclic codes.

UNIT 5		9

Special cyclic codes: BCH codes – Parameters of BCH codes – Decoding of BCH codes – Reed Solomon codes.

LECTURE	45	TUTORIAL	0	PRACTICAL	0	TOTAL	45

TEXT BOOK

1.San Ling and Chaoping Xing , Coding Theory: A First Course, Cambridge University Press, 2004.

Unit 1 : Sections 2.1, 2.2, 2.3, 2.4, 2.5

Unit 2 : Sections 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8

Unit 3 : Sections 5.1, 5.2, 5.3, 5.4, 5.5,

Unit 4 : Sections 7.1, 7.2, 7.3, 7.

Unit 5 : Sections 8.1, 8.2

REFERENCES

1. S. Lin & D. J. Costello, Jr., Error Control Coding: Fundamentals and Applications, Prentice-Hall, Inc., New Jersey,1983.
2. Vera Pless, Introduction to the Theory of Error Correcting Codes, Wiley, NewYork, 1982.
3. E. R Berlekamp, Algebraic Coding Theory, Mc Graw-Hill,1968.
4. H. Hill, A First Course in Coding Theory, OUP,1986

COs VS POs

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO 1	3	3	3	2	3	1	1	1	1
CO 2	3	3	3	2	3	1	1	1	1
CO 3	3	3	2	1	3	1	0	1	1
CO 4	3	3	3	2	3	1	1	1	1
CO 5	3	3	3	3	3	1	2	1	1
TOTAL	15	15	14	10	15	5	6	5	5
SCALED VALUE	3	3	3	2	3	1	2	1	1

0 - No Relation, 1 – Low Relation, 2- Medium Relation, 3- High Relation

1-5→1, 6-10→2, 11-15→3

COURSE NAME			NEURAL NETWORKS	L	T	P	C
COURSE CODE			YMA1E3	3	0	0	3
C	P	A		L	T	P	H
3	0	0		3	0	0	3

PREREQUISITE	Linear algebra

On successful completion of this course, the students will be able to:

	COURSE OUTCOMES	DOMAIN	LEVEL
CO 1	**Summarize** different neuron network models	Cognitive	Understanding
CO 2	**Explain** Perceptron Architectures and Learning Rules	Cognitive	Understanding
CO 3	**Apply** Hebb rule for finding the appropriate weight matrix for the given linear associator	Cognitive	Applying
CO 4	**Construct** back propagation algorithm for the given network	Cognitive	Applying
CO 5	**Identify** the second order Taylor series expansions for the given function about the two minima	Cognitive	Applying

UNIT 1	**Neuron Model and Network Architectures**	9

Mathematical Neuron Model- Network Architectures- Perceptron-Hamming Network- Hopfield Network- Learning Rules.

UNIT 2	**Perceptron Architectures**	9

Perceptron Architectures and Learning Rule with Proof of Convergence. Supervised Hebbian Learning - Linear Associator.

UNIT 3	**Supervised Hebbian Learning**	9

The Hebb Rule-Pseudo inverse Rule-Variations of Hebbian Learning-Back Propagation - Multilayer Perceptron

UNIT 4	**Back Propagation**	9

Back propagation Algorithm-Convergence and Generalization - Performances Surfaces and Optimum Points-Taylor series.

UNIT 5	**Performance Surfaces and Performance Optimizations**	9

Directional Derivatives - Minima-Necessary Conditions for Optimality-Quadratic Functions-Performance Optimizations-Steepest Descent-Newton's Method-Conjugate Gradient.

LECTURE	45	TUTORIAL	0	PRACTICAL	0	TOTAL	45

TEXT BOOK
1.Martin T. Hagan, Howard B. Demuth and Mark Beale, Neural Network Design, Vikas Publishing House, New Delhi,2002.
REFERENCES
1. James A. Freeman, David M. Skapura, Neural Networks Algorithms, Applications and Programming Techniques, Pearson Education, 2003. 2. Robert J. Schalkoff, Artificial Neural Network, McGraw-Hill International Edition, 1997.

COs VS POs

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO 1	3	3	2	1	3	1	0	1	1
CO 2	3	3	2	1	3	1	0	1	1
CO 3	3	3	3	2	3	1	1	1	1
CO 4	3	3	3	2	3	1	1	1	1
CO 5	3	3	3	2	3	1	1	1	1
TOTAL	**15**	**15**	**13**	**8**	**15**	**5**	**3**	**5**	**5**
SCALED VALUE	**3**	**3**	**3**	**2**	**3**	**1**	**1**	**1**	**1**
0 - No Relation, 1 – Low Relation, 2- Medium Relation, 3- High Relation									
1-5→1, 6-10→2, 11-15→3									

SEMESTER II

COURSE NAME			ALGEBRA - II	L	T	P	C
COURSE CODE			YMA201	4	1	0	5
C	P	A		L	T	P	H
5	0	0		4	1	0	5

PREREQUISITE	YMA101

On successful completion of this course, the students will be able to:

	COURSE OUTCOMES	DOMAIN	LEVEL
CO 1	**Explain** the concepts of prime ideal and Maximal ideal	Cognitive	Understanding
CO 2	**Explain** the concepts of splitting fields	Cognitive	Understanding
CO 3	**Explain** the proof solvability by radicals	Cognitive	Understanding
CO 4	**Explain** the concepts of Galois's Extensions	Cognitive	Understanding
CO 5	**Explain** the proof of fundamental theorem of Galois's Theory	Cognitive	Understanding

UNIT 1		12+3
Prime ideals and Maximal Ideals, Irreducible polynomials.		
UNIT 2		**12+3**
Classical Formulas, Splitting Fields		
UNIT 3		**12+3**
The Galois Group, Roots of Unity, Solvability by Radicals.		
UNIT 4		**12+3**
Independence of Characters, Galois Extensions		
UNIT 5		**12+3**
The Fundamental theorem of Galois theory, Applications, Galois Great Theorem.		

LECTURE	60	TUTORIAL	15	PRACTICAL	0	TOTAL	75

TEXT BOOK

1.Joseph Rotman, Galois Theory, 2nd edition, Springer Verlag, 1990.

UNIT – I Pages 31 - 43

UNIT – II Pages 44 -58

UNIT – III Pages 59 - 75

UNIT – IV Pages 76-82

UNIT – V Pages 83-95

REFERENCES
1. David S. Dummitand Richard M.Foote,Abstract Algebra,2nd Edition,Wiley Student Edition, 2008. 2. Serge Lang. Algebra-Revised third edition-Springer–Verlag-2002. 3. Ian Stewart, GaloisTheory, Chapman and Hall,1973

COs VS POs

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO 1	3	3	2	1	3	1	0	1	1
CO 2	3	3	2	1	3	1	0	1	1
CO 3	3	3	2	1	3	1	0	1	1
CO 4	3	3	2	1	3	1	0	1	1
CO 5	3	3	2	1	3	1	0	1	1
TOTAL	**15**	**15**	**15**	**5**	**15**	**5**	**0**	**5**	**5**
SCALED VALUE	**3**	**3**	**3**	**1**	**3**	**1**	**0**	**1**	**1**
0 - No Relation, 1 – Low Relation, 2- Medium Relation, 3- High Relation									
1-5→1, 6-10→2, 11-15→3									

COURSE NAME			REAL ANALYSIS - II	L	T	P	C
COURSE CODE			YMA202	4	1	0	5
C	P	A		L	T	P	H
5	0	0		4	1	0	5

PREREQUISITE	Basic concepts of convergence and uniform convergence

On successful completion of this course, the students will be able to:

	COURSE OUTCOMES	DOMAIN	LEVEL
CO 1	**Explain** mean value theorem and functions of bounded variations	Cognitive	Understanding
CO 2	**Compare** mean value theorems for Riemann Stieltjes Integrals	Cognitive	Applying
CO 3	**Explain** uniform convergence and integration and differentiation	Cognitive	Understanding
CO 4	**Explain** directional derivatives and total derivative	Cognitive	Understanding
CO 5	**Explain** Inverse function theorem and Implicit function theorem	Cognitive	Understanding

UNIT 1		12+3

Differentiation of single variable: Derivatives – The chain rule – local extrema – Rolle's theorem – Mean Value Theorem – Taylor's formula – Derivatives of vector – valued functions – Functions of Bounded variation and rectifiable curves – Total variation – Functions of bounded variation – Equivalence of paths – Change of parameter.

UNIT 2		12+3

Riemann – Stieltjes integral:Definition –linear properties of the integral– Necessary conditions for the existence -First fundamental theorem of Integral calculus -Mean Value Theorem for integrals – Second fundamental theorem of Integral calculus-Change of variable in a Riemann integral – Second Mean value Theorem for Riemann integrals.

UNIT 3		12+3

Sequence and series of functions–Pointwise convergence–Uniform convergence–Uniform convergence and integration–Uniform convergence and Differentiation– Sufficient conditions for uniform convergence of a series.

UNIT 4		**12+3**
Functions of Several variables – Directional derivative –Total derivative – Jacobian – Chain rule –Mean Value Theorem – Taylor's formula.		
UNIT 5		**12+3**
Inverse function theorem – Implicit function theorem – Extremum problems with side conditions.		

LECTURE	**60**	**TUTORIAL**	**15**	**PRACTICAL**	**0**	**TOTAL**	**75**

TEXT BOOK

Tom M. Apostol, Mathematical Analysis Second Edition,Narosa Publishing House,New Delhi,1985.
UNIT–I-Chapter5 and 6
UNIT–II-Chapter7Section 7.1-7.22
UNIT–III- Chapter 9Section 9.1 - 9.11 and 9.14 -9.18
UNIT–IV-Chapter12
UNIT–V-Chapter13

REFERENCES

i. Walter Rudin,Principles of Mathematical Analysis,Third Edition, McGraw Hill,1976.
i. Tom Apostol,Calculus II, McGraw Hill,1983.

COs VS POs

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO 1	3	3	2	1	3	1	0	1	1
CO 2	3	3	3	2	3	1	1	1	1
CO 3	3	3	2	1	3	1	0	1	1
CO 4	3	3	2	1	3	1	0	1	1
CO 5	3	3	2	1	3	1	0	1	1
TOTAL	15	15	11	6	15	5	1	5	5
SCALED VALUE	3	3	2	2	3	1	1	1	1

0 - No Relation, 1 – Low Relation, 2- Medium Relation, 3- High Relation

1-5→1, 6-10→2, 11-15→3

COURSE NAME			PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
COURSE CODE			YMA203	4	1	0	5
C	P	A		L	T	P	H
5	0	0		4	1	0	5

PREREQUISITE	Knowledge in Undergraduate differential equations

On successful completion of this course, the students will be able to:

	COURSE OUTCOMES	DOMAIN	LEVEL
CO 1	**Summarize** the first order partial differential equations	Cognitive	Understanding
CO 2	**Analyze** the different methods of Partial Differential Equations of the Second Order	Cognitive	Analyzing
CO 3	**Apply** the method of variable separable for solving Laplace Equation	Cognitive	Applying
CO 4	**Apply** the partial differential equations for obtaining general solutions of wave equation	Cognitive	Applying
CO 5	**Utilize** Green's Function for finding solutions of diffusion equation	Cognitive	Applying

UNIT 1	**Partial Differential Equations of the First Order**	12+3

Partial Differential Equations–Origins of First Order Differential Equations–Cauchy's Problem for first order equations– Linear Equations of the first order– Nonlinear partial differential equations of the first order – Cauchy's method of characteristics – Compatible system of First order Equations–Solutions satisfying given Condition- Jacobi's method.

UNIT 2	**Partial Differential Equations of the Second Order**	12+3

The Origin of Second Order Equations – Linear partial Differential Equations with constant coefficients – Equations with variable coefficients – Separation of variables – The method of Integral Transforms– Non – linear equations of the second order.

UNIT 3	**Laplace's Equation**	12+3

Elementary solutions of Laplace equation – Families of Equipotential Surfaces – Boundary value problems – Separation of variables – Surface Boundary Value Problems – Separation of Variables – Problems with Axial Symmetry – The Theory of Green's Function for Laplace Equation.

UNIT 4	The Wave Equation	12+3
The Occurrence of the wave equation in Physics–Elementary Solutions of the One–dimensional Wave equations – Vibrating membrane, Application of the calculus of variations –Three dimensional problem– General solutions of the Wave equation		
UNIT 5	**The Diffusion Equation**	**12+3**
Elementary Solutions of the Diffusion Equation – Separation of variables – The use of Integral Transforms – The use of Green's functions		

LECTURE	60	TUTORIAL	15	PRACTICAL	0	TOTAL	75

TEXT BOOK

1.Ian Sneddon, Elements of Partial Differential Equations, McGraw Hill International Book Company, New Delhi, 1983

REFERENCES

1. M. D. Raisinghania, Advanced Differential Equations, S. Chand and Company Ltd., New Delhi, 2001.
2. K. Sankara Rao, Introduction to Partial Differential Equations, Second edition, Prentice-Hall of India, New Delhi, 2006.
3. J. N. Sharma and K. Singh, Partial Differential Equations for Engineers and Scientists, Narosa Publishing House, 2001.

COs VS POs

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO 1	3	3	2	1	3	1	0	1	1
CO 2	3	3	3	3	3	1	2	1	1
CO 3	3	3	3	2	3	1	1	1	1
CO 4	3	3	3	2	3	1	1	1	1
CO 5	3	3	3	2	3	1	1	1	1
TOTAL	15	15	14	10	15	5	5	5	5
SCALED VALUE	3	3	3	2	3	1	1	1	1

0 - No Relation, 1 – Low Relation, 2- Medium Relation, 3- High Relation

1-5→1, 6-10→2, 11-15→3

COURSE NAME			CLASSICAL DYNAMICS	L	T	P	C
COURSE CODE			YMA204	4	1	0	5
C	P	A		L	T	P	H
5	0	0		4	1	0	5

PREREQUISITE	Trigonometry and Statics

On successful completion of this course, the students will be able to:

	COURSE OUTCOMES	DOMAIN	LEVEL
CO 1	**Explain** the mechanical system, energy and momentum.	Cognitive	Understanding
CO 2	**Explain** Lagrange's equation and integrals of motion.	Cognitive	Understanding
CO 3	**Explain** Rayleigh's dissipation function and impulsive motion	Cognitive	Understanding
CO 4	**Explain** Hamilton's principle and Hamilton's equations	Cognitive	Understanding
CO 5	**Explain** Hamilton's Principal Function, The Hamilton and Jacobi's equation	Cognitive	Understanding

UNIT 1		12+3

Introductory concepts: The mechanical system - Generalized Coordinates - constraints - virtual work - Energy and momentum.

UNIT 2		12+3

Lagrange's equation: Derivation and examples - Integrals of the Motion - Small oscillations.

UNIT 3		12+3

Special Applications of Lagrange's Equations: Rayleigh's dissipation function - impulsive motion - Gyroscopic systems - velocity dependent potentials.

UNIT 4		12+3

Hamilton's equations: Hamilton's principle - Hamilton's equations - Other variational principles - phase space.

UNIT 5		12+3

Hamilton - Jacobi Theory: Hamilton's Principal Function – The Hamilton – Jacobi's equation - Separability.

LECTURE	60	TUTORIAL	15	PRACTICAL	0	TOTAL	75

TEXT BOOK

1.Donald T. Greenwood,Classical Dynamics, PHI Pvt. Ltd., New Delhi-1985. UNIT – I Chapter 1: Sections 1.1 to 1.5 UNIT – II Chapter 2: Sections 2.1 to 2.4 UNIT – III Chapter 3 : Sections 3.1 to 3.4 UNIT – IV Chapter 4: Sections 4.1 to 4.4 UNIT – V Chapter 5: Sections 5.1 to 5.3
REFERENCES
1.H. Goldstein, Classical Mechanics, (2nd Edition), Narosa Publishing House, New Delhi. 2. Narayan Chandra Rana & Promod Sharad Chandra Joag, Classical Mechanics, Tata McGrawHill, 1991.

COs VS POs

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO 1	3	3	2	1	3	1	0	1	1
CO 2	3	3	2	1	3	1	0	1	1
CO 3	3	3	2	1	3	1	0	1	1
CO 4	3	3	2	1	3	1	0	1	1
CO 5	3	3	2	1	3	1	0	1	1
TOTAL	**15**	**15**	**10**	**5**	**15**	**5**	**0**	**5**	**5**
SCALED VALUE	**3**	**3**	**2**	**1**	**3**	**1**	**0**	**1**	**1**
0 - No Relation, 1 – Low Relation, 2- Medium Relation, 3- High Relation									
1-5→1, 6-10→2, 11-15→3									

COURSE NAME			COMPUTER PROGRAMMING (C++ Theory and Lab)	L	T	P	C
COURSE CODE			YMA205	3	0	2	5
C	P	A		L	T	P	H
5	0	0		3	0	2	5
PREREQUISITE							

On successful completion of this course, the students will be able to:

COURSE OUTCOMES		DOMAIN	LEVEL
CO 1	**Explain** C programming fundamentals	Cognitive	Understanding
CO 2	**Apply** structure and union for various functions	Cognitive	Applying
CO 3	**Explain** advanced concept of pointers and files	Cognitive	Understanding
CO 4	**Explain** object-oriented technologies	Cognitive	Understanding
CO 5	**Explain** Algorithms Using Functions and Objects	Cognitive	Understanding

UNIT 1	INTRODUCTION TO C LANGUAGE	12+3

Overview of C – Constants, Variables and Data Types – Operators and Expressions – Managing Input/Output Operations – Formatted I/O – Decision Making - Branching –- if, nested if , switch, goto and Looping- while, do, for statements.

Lab:

1.Program to implement formatted I/O operations
2. Program to implement formatted I/O operations
3.Program to implement control structures

UNIT 2	ARRAYS, FUNCTIONS, STRUCTURES AND UNIONS	12+3

Arrays – dynamic and multi-dimensional arrays - Character arrays and Strings – String handling Functions - User defined Functions – Categories of Functions – Recursion - Structures and Unions – Array of Structures – Structures and Functions

Lab:

4. Program using 2D arrays
5.Program to implement calling the function through call by value method & call by reference
6.Program to implement Structures

UNIT 3	POINTERS AND FILE MANAGEMENT	12+3

Pointers – Declaration, Accessing a variable, character strings, pointers to functions and structures - File Management in C – Dynamic Memory allocation – Linked Lists – Preprocessors.

Lab:

7.Program to implement dynamic memory allocation
8.Program to implement pointer to function
9.Program to implement an array of pointers

UNIT 4	INTRODUCTION TO C++	12+3

Overview of C++-Classes and Objects-Friend Functions-Friend Classes-Inline Function-Static Members-Arrays-Pointers-References-Dynamic Allocation- Function Overloading-Overloading Constructor Functions-Copy Constructors-Default Argument-Operator Overloading-Member Operator Overloading

Lab:

10. Demonstrate Inline Functions
11.Implement Class and Subclass
12. Demonstrate Constructors & Destructors.

UNIT 5	**ADDITIONAL FEATURES**	**12+3**

Inheritance-Base Class-Access Control-Virtual Functions-Pure Virtual Functions-Templates-Generic Functions-Applying Generic Functions-Generic Classes-Exception Handling-C++ I/O Streams-File I/O-STL-Overview-Container Classes-Lists-Maps-Algorithms Using Functions and Objects-String Class

Lab:

13. Implement Virtual Function
14.Programs to implement the concept of exception handling
15. Program to implement file operations.

LECTURE	**45**	**TUTORIAL**	**0**	**PRACTICAL**	**30**	**TOTAL**	**75**

TEXT BOOKS

1. E.Balagurusamy, Programming in ANSI C , Tata McGraw Hill, 2008
2. Herbert Schildt, C++ The Complete Reference, Tata McGrawHill Edition, 2014

REFERENCES

1. Deitel and Deitel, C How to Program, Addison Wesley, 2011
2. K. N. King,C Programming: A Modern Approach, 2nd Edition**,** W. W. Norton & Company; 2 editions,2008
3. Robert Lafore, OOP in Turbo C++,Galgotia Publications, 2001

COs VS POs

	PO 1	**PO2**	**PO3**	**PO 4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO 1	3	3	2	1	3	1	0	1	1
CO 2	3	3	3	2	3	1	1	1	1
CO 3	3	3	2	1	3	1	0	1	1
CO 4	3	3	2	1	3	1	0	1	1
CO 5	3	3	2	1	3	1	0	1	1
TOTAL	**15**	**15**	**11**	**6**	**15**	**5**	**1**	**5**	**5**
SCALED VALUE	**3**	**3**	**3**	**2**	**3**	**1**	**1**	**1**	**1**

0 - No Relation, 1 – Low Relation, 2- Medium Relation, 3- High Relation

1-5→1, 6-10→2, 11-15→3

COURSE NAME			FLUID DYNAMICS	L	T	P	C
COURSE CODE			YMA2E1	3	0	0	3
C	P	A		L	T	P	H
3	0	0		3	0	0	3
PREREQUISITE			Trigonometry				

On successful completion of this course, the students will be able to:

COURSE OUTCOMES		DOMAIN	LEVEL
CO 1	Recall the basic concepts of velocity, density and curvilinear co-ordinates.	Cognitive	Remembering
CO 2	Understand the concepts and equations of fluid dynamics	Cognitive	Understanding
CO 3	Analyze and understand the concepts of the force experienced by a two-dimensional fixed body in a steady irrotational flow	Cognitive	Understanding Analyze
CO 4	Analyze the approximate solutions of the Navier – Stokes equation.	Cognitive	Applying
CO 5	Apply the appropriate method to solve integral equation of boundary layer, Blasius equation and its series solution	Cognitive	Applying

UNIT 1	**Bernoulli's Equation and Equations of Motion**	9

Introductory Notions – Velocity – Stream Lines and Path Lines – Stream Tubes and Filaments – Fluid Body – Density – Pressure. Differentiation with respect to the time – Equation of continuity – Boundary conditions – Kinematical and physical – Rate of change of linear momentum – Equation of motion of an inviscid fluid.

UNIT 2	**Equations of Motion (Contd)**	9

Euler's momentum Theorem – Conservative forces – Bernoulli's theorem in steady motion – energy equation for inviscid fluid – circulation – Kelvin's theorem – vortex motion – Helmholtz equation.

UNIT 3	**Two-Dimensional Motion**	9

Two-Dimensional Motion – Two Dimensional Functions – Complex Potential – basic singularities – source – sink – Vortex – doublet – Circle theorem. Flow past a circular cylinder with circulation – Blasius Theorem – Lift force. (Magnus effect)

UNIT 4	**Dynamics of Real Fluids**	9

Viscous flows – Navier-Stokes equations – Vorticity and circulation in a viscous fluid – Steady flow through an arbitrary cylinder under pressure – Steady Couette flow between cylinders in relative motion – Steady flow between parallel planes.

UNIT 5	**The Laminar Boundary Layer in Incompressible Flow**	**9**

Boundary Layer concept – Boundary Layer equations – Displacement thickness, Momentum thickness – Kinetic energy thickness – integral equation of boundary layer – flow parallel to semi-infinite flat plate – Blasius equation and its solution in series.

LECTURE	**45**	**TUTORIAL**	**0**	**PRACTICAL**	**0**	**TOTAL**	**45**

TEXT BOOKS

1. Units I and II: L. M. Milne Thomson, Theoretical Hydro Dynamics, Macmillan Company, 5th Edition (1968). Chapter I : Sections 1.0 – 1.3., 3.10-3.41 (omit 3.32) Chapter III : Sections 3.42 – 3.53 (omit 3.44)
2. Units III, IV and V: Modern Fluid Dynamics Volume I, N. Curle and H. J. Davies, D. Van Nostrand Company Limited, London, 1968. Chapter III : Sections 3.1 – 3.7.5 (omit 3.3.4, 3.4, 3.5.2,3.6) Chapter V : Sections 5.2.1– 5.3.3 Chapter VI : Sections 6.1 – 6.3.1 (omit 6.2.2., 6.2.5)

REFERENCES

1. F. Chorlton, Textbook of Fluid Dynamics, CBS Publishers, New Delhi, 2004.
2. A. J. Chorin and A. Marsden, A Mathematical Introduction to Fluid Dynamics, Springer Verlag, New York, 1993.

E – Resources (MOOC, SWAYAM, NPTEL, Websites etc) 1

https://nptel.ac.in/courses/112/106/112106200/

COs VS POs

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO 1	3	3	2	1	3	1	0	1	1
CO 2	3	3	2	1	3	1	0	1	1
CO 3	3	3	2	1	3	1	0	1	1
CO 4	3	3	2	1	3	1	0	1	1
CO 5	3	3	2	1	3	1	0	1	1
TOTAL	**15**	**15**	**10**	**5**	**15**	**5**	**0**	**5**	**5**
SCALED VALUE	**3**	**3**	**2**	**1**	**3**	**1**	**0**	**1**	**1**

0 - No Relation, 1 – Low Relation, 2- Medium Relation, 3- High Relation

COURSE NAME			COMBINATORICS	L	T	P	C
COURSE CODE			YMA2E2	3	0	0	3
C	P	A		L	T	P	H
3	0	0		3	0	0	3
PREREQUISITE			Basics of sets				

On successful completion of this course, the students will be able to:

	COURSE OUTCOMES	DOMAIN	LEVEL
CO 1	**Explain** the distributions of distinct objects and non-distinct objects	Cognitive	Understanding
CO 2	**Apply** diverse counting strategies to solve varied problems involving strings, combinations, distributions, and partitions	Cognitive	Applying
CO 3	**Solve** linear recurrence relations by recognizing homogeneity, linearity, constant coefficients, degree, and characteristic equation	Cognitive	Applying
CO 4	**Identify** the number of permutations with forbidden positions using rook polynomials	Cognitive	Applying
CO 5	**Apply** Polya's theorem for finding number of permutations of given objects	Cognitive	Applying

UNIT 1	**Permutations and combinations**	**9**
Distributions of distinct objects – Distributions of non-distinct objects – Stirling's formula.		
UNIT 2	**Generating functions**	**9**
Generating function for combinations – Enumerators for permutations distributions of distinct objects into non distinct cells – partitions of integers – Ferrers graphs – Elementary relations.		
UNIT 3	**Recurrence relation**	**9**
Linear recurrence relations with constant coefficients- solutions by the technique of generating functions – A special class of nonlinear difference equations – Recurrence relations with two indices.		
UNIT 4	**The principle of inclusion and exclusion**	**9**
General formula – Permutations with restriction on relative positions – Derangements – Rook polynomials – permutations with forbidden positions.		
UNIT 5	**Polya's theory of counting**	**9**

Equivalence classes under a permutation group – Burnside theorem – Equivalence classes of functions – Weights and inventories of functions – Polya's fundamental theorem – Generalization of Polya's theorem							
LECTURE	**45**	**TUTORIAL**	**0**	**PRACTICAL**	**0**	**TOTAL**	**45**

TEXT BOOKS

1. Cameron, P.J. (1998) Combinatorics: Topics, Techniques, Algorithms. Cambridge: Cambridge University Press.
2. Liu, C.L., Eddberg, M. (1968). Solutions to problems in Introduction to Combinatorial Mathematics. New York: McGraw-Hill Book & Co.

REFERENCES

1. Liu, C.L. (1968). Introduction of Combinatorial Mathematics. New York: McGraw Hill Book Co.
2. Stanley, R.P. (1997). Enumerative Combinatorics, Volume I, Cambridge Studies in Advanced Mathematics, Volume 49. Cambridge University Press.

COs VS POs

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO 1	3	3	2	1	3	1	0	1	1
CO 2	3	3	3	2	3	1	1	1	1
CO 3	3	3	3	2	3	1	1	1	1
CO 4	3	3	3	2	3	1	1	1	1
CO 5	3	3	3	2	3	1	1	1	1
TOTAL	15	15	14	9	15	5	4	5	5
SCALED VALUE	3	3	3	2	3	1	1	1	1

0 - No Relation, 1 – Low Relation, 2- Medium Relation, 3- High Relation

1-5→1, 6-10→2, 11-15→3

COURSE NAME			CRYPTOGRAPHY	L	T	P	C
COURSE CODE			YMA2E3	3	0	0	3
C	P	A		L	T	P	H
3	0	0		3	0	0	3
PREREQUISITE			Basic concepts of number theory				

On successful completion of this course, the students will be able to:

	COURSE OUTCOMES	DOMAIN	LEVEL
CO 1	**Apply** the concept and properties of modular arithmetic in various algorithms to find the solution	Cognitive	Applying
CO 2	**Utilize** Pollard's rho method for solving the elliptic curve discrete logarithm problem	Cognitive	Applying
CO 3	**Utilize** basic properties of finite fields for factoring polynomials over finite fields	Cognitive	Applying
CO 4	**Demonstrate** the concepts of stream ciphers and block ciphers	Cognitive	Understanding
CO 5	**Analyze** the concepts of public key cryptography, RSA and Elliptic curve cryptography	Cognitive	Applying

UNIT 1		9
Introduction – Encryption and Secrecy – The objective of Cryptography - Number Theory – Introduction – Modular Arithmetic.		
UNIT 2		**9**
Integer factorization problem – Pollard's rho factoring – Elliptic curve factoring – Discrete logarithm problem.		
UNIT 3		**9**
Finite fields – Basic properties – Arithmetic of polynomials –Factoring polynomials over finite fields – Square free factorization.		
UNIT 4		**9**
Symmetric key encryption – Stream ciphers – Block Ciphers – DES.		

UNIT 5		9

Public key cryptography – Concepts of public key cryptography – Modular arithmetic – RSA – Discrete logarithm – Elliptic curve cryptography.

LECTURE	45	TUTORIAL	0	PRACTICAL	0	TOTAL	45

TEXT BOOKS

1. Hans Delfs, Helmut Knebl, Introduction to Cryptography, Springer Verlag, 2002.
2. Alfred J. Menezes, Paul C. Van Oorschot, Scott A. Vanstone, Handbook of Applied Cryptography, CRC Press, 2000.
3. William Stallings, Cryptography and Network Security, Prentice Hall of India, 2000.

REFERENCES

1. Pachghare V.K., Cryptography and Information Security, PHI Learning Pvt. Ltd., New Delhi, 2009
2. Behrouz A. Forouzan and Debdeep Mukhopathyey, Cryptography and Network Security, 2013, second edition, McGraw Hill Education Pvt. Ltd., New Delhi.

COs VS POs

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO 1	3	3	3	2	3	1	1	1	1
CO 2	3	3	3	2	3	1	1	1	1
CO 3	3	3	3	2	3	1	1	1	1
CO 4	3	3	2	1	3	1	0	1	1
CO 5	3	3	3	2	3	1	1	1	1
TOTAL	**15**	**15**	**14**	**9**	**15**	**5**	**4**	**5**	**5**
SCALED VALUE	**3**	**3**	**3**	**2**	**3**	**1**	**1**	**1**	**1**

0 - No Relation, 1 – Low Relation, 2- Medium Relation, 3- High Relation

1-5→1, 6-10→2, 11-15→3

SEMESTER III

COURSE NAME			TOPOLOGY	L	T	P	C
COURSE CODE			YMA301	4	1	0	5
C	P	A		L	T	P	H
5	0	0		4	1	0	5
PREREQUISITE			Basic concepts of sets				

On successful completion of this course, the students will be able to:

	COURSE OUTCOMES	DOMAIN	LEVEL
CO 1	**Identify** whether a given family of subsets is a topology or not	Cognitive	Applying
CO 2	**Apply** the concepts of continuous function on product topology and metric topology	Cognitive	Applying
CO 3	**Explain** the concepts of local connectedness and path connectedness	Cognitive	Understanding
CO 4	**Explain** the concepts of limit point compactness and local compactness	Cognitive	Understanding
CO 5	**Apply** the concept of separation axiom and normal spaces to prove the Urysohnmetrization theorem and the Tietz extension theorem	Cognitive	Applying

UNIT 1	Topological Spaces	12+3

Topological spaces - Basis for a topology - The order topology - The product topology on X x Y - The subspace topology.

UNIT 2	Continuous Functions	12+3

Closed sets and limit points-Continuous functions - the product topology - The metric topology - The metric topology (continued) - Uniform limit theorem.

UNIT 3	Connectedness	12+3

Connected spaces - connected subspaces of the Real line - Components and local connectedness.

UNIT 4	Compactness	12+3

Compact spaces - compact subspaces of the Real line - Limit Point Compactness – Local Compactness.

UNIT 5	Countability and Separation Axiom	12+3

The Countability Axioms - The separation Axioms - Normal spaces - The Urysohn Lemma - The

Urysohnmetrization Theorem - The Tietz extension theorem							
LECTURE	**60**	**TUTORIAL**	**15**	**PRACTICAL**	**0**	**TOTAL**	**75**

TEXT BOOK

1.James R. Munkres, "Topology", (2nd Edition) PHI Learning Pvt. Ltd., (Third Indian Reprint) NewDelhi,2014

Unit I - Chapter 2: Sections 12 to 17

Unit II - Chapter 2: Sections 18 to 21 (Omit Section 22)

Unit III - Chapter 3: Sections 23 to25

Unit IV - Chapter 3: Sections 26 to29

Unit V - Chapter 4: Sections 30 to 35

REFERENCES

1. J. Dugundji, "Topology", Prentice Hall of India, New Delhi,1975.
2. George F.Simmons, "Introduction to Topology and Modern Analysis", McGraw Hill Book Co., 1963.
3. J.L. Kelly, "General Topology", Van Nostrand, Reinhold Co., NewYork.1995
4. L.Steen and J.Subhash, "Counter Examples in Topology", Holt, Rinehart and Winston, New York,1970.
5. S.Willard, "General Topology", Addison - Wesley,Mas.1970.

COs VS POs

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO 1	3	3	3	2	3	1	1	1	1
CO 2	3	3	3	2	3	1	1	1	1
CO 3	3	3	3	2	3	1	1	1	1
CO 4	3	3	2	1	3	1	0	1	1
CO 5	3	3	3	2	3	1	1	1	1
TOTAL	**15**	**15**	**14**	**9**	**15**	**5**	**4**	**5**	**5**
SCALED VALUE	**3**	**3**	**3**	**2**	**3**	**1**	**1**	**1**	**1**

0 - No Relation, 1 – Low Relation, 2- Medium Relation, 3- High Relation

1-5→1, 6-10→2, 11-15→3

COURSE NAME			INTEGRAL EQUATIONS, CALCULUS OF VARIATIONS AND TRANSFORMS	L	T	P	C
COURSE CODE			YMA302	4	1	0	5
C	P	A		L	T	P	H
5	0	0		4	1	0	5
PREREQUISITE			Multivariable calculus and vector calculus				

On successful completion of this course, the students will be able to:

	COURSE OUTCOMES	DOMAIN	LEVEL
CO 1	**Identify** maxima and minima of functionals	Cognitive	Applying
CO 2	**Utilize** Fourier transform for solving boundary value problems	Cognitive	Applying
CO 3	**Solve** Bessel function integrals over a finite interval	Cognitive	Applying
CO 4	**Identify** eigenvalues and eigen function of the homogeneous integral equations with degenerate kernels	Cognitive	Applying
CO 5	**Solve** Volterra integral equation and Fredholm integral equations by using method of successive approximations	Cognitive	Applying

UNIT 1		12+3
Calculus of variations – Maxima and Minima – the simplest case – Natural boundary and transition conditions - variational notation – more general case – constraints and Lagrange's multipliers – variable end points – Sturm-Liouville problems		
UNIT 2		**12+3**
Fourier transform - Fourier sine and cosine transforms - Properties Convolution -Solving integral equations - Finite Fourier transform - Finite Fourier sine and cosine transforms - Fourier integral theorem - Parseval's identity		
UNIT 3		**12+3**
Hankel Transform: Definition – Inverse formula – Some important results for Bessel function – Linearity property – Hankel Transform of the derivatives of the function –Hankel Transform of differential operators – Parseval's Theorem		
UNIT 4		**12+3**

Linear Integral Equations - Definition, Regularity conditions – special kind of kernels –eigen values and eigenfunctions – 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.

UNIT 5		**12+3**

Method of successive approximations: Iterative scheme – examples – Volterra Integral equation – examples – some results about the resolvent kernel. Classical Fredholm Theory: the method of solution of Fredholm – Fredholm's first theorem – second theorem – third theorem

LECTURE	**60**	**TUTORIAL**	**15**	**PRACTICAL**	**0**	**TOTAL**	**75**

TEXT BOOKS

1. Ram.P.Kanwal – Linear Integral Equations Theory and Practice, Academic Press 1971.
2. F.B. Hildebrand, Methods of Applied Mathematics II ed. PHI, ND 1972.
3. A.R. Vasishtha, R.K. Gupta, Integral Transforms, Krishna Prakashan Media Pvt Ltd, India, 2002.

UNIT – I Chapter 2: Sections 2.1 to 2.9 of [2]
UNIT – II Chapter 7 of [3]
UNIT – III Chapter 9 of [3];
UNIT – IV -Chapters 1 and 2 of [1]
UNIT – V Chapters 3 and 4 of [1]

REFERENCES

1. S.J. Mikhlin, Linear Integral Equations (translated from Russian), Hindustan Book Agency, 1960.
2. I.N. Snedden, Mixed Boundary Value Problems in Potential Theory, North Holland,1966.

COs VS POs

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO 1	3	3	3	2	3	1	1	1	1
CO 2	3	3	3	2	3	1	1	1	1
CO 3	3	3	3	2	3	1	1	1	1
CO 4	3	3	3	2	3	1	1	1	1
CO 5	3	3	3	2	3	1	1	1	1
TOTAL	**15**	**15**	**15**	**10**	**15**	**5**	**5**	**5**	**5**
SCALED VALUE	**3**	**3**	**3**	**2**	**3**	**1**	**1**	**1**	**1**

0 - No Relation, 1 – Low Relation, 2- Medium Relation, 3- High Relation

1-5→1, 6-10→2, 11-15→3

COURSE NAME			FUNCTIONAL ANALYSIS	L	T	P	C
COURSE CODE			YMA303	4	1	0	5
C	P	A		L	T	P	H
5	0	0		4	1	0	5

PREREQUISITE	Basic concepts of algebra

On successful completion of this course, the students will be able to:

	COURSE OUTCOMES	DOMAIN	LEVEL
CO 1	**Explain** Normed Spaces and Hahn – Banach Theorems.	Cognitive	Understanding
CO 2	**Explain** Closed Graph and Open Mapping Theorems.	Cognitive	Understanding
CO 3	**Explain** Bounded Inverse Theorem – Spectrum of a Bounded Operator.	Cognitive	Understanding
CO 4	**Explain** Inner Product Spaces and Riesz Representation Theorems.	Cognitive	Understanding
CO 5	**Explain** Bounded Operators and Self-adjoint Operators.	Cognitive	Understanding

UNIT 1		12+3
Normed Spaces – Continued of Linear Maps – Hahn – Banach Theorems.		
UNIT 2		**12+3**
Banach Spaces – Uniform Boundedness Principle – Closed Graph and Open Mapping Theorems.		
UNIT 3		**12+3**
Bounded Inverse Theorem – Spectrum of a Bounded Operator.		
UNIT 4		**12+3**
Inner Product Spaces – Orthonormal Sets – Projection and Riesz Representation Theorems.		
UNIT 5		**12+3**
Bounded Operators and adjoint, Normal, Unitary and Self-adjoint Operators.		

LECTURE	60	TUTORIAL	15	PRACTICAL	0	TOTAL	75

TEXT BOOK

1.Balmohan V Limaye, “Functional Analysis”, 3rd Edition, New Age International (P) Limited Publishers, New Delhi, 2017

REFERENCES

1. G.F.Simmons,"Introduction to Topology and Modern Analysis",McGraw Hill International Book Company, New York, 1963.
2. W. Rudin, "Functional Analysis", Tata McGraw-Hill Publishing Company, New Delhi, 1973.
3. E. Kreyszig, "Introductory Functional Analysis with Applications", John Wiley & Sons, New York, 1978.
4. H. C. Goffman and G.Fedrick, "First Course in Functional Analysis", Prentice Hall of India, New Delhi, 1987

COs VS POs

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO 1	3	3	2	1	3	1	0	1	1
CO 2	3	3	2	1	3	1	0	1	1
CO 3	3	3	2	1	3	1	0	1	1
CO 4	3	3	2	1	3	1	0	1	1
CO 5	3	3	2	1	3	1	0	1	1
TOTAL	**15**	**15**	**10**	**5**	**15**	**5**	**0**	**5**	**5**
SCALED VALUE	**3**	**3**	**2**	**1**	**3**	**1**	**0**	**1**	**1**
0 - No Relation, 1 – Low Relation, 2- Medium Relation, 3- High Relation									
1-5→1, 6-10→2, 11-15→3									

COURSE NAME			DIFFERENTIAL GEOMETRY	L	T	P	C
COURSE CODE			YMA304	4	1	0	5
C	P	A		L	T	P	H
5	0	0		4	1	0	5

PREREQUISITE	Multivariable Calculus and Vector Calculus

On successful completion of this course, the students will be able to:

	COURSE OUTCOMES	DOMAIN	LEVEL
CO 1	**Identify** involutes and evolutes of a given curve	Cognitive	Applying
CO 2	**Explain** the concept of Helicoids and Families of curves	Cognitive	Understanding
CO 3	**Identify** Geodesic curvature, Gaussian curvature and Surfaces of constant curvature of a given curve	Cognitive	Applying
CO 4	**Explain** non intrinsic properties of a surface	Cognitive	Understanding
CO 5	**Explain** compact surface and complete surface	Cognitive	Understanding

UNIT 1	SPACE CURVES	12+3

Definition of Space curves – Arc length – tangent – normal and binormal – curvature and torsion – contact between curves and surfaces – tangent surface – involutes and evolutes – intrinsic equations – Fundamental Existence Theorem for space curves – Helics.

UNIT 2	INTRINSIC PROPERTIES OF A SURFACE	12+3

Definition of surface - Curves on a surface - Surfaces of revolution – Helicoids – Metric - Direction coefficients - Families of curves - Isometric correspondence - Intrinsic properties – Geodesics - Canonical geodesic equations.

UNIT 3	GEODESICS	12+3

Normal property of geodesic - Existence theorems - Geodesic parallels - Geodesic curvature - Gauss Bonnet theorem - Gaussian curvature - Surfaces of constant curvature - Conformal mapping - Geodesic mapping.

UNIT 4	NON-INTRINSIC PROPERTIES OF A SURFACE	12+3

Second fundamental form - Principal curvatures- Lines of curvature – Developables - Developables associated with space curves - Developables associated with curves on surfaces- Minimal surfaces and ruled surfaces - Fundamental equations of Surface theory - Parallel surfaces.

UNIT 5	DIFFERENTIAL GEOMETRY OF SURFACES	12+3

Compact surfaces whose points are umbilics- Hilbert's lemma- Compact surfaces of constant Gaussian or mean curvature- Complete surfaces- Characterization of complete surfaces- Hilbert's theorem- Conjugate points on geodesics.

LECTURE	60	TUTORIAL	15	PRACTICAL	0	TOTAL	75

TEXT BOOK

1.T. J. Wilmore, "An introduction to Differential Geometry", Oxford University Press, 1997.

REFERENCES

1. Do Carmo,"Geometry of curves and surfaces", Academic Press, 2017.
2. D.Somasundaram, "Differential Geometry", Narosa Publ. House, Chennai, 2005.
3. J.A.Thorpe, "Elementary Topics in Differential Geometry", Springer - Verlag, New York, 1979.

COs VS POs

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO 1	3	3	3	2	3	1	1	1	1
CO 2	3	3	2	1	3	1	0	1	1
CO 3	3	3	3	2	3	1	1	1	1
CO 4	3	3	2	1	3	1	0	1	1
CO 5	3	3	2	1	3	1	0	1	1
TOTAL	**15**	**15**	**12**	**7**	**15**	**5**	**2**	**5**	**5**
SCALED VALUE	**3**	**3**	**3**	**2**	**3**	**1**	**1**	**1**	**1**

0 - No Relation, 1 – Low Relation, 2- Medium Relation, 3- High Relation

1-5→1, 6-10→2, 11-15→3

COURSE NAME			COMPLEX ANALYSIS	L	T	P	C
COURSE CODE			YMA305	4	1	0	5
C	P	A		L	T	P	H
5	0	0		4	1	0	5

PREREQUISITE	Basic concepts of real numbers

On successful completion of this course, the students will be able to:

	COURSE OUTCOMES	DOMAIN	LEVEL
CO 1	**Explain** Cauchy's Theorem for rectangle and disc	Cognitive	Understanding
CO 2	**Apply** Cauchy's integral formula and Taylor's theorem for finding the higher order derivatives	Cognitive	Applying
CO 3	**Explain** Locally Exact Differentials – Multiply Connected regions	Cognitive	Applying
CO 4	**Evaluate** the given definite integrals using Cauchy' theorem	Cognitive	Analyzing
CO 5	**Utilize** the Taylor Series and the Laurent Series for finding zeros and poles for the given problem	Cognitive	Applying

UNIT 1		12+3

Line Integrals- Rectifiable arc – Line integrals as functions of arc- Cauchy's Theorem for rectangle- Cauchy's Theorem for disc

UNIT 2		12+3

The Index of a point - Integral Formula – Higher derivatives – Removable singularities – Taylor's theorem – Zeros and Poles – The Local Mapping – The Maximum Principle

UNIT 3		12+3

Chains and Cycles – Simple Connectivity – Homology – The General Statement of Cauchy's Theorem – Proof of Cauchy's Theorem – Locally Exact Differentials – Multiply Connected Regions

UNIT 4		12+3

The Residue Theorem – The Argument Principle – Evaluation of Definite Integrals – The Mean – value property – Poisson's formula- Schwarz's Theorem – The Reflection Principle

UNIT 5		12+3

Weierstrass's Theorem – The Taylor Series – The Laurent Series – Partial Fractions- Jensen's Formula – Hadamard's Theorem

LECTURE	60	TUTORIAL	15	PRACTICAL	0	TOTAL	75

TEXT BOOK
1.LarsV.Ahlfors, "Complex Analysis", 3rd Edition McGraw Hill Education (India) Private Ltd.2013. Chapter 4 - Section 1.1 to 1.5, Section 2.1 to 2.3, Section 3.1 to 3.4, Section 4.1 to 4.7, Section 5.1 to 5.3 , Section 6.1 to 6.5. Chapter 5 - Section 1.1 to 1.3, Section 2.1, Section 3.1 & 3.2.
REFERENCE
1.S. Ponnusamy, "Complex Analysis", Alpha Science International Ltd; 2nd Revised edition, 2005

COs VS POs

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO 1	3	3	2	1	3	1	0	1	1
CO 2	3	3	3	2	3	1	1	1	1
CO 3	3	3	3	2	3	1	1	1	1
CO 4	3	3	3	3	3	1	2	1	1
CO 5	3	3	3	2	3	1	1	1	1
TOTAL	**15**	**15**	**14**	**10**	**15**	**5**	**5**	**5**	**5**
SCALED VALUE	**3**	**3**	**3**	**2**	**3**	**1**	**1**	**1**	**1**
0 - No Relation, 1 – Low Relation, 2- Medium Relation, 3- High Relation									
1-5→1, 6-10→2, 11-15→3									

COURSE NAME			ELEMENTS OF STOCHASTIC PROCESS			L	T	P	C
COURSE CODE			YMA3E1			3	0	0	3
C	P	A				L	T	P	H
3	0	0				3	0	0	3
PREREQUISITE			Probability and Statistics						
On successful completion of this course, the students will be able to:									
COURSE OUTCOMES						DOMAIN	LEVEL		
CO 1	**Utilize** continuous time Markov model for constructing TPM.					Cognitive	Applying		
CO 2	**Explain** renewal process and long-term analysis with examples					Cognitive	Understanding		
CO 3	**Apply** different methods and solve Birth and Death queues					Cognitive	Applying		
CO 4	**Examine** the computations of M/G/1 and G/M/1 Queues and Network of Queues					Cognitive	Analyzing		
CO 5	**Conclude** the idea of Brownian Motion and First Passage Times					Cognitive	Evaluating		
UNIT 1	**Continuous-Time Markov Models**								9
Continuous Time Markov Chain, Examples, Transient Analysis, Occupancy Times, Limiting Behavior									
UNIT 2	**Generalized Markov Models**								9
Renewal Process, Cumulative Process, Semi-Markov Process, Examples and Long-term Analysis.									
UNIT 3	**Queueing Models**								9
Queueing Systems, Single-Station Queues, Birth and Death queues with Finite and Infinite Capacity.									
UNIT 4	**Queueing Models (Contd)**								9
M/G/1 and G/M/1 Queues and Network of Queues.									
UNIT 5	**Brownian Motion**								9
Standard Brownian Motion, Brownian Motion and First Passage Times.									
LECTURE	45	TUTORIAL	0	PRACTICAL	0	TOTAL	45		
TEXT BOOK									
1.V. G. Kulkarni, Introduction to Modeling and Analysis of Stochastic Systems, Second Edition, Springer, 2011									
REFERENCES									
1. J. Medhi, Stochastic Processes, New Age, 2009. 2. S. M. Ross, Stochastic Processes, Wiley Series in Probability and Statistics, 1996									

COs VS POs

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO 1	3	3	3	2	3	1	1	1	1
CO 2	3	3	2	1	3	1	0	1	1
CO 3	3	3	3	2	3	1	1	1	1
CO 4	3	3	3	3	3	1	2	1	1
CO 5	3	3	3	3	3	1	3	1	1
TOTAL	**15**	**15**	**14**	**11**	**15**	**5**	**7**	**5**	**5**
SCALED VALUE	**3**	**3**	**3**	**3**	**3**	**1**	**2**	**1**	**1**
0 - No Relation, 1 – Low Relation, 2- Medium Relation, 3- High Relation									
1-5→1, 6-10→2, 11-15→3									

COURSE NAME			MATHEMATICAL MODELING	L	T	P	C
COURSE CODE			YMA3E2	3	0	0	3
C	P	A		L	T	P	H
3	0	0		3	0	0	3
PREREQUISITE			YMA103				

On successful completion of this course, the students will be able to:

	COURSE OUTCOMES	DOMAIN	LEVEL
CO 1	**Compare** models that can be constructed by ordinary differential equations of first order under study	Cognitive	Applying
CO 2	**Utilize** compartment models to solve the problems involved in economics and medicine	Cognitive	Applying
CO 3	**Analyze** mathematical models that can be developed by second order linear differential equations	Cognitive	Analyzing
CO 4	**Apply** linear difference equation to solve problems in finance and economics	Cognitive	Applying
CO 5	**Identify** the solutions of the given problems that can be modeled through graphs	Cognitive	Applying

UNIT 1	**Mathematical Modeling through Ordinary Differential Equations of First order**	**9**
Linear Growth and Decay Models – Non-Linear Growth and Decay Models –Compartment Models – Dynamics problems – Geometrical problems		
UNIT 2	**Mathematical Modeling through Systems of Ordinary Differential Equations of First Order**	**9**
Population Dynamics – Epidemics – Compartment Models – Economics –Medicine, Arms Race, Battles and International Trade – Dynamics		
UNIT 3	**Mathematical Modeling through Ordinary Differential Equations of Second Order**	**9**
Planetary Motions – Circular Motion and Motion of Satellites – Mathematical Modeling through Linear Differential Equations of Second Order –Miscellaneous Mathematical Models		
UNIT 4	**Mathematical Modeling through Difference Equations**	**9**
Simple Models – Basic Theory of Linear Difference Equations with ConstantCoefficients – Economics and Finance – Population Dynamics and Genetics –Probability Theory		
UNIT 5	**Mathematical Modeling through Graphs**	**9**

Solutions that can be Modeled through Graphs – Mathematical Modeling in Terms of Directed Graphs, Signed Graphs, Weighted Digraphs and Unoriented Graphs							
LECTURE	**45**	**TUTORIAL**	**0**	**PRACTICAL**	**0**	**TOTAL**	**45**
TEXT BOOK							
1.J.N. Kapur, Mathematical Modeling, Wiley Eastern Limited, New Delhi, 1988							
REFERENCE							
1.J. N. Kapur, Mathematical Models in Biology and Medicine, Affiliated East –West Press Pvt Limited, New Delhi, 19							

COs Vs POs

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO 1	3	3	3	2	3	1	1	1	1
CO 2	3	3	3	2	3	1	1	1	1
CO 3	3	3	3	3	3	1	2	1	1
CO 4	3	3	3	2	3	1	1	1	1
CO 5	3	3	3	2	3	1	1	1	1
TOTAL	**15**	**15**	**15**	**11**	**15**	**5**	**6**	**5**	**5**
SCALED VALUE	**3**	**3**	**3**	**3**	**3**	**1**	**2**	**1**	**1**
0 - No Relation, 1 – Low Relation, 2- Medium Relation, 3- High Relation									
1-5→1, 6-10→2, 11-15→3									

COURSE NAME			DATA ANALYSIS USING SPSS	L	T	P	C
COURSE CODE			YMA3E3	3	0	0	3
C	P	A		L	T	P	H
3	0	0		3	0	0	3
PREREQUISITE			Probability and Statistics				

On successful completion of this course, the students will be able to:

COURSE OUTCOMES		DOMAIN	LEVEL
CO 1	**Explain** basic concepts of SPSS, working with the Data Editor and Plotting of Charts using Bar and Pie diagram	Cognitive	Understanding
CO 2	**Explain** measures of central tendencies and measures of dispersion using SPSS	Understanding	Understanding
CO 3	**Utilize** concept of testing hypothesis for finding significance level for the given data using one sample t-test, independent sample t-test and paired t-test in SPSS	Cognitive	Applying
CO 4	**Apply** One-way ANOVA, two-way ANOVA and Chi-square test for the given data in SPSS	Cognitive	Applying
CO 5	**Compare** the relationship for the datausing methods of correlation and regression in SPSS	Cognitive	Applying

UNIT 1		9

Introduction to SPSS – Starting SPSS – SPSS Main Menus – Working with the Data Editor – SPSS Viewer – Importing and Exporting data. Plotting of Charts: Simple Bar diagram, Multiple Bar Diagram and Pie Diagram.

UNIT 2		9

Descriptive Statistics and Frequencies using SPSS. Measures of central tendencies: Arithmetic mean, Median, Mode, Geometric mean and Harmonic Mean. Measures of Dispersion: Range, inter quartile range, Mean Deviation and Standard deviation. Measures of Skewness and Kurtosis.

UNIT 3		9

Testing of Hypothesis: Type I error and Type II Errors – Concept of p values – Basic Concepts of One Sample t-test, Independent Samples t-test, Paired samples t-test using SPSS with interpretation.

UNIT 4		9

Analysis of Variance: Basic concepts of ANOVA – One Way and Two-Way ANOVA using SPSS with interpretation. Chi-square Test for Independence of attributes using SPSS.							
UNIT 5							**9**
Correlation: Karl Pearson's coefficient of Correlation – Spearman's Rank correlation – Simple linear Regression using SPSS with interpretation.							
LECTURE	**45**	**TUTORIAL**	**0**	**PRACTICAL**	**0**	**TOTAL**	**45**
TEXT BOOK							
1.Ajai J Gaur and Sanjay S. Gaur (2008): Statistical Methods for Practice and Research:A guide to data analysis using SPSS, First Edition, Sage Publications							
REFERENCES							
1. Andy Field.(2011); Discovering Statistics Using SPSS, Sage Publications. 2. Hinton P R, Brownlow C, McMurray,I. and Cozens, B. (2004) SPSS Explained, Routledge							

COs VS POs

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO 1	3	3	2	1	3	1	0	1	1
CO 2	3	3	2	1	3	1	0	1	1
CO 3	3	3	3	2	3	1	1	1	1
CO 4	3	3	3	2	3	1	1	1	1
CO 5	3	3	3	2	3	1	1	1	1
TOTAL	**15**	**15**	**13**	**8**	**15**	**5**	**3**	**5**	**5**
SCALED VALUE	**3**	**3**	**3**	**2**	**3**	**1**	**1**	**1**	**1**
0 - No Relation, 1 – Low Relation, 2- Medium Relation, 3- High Relation									
1-5→1, 6-10→2, 11-15→3									

SEMESTER IV

SEMESTER	COURSE CODE	COURSE NAME	L	T	P	H	C
IV	YMA401	PROJECT WORK	0	0	0	30	8
		TOTAL				**30**	**8**