DEPARTMENT OF MATHEMATICS

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Curriculum & Syllabus
M.Sc., Mathematics

REGULATION 2018 (REVISION - I)

Applicable for students admitted during

Academic Year 2019 – 2020 Onwards

Based on Outcome Based Education

CURRICULUM AND SYLLABUS FOR
M.Sc. (Mathematics) - MASTER OF SCIENCE (After Revision) (TWO YEARS - FULL TIME)

REGULATION – 2018 – (Revision I)

(Applicable to the students admitted from the academic year 2019-2020 onwards)

Semester	Course Code	Course Name	Lecture	Tutorial	Practical	Credit
I	YMA101	Groups and Rings	4	1	0	5
	YMA102	Analysis - I	4	1	0	5
	YMA103	Differential Equations	3	1	0	4
	YMA104	Discrete Mathematics	3	1	0	4
	YMA1E*	One among the list of Electives (1E)	3	0	0	3
						21

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

Elective Code	Course Name	L	T	P	C
01	Graph Theory	3	0	0	3
02	Coding Theory	3	0	0	3
03	Mathematical Logic	3	0	0	3

Semester	Course Code	Course Name	Lecture	Tutorial	Practical	Credit
II	YMA201	Linear Algebra	4	1	0	5
	YMA202	Analysis - II	4	1	0	5
	YMA203	Integral Equations, Calculus Of Variations And Transforms	3	1	0	4
	YMA204	Operations Research	3	1	0	4
	YMA2E*	One among the list of Electives (2 E)	3	0	0	3
						21

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

Elective Code	Course Name	L	T	P	C
01	Algebraic Number Theory	3	0	0	3
02	Data structures and Algorithms	3	0	0	3
03	Fuzzy sets and Fuzzy logic	3	0	0	3

Semester	Course Code	Course Name	Lecture	Tutorial	Practical	Credit
III	YMA301	Field Theory	3	1	0	4
	YMA302	Topology	4	1	0	5
	YMA303	Automata Theory	3	1	0	4
	YMA304	Mathematical Statistics	3	1	0	4
	YMA3E*	One among the list of Electives (3 E)	3	0	0	3
						20

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

Elective Code	Course Name	L	T	P	C
01	Data Analysis Using Spss	3	0	0	3
02	Numerical Methods	3	0	0	3
03	Commutative Algebra	4	0	0	3

Semester	Course Code	Course Name	Lecture	Tutorial	Practical	Credit
IV	YMA401	Complex Analysis	4	1	0	5
	YMA402	Functional Analysis	4	1	0	5
	YMA403	Mathematical Modeling	3	1	0	4
		Project work				8
						22

Total Numberof Credits : 84

SEMESTER I

COURSECODE			COURSENAME	L	T	P	C
YMA101			GROUPS AND RINGS	4	1	0	5
C	P	A					
5	0	0		L	T	P	H
				4	1	0	5

PREREQUISITE: Basic concepts of sets, groups and rings

COURSE OUTCOMES:

Course outcomes:	Domain	Level
CO1: Define and Explain Subgroups, Normal subgroups and Quotient Groups, Lagrange's Theorem.	Cognitive	Remembering Understanding
CO2: Define and Explain Homomorphism Theorems, Isomorphism Theorems, Automorphisms Theorems, Cayley's theorem. Permutation groups, Another Counting principle.	Cognitive	Remembering Understanding
CO3: Define and Explain Sylow's Theorems and their simple applications, Direct Products: External and Internal, Finite Abelian Groups.	Cognitive	Remembering Understanding
CO4: Define and Explain Rings, Subrings, Ideals, Factor Rings, Homomorphism and Integral Domains. Maximal and prime ideals. The field of Quotients of an integral domain.	Cognitive	Remembering Understanding
CO5:Define and Explain Euclidean Ring, A Particular Euclidean Ring, Polynomial Ring, and Polynomial over the Rational Field, Polynomial Rings over Commutative Rings.	Cognitive	Remembering Understanding

UNIT I	**15**
Definition & examples: Groups, Subgroups, Normal subgroups and Quotient Groups, Lagrange's Theorem.	
UNIT II	**15**
Homomorphism Theorems, Isomorphism Theorems, Automorphisms Theorems, Cayley's theorem. Permutation groups, Another Counting principle.	
UNITIII	**15**
Sylow's Theorems and their simple applications, Direct Products: External and Internal, Finite Abelian Groups.	
UNIT IV	**15**
Rings, Subrings, Ideals, Factor Rings, Homomorphism, Integral Domains. Maximal and prime ideals. The field of Quotients of an integral domain.	
UNIT V	**15**
Euclidean Ring, A Particular Euclidean Ring, Polynomial Ring, Polynomial over the Rational Field, Polynomial Rings over Commutative Rings.	

LECTURE	TUTORIAL	TOTAL
60	15	75

TEXTBOOK

1. Herstein, I.N., "Topics in Algebra", Willey Eastern 1975. Unit
   I - Chapter 2 (Section 2.1 - 2.6)
   Unit II - Chapter 2 (Section 2.7 – 2.11)
   Unit III - Chapter 2 (Section 2.12 – 2.14)
   Unit IV - Chapter 3 (Section 3.1 - 3.6)
   Unit V - Chapter 3 (Section 3.7 – 3.11)

REFERENCES

1. John B. Fraleigh, "A First Course in Abstract Algebra", Narosa Publication, Third Edition,2003.
2. Cohn P. M., "Basic Algebra", Springer's Publications, Second Edition,2005.

COs vs POs Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**3**	**2**			**1**	**1**	**1**	**1**	**1**
CO2	**3**	**2**			**1**	**1**	**1**	**1**	**1**
CO3	**3**	**2**			**1**	**1**	**1**	**1**	**1**
CO4	**3**	**2**			**1**	**1**	**1**	**1**	**1**
CO5	**3**	**2**			**1**	**1**	**1**	**1**	**1**
Total	**15**	**10**			**5**	**5**	**5**	**5**	**5**
Scaled Value	**3**	**2**			**1**	**1**	**1**	**1**	**1**

1-5→1, 6-10→2, 11-15→3

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

COURSECODE			COURSE NAME	L	T	P	C
YMA102			ANALYSIS - I	4	1	0	5
C	P	A					
5	0	0		L	T	P	H
				4	1	0	5

PREREQUISITE:

COURSE OUTCOMES: Basic concepts of real numbers

Course outcomes:	Domain	Level
CO1: Define and Explain the Real and Complex Number Systems.	Cognitive	Remembering Understanding
CO2: Define and Explain Basic Topology.	Cognitive	Remembering Understanding
CO3: Define and Explain convergence of sequences and series	Cognitive	Remembering Understanding
CO4: Define and Explain Continuity of functions	Cognitive	Remembering Understanding
CO5: Define and Explain the derivative of a real function, the Continuity of Derivatives, Derivatives of Higher Order, and Taylor's Theorem.	Cognitive	Remembering Understanding

UNIT I The Real and Complex Number Systems:	**15**
Ordered sets, The real field, The complex field, Euclidean spaces.	
UNITII Basic Topology:	**15**
Finite, Countable and Uncountable sets, Metric space, Compact sets, Perfect Sets, Connected Sets.	
UNITIII Numerical Sequences and Series:	**15**
Convergent sequences (in Metric Spaces), subsequences, Cauchy sequences, Upper and Lower Limits, Some Special Sequences, Series, Series of Negative terms, The root and ratio tests.	
UNIT IVContinuity:	**15**
Limits of functions (in metric spaces) Continuous functions, Continuity and Compactness, Continuity and Connectedness, Discontinuities, Monotonic functions, Uniform Continuity, Infinite Limits and Limits at Infinity.	
UNIT V Differentiation:	**15**
The Derivative of a Real Function, Mean Value Theorems, The Continuity of Derivatives, L'Hospital's Rule, Derivatives of Higher Order, Taylor's Theorem.	
LECTURE **TUTORIAL**	**TOTAL**

60	**15**	**75**

TEXTBOOK

1. Walter Rudin,"Principles of Mathematical Analysis", (3rd Edition) McGraw-Hill, 2016.

Unit I - Chapter 1 (Pages: 3-5, 8-11, 12-16)
Unit II - Chapter 2 (Pages: 24 -42)
Unit III - Chapter 3 (Pages: 47-63, 65-69) Unit IV
- Chapter 4 (Pages:83-97)
Unit V - Chapter 5 (Section 103-111)

REFERENCES

1. Shanti Narayan,"A Course of Mathematical Analysis", S.Chand & Co,2005.
2. Apostol, T.M,"Mathematical Analysis", 2nd Edition,1996.
3. Malik, S.C,"Mathematical Analysis", Wiley Eastern Ltd,2017.

COs vs POs Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**3**	**2**			**1**	**1**	**1**	**1**	**1**
CO2	**3**	**2**			**1**	**1**	**1**	**1**	**1**
CO3	**3**	**2**			**1**	**1**	**1**	**1**	**1**
CO4	**3**	**2**			**1**	**1**	**1**	**1**	**1**
CO5	**3**	**2**			**1**	**1**	**1**	**1**	**1**
Total	**15**	**10**			**5**	**5**	**5**	**5**	**5**
Scaled Value	**3**	**2**			**1**	**1**	**1**	**1**	**1**

1-5→1, 6-10→2, 11-15→3

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

COURSECODE			COURSETITLE	L	T	P	C
YMA103			DIFFERENTIAL EQUATIONS	3	1	0	4
C	P	A					
4	0	0		L	T	P	H
				3	1	0	4

PREREQUISITE: Differentiation and Integration

COURSE OUTCOMES:

Course outcomes:	Domain	Level
CO1: Find The general solution of the homogeneous equations using various methods.	Cognitive	Remembering Understanding
CO2: Solve the homogeneous linear system with constant coefficients and special functions.	Cognitive	Applying
CO3: Find the critical points and stability for linear systems by Liapounov's direct method.	Cognitive	Remembering Understanding
CO4: Solve First order linear partial differential equations using various methods.	Cognitive	Applying
CO5: Solve initial and boundary value problems.	Cognitive	Applying

UNIT I **12**

The general solution of the homogeneous equation – The use of one known solution to find another – The method of variation of parameter – Power series solutions – Series solutions of first order equations – Second order linear equations – ordinary points – Regular singular points – Gauss hyper geometric equations – the point 0 at infinity.

UNIT II **12**

Legendre polynomials – Properties of Legendre polynomials – Bessel functions – The gamma function – Properties of Bessel function – linear systems – Homogeneous linear system with constant coefficients.

UNITIII **12**

The existence and uniqueness of solutions – The method of Successive approximation – Picard's theorem – Types of critical points – Critical points and stability for linear systems – Stability by Liapunov's direct method.

UNIT IV **12**

First order partial differential equations – Linear equations of the first order – Partial differential equations – Compatible systems – Charpit's method – Jacobi's method – Integral surface through a given circle.

UNIT V **12**

Solution of initial and boundary value problems – Characteristics – D'Alembert's solution – Significance of characteristic curves – Laplace transforms solutions for displacement in a string – a long string under its weight – Longitudinal vibration of a elastic bar with prescribed force on one end – free vibrations ofstring.

	LECTURE	TUTORIAL	TOTAL

45	**15**	**60**

TEXTBOOK

1. Simmons, G.F.,"Differential Equations with Applications and Historical Notes", TMH,New Delhi,2003
2. T. Amarnath, "An Elementary Course in Partial Differential Equations", Narosa, New Delhi, 1997.
   Unit I- Chapter 3: Sections – 15,16,19, Chapter 5: Sections – 26 to 31
   Unit II- Chapter 8: Sections – 44 to 47, Chapter 10: Sections – 54 to 56
   Unit III- Chapter 13: Sections – 68, 69, Chapter 11: Sections – 60, 61 Unit IV – Chapter 1: Sections – 1.4 to 1.9
   Unit V - Chapter 2: Sections – 2.1, 2.2, 2.3.1, 2.3.2, 2.3.3, 2.3.5, 2.5.1, 2.5.2

REFERENCES

1. W.T.Reid, "Ordinary Differential Equations", John Wiley, New York,1971.
2. E.A.Coddington and E.Levinson, "Theory of ODE", Mc Graw Hill Publishing Company, New york, 1955.
3. J.N. Sneddon, "Elements of Partial Differential Equations", Mc Graw Hill Publishing Company, New york,1957.

COs vs POs Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**2**	**1**	**1**	**1**		**2**			**1**
CO2	**2**	**1**	**1**	**1**		**2**			**1**
CO3	**2**	**1**	**1**	**1**		**2**			**1**
CO4	**2**	**1**	**1**	**1**		**2**			**1**
CO5	**2**	**1**	**1**	**1**		**2**			**1**
Total	**10**	**5**	**5**	**5**		**10**			**5**
Scaled Value	**2**	**1**	**1**	**1**		**2**			**1**

1-5→1, 6-10→2, 11-15→3

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

COURSECODE			COURSENAME	L	T	P	C
YMA104			DISCRETE MATHEMATICS	3	1	0	4
C	P	A					
4	0	0		L	T	P	H
				3	1	0	4

PREREQUISITE: Algebra

COURSE OUTCOMES:

Course outcomes:	Domain	Level
CO1: Define and Explain Basic logical operations.	Cognitive	Remembering Understanding
CO2: Define and Explain the theory of inference for the statement Calculus.	Cognitive	Remembering Understanding
CO3: Solve Recurrence Relations using Generating Functions**.**	Cognitive	Applying
CO4: Define and Explain Lattices and Boolean Algebra.	Cognitive	Remembering Understanding
CO5: Define and Explain Grammar and Languages.	Cognitive	Remembering Understanding

UNIT I Mathematical Logic : **12**

Basic logical operations, conditional and biconditional statements, tautologies, contradiction, Normal forms.

UNIT II The theory of inference for the statement Calculus: **12**

Rules of inference, Consistency, Automatic Theorem proving, Predicate Calculus, quantifiers, Inference Theory of the Predicate Calculus.

UNIT III Recurrence Relations and Generating Functions: **12**

Polynomial expressions, telescopic form, recursion theorem, closed form expression, generating function, solution of recurrence relation using generating function.

UNIT IV Lattices and Boolean Algebra: **12**

Partial ordered sets, Properties of Lattices, Lattices as Algebraic Systems, Boolean Algebra.

UNIT V Grammar and Languages: **12**

Phrase structure grammars, rewriting rules, derivation sentential forms, language generated by grammar, regular, context free and context sensitive grammar and languages.

LECTURE	TUTORIAL	TOTAL
45	15	60

TEXTBOOK

1. P. Tremblay, R. Manohar,"Discrete Mathematical Structure with Applications to Computer Science", Mc Graw- Hill International Edition, 1997.
   Unit I - Chapter 1 (Section 1.1,1.2 & 1.3)
   Unit II - Chapter 1 (Section 1.4 ,1.5 & 1.6)
   Unit IV - Chapter 4 (Section 4.1& 4.2) Unit V
   – Chapter 4 (Section 4.6)
2. Alan Doerr, "Applied Discrete Structure for Computer Science", Pearson Education,2013
   Unit III – Chapter 8 (Section 8.1,8.2,8.3 &8.5)

REFERENCE

1. Kenneth H. Rosen, "Discrete Mathematics and Its Applications", Mc Graw- Hill International Edition,2002.

COs vs POs Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**2**	**1**	**1**	**1**		**2**			**1**
CO2	**2**	**1**	**1**	**1**		**2**			**1**
CO3	**2**	**1**	**1**	**1**		**2**			**1**
CO4	**2**	**1**	**1**	**1**		**2**			**1**
CO5	**2**	**1**	**1**	**1**		**2**			**1**
Total	**10**	**5**	**5**	**5**		**10**			**5**
Scaled Value	**2**	**1**	**1**	**1**		**2**			**1**

1-5→1, 6-10→2, 11-15→3

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

LIST OF ELECTIVES

COURSECODE			COURSENAME	L	T	P	C
YMA1E1			GRAPH THEORY	3	0	0	3
C	P	A					
3	0	0		L	T	P	H
				3	0	0	3

PREREQUISITE:

COURSE OUTCOMES: Basic concepts of Graph Theory

Course outcomes:	Domain	Level
CO1: Define and Explain Graphs, subgraphs and trees.	Cognitive	Remembering Understanding
CO2: Define and Explain Connectivity - Blocks - Euler tours - Hamilton Cycles.	Cognitive	Remembering Understanding
CO3: Define and Explain Matchings and Coverings in Bipartite Graphs , Edge Chromatic Number and Vizing's Theorem.	Cognitive	Applying
CO4: Define and Explain independent sets and cliques, vertex colourings.	Cognitive	Remembering Understanding
CO5: Define and Explain Plane and planar Graphs, Dual graphs, Euler's Formula , The Five-Colour Theorem and the Four- Colour Conjecture- Applications.	Cognitive	Remembering Understanding

UNIT I GRAPHS, SUBGRAPHS AND TREES	**9**
Graphs and simple graphs - Graph Isomorphism - The Incidence and Adjacency Matrices - Subgraphs - Vertex Degrees - Paths and Connection - Cycles - Trees - Cut Edges and Bonds - Cut Vertices.	
UNIT II CONNECTIVITY, EULER TOURS AND HAMILTON CYCLES	**9**
Connectivity - Blocks - Euler tours - Hamilton Cycles – Applications.	
UNITIII MATCHINGS, EDGE COLOURINGS	**9**
Matchings - Matchings and Coverings in Bipartite Graphs - Edge Chromatic Number - Vizing's Theorem- Applications.	
UNIT IV INDEPENDENT SETS AND CLIQUES, VERTEX COLOURINGS	**9**
Independent sets - Ramsey's Theorem - Chromatic Number - Brooks' Theorem - Chromatic Polynomials- Applications.	
UNIT V PLANAR GRAPHS	**9**
Plane and planar Graphs - Dual graphs - Euler's Formula - The Five-Colour Theorem and the Four-Colour Conjecture- Applications.	
LECTURE	**TOTAL**

45		**45**

TEXTBOOK

1. J.A.Bondy and U.S.R. Murthy, "Graph Theory and Applications", Macmillan, London, 1976. Unit I - Chapter 1 (Section 1.1 - 1.7); Chapter 2 (Section 2.1 - 2.3)
   Unit II - Chapter 3 (Section 3.1 - 3.2); Chapter 4 (Section 4.1 - 4.2)
   Unit III - Chapter 5 (Section 5.1 - 5.2); Chapter 6 (Section 6.1 - 6.2)
   Unit IV - Chapter 7 (Section 7.1 – 7.2); Chapter 8 (Section 8.1 – 8.2, 8.4)
   Unit V - Chapter 9 (Section 9.1 - 9.3, 9.6)

REFERENCES

1.Harary , "Graph Theory" Narosa Publishing House., 2001.
2.A.Gibbons, "Algorithmic Graph Theory, Cambridge University Press, Cambridge, 1989. 3.R.J.Wilson and J.J.Watkins, "Graphs: An Introductory Approach", John Wiley and Sons, New York, 1989.
4.V.K. Balakrishnan, Schaum's Outlines of "Theory and problems of Graph Theory", Tata McGraw Hill Education Private Limited Delhi, 2004.
5.S.A.Choudum, "A First Course in Graph Theory", MacMillan India Ltd. 1987.

COs vs POs Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**2**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**1**
CO2	**2**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**1**
CO3	**2**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**1**
CO4	**2**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**1**
CO5	**2**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**1**
Total	**10**	**5**	**5**	**5**	**5**	**10**	**5**	**5**	**5**
Scaled Value	**2**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**1**

1-5→1, 6-10→2, 11-15→3

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

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

PREREQUISITE:

COURSE OUTCOMES:

Course outcomes:	Domain	Level
CO1: DefineandExplain Error detection, Correction and decoding	Cognitive	Remembering Understanding
CO2: Define and Explain Linear codes	Cognitive	Remembering Understanding
CO3: Define and Explain Linear codes Bounds in coding theory	Cognitive	Remembering Understanding
CO 4: Define and Explain Cyclic codes: Definitions – Generator polynomials – Generator matrix and parity check matrix – Decoding of Cyclic codes	Cognitive	Remembering Understanding
CO 5: Define and Explain Special cyclic codes	Cognitive	Remembering Understanding

UNIT-I	**9**
Error detection, Correction and decoding: Communication channels – Maximum likelihood decoding – Hamming distance – Nearest neighbourhood minimum distance decoding – Distance of a code	
UNIT-II	**9**
Linear codes: Linear codes – Self orthogonal codes – Self dual codes – Bases for linear codes – Generator matrix and parity check matrix – Enconding with a linear code – Decoding of linear codes – Syndrome decoding.	
UNIT-III	**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-IV	**9**
Cyclic codes: Definitions – Generator polynomials – Generator matrix and parity check matrix – Decoding of Cyclic codes.	
UNIT-V	**9**
Special cyclic codes: BCH codes – Parameters of BCH codes – Decoding of BCH codes – Reed Solomon codes.	

	LECTURE		**TOTAL**
	45		**45**

TEXT BOOKS:

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, 7.4
   Unit 5 : Sections 8.1, 8.2

REFERENCES:

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

COs vs POs Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**2**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**1**
CO2	**2**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**1**
CO3	**2**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**1**
CO4	**2**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**1**
CO5	**2**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**1**
Total	**10**	**5**	**5**	**5**	**5**	**10**	**5**	**5**	**5**
Scaled Value	**2**	**1**	**1**	**1**	**1**	**2**	**1**	**1**	**1**

1-5→1, 6-10→2, 11-15→3

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

COURSE CODE			COURSE NAME	L	T	P	C
YMA1E3			Mathematical Logic	3	0	0	3
C	P	A		L	T	P	H
3	0	0		3	0	0	3

PREREQUISITE: **Discrete Mathematics**

COURSE OUTCOMES:

Course outcomes:	Domain	Level
CO1: Define and Explain Syntax of First-Order Logic, Semantics of First-Order Languages, Structures of First-Order Languages .	Cognitive	Remembering Understanding
CO2: Define and Explain Propositional Logic and Tautology	Cognitive	Remembering Understanding
CO3: Define and Explain Consistency and Completeness and Extensions by definition of first order theories	Cognitive	Remembering Understanding
CO 4: Define and Explain Embeddings and Isomorphisms Compactness theorem, Categoricity and Complete theories	Cognitive	Remembering Understanding
CO 5: Define and Explain Recursive functions, Arithmatization of first order theories and Godel's first Incompleteness theorem.	Cognitive	Remembering Understanding

UNIT-I	**9**
Syntax of First-Order Logic: First Order Languages, Terms and Formulas of a First Order language, First Order Theories. Semantics of First-Order Languages: Structures of First-Order Languages, Truth in a Structure, Model of a Theory	
UNIT-II	**9**
Propositional Logic: Tautologies and Theorems of propositional Logic, Tautology Theorem. Proof in First Order Logic, Meta theorems of a first order theory, e.g. , theorems on constants, equivalence theorem, deduction and variant theorems etc.,	
UNIT-III	**9**
Consistency and Completeness, Lindenbaum Theorem. Henkin Extension, Completeness theorem, Extensions by definition of first order theories, Interpretation theorem.	
UNIT-IV	**9**
Model Theory: Embeddings and Isomorphisms, Lowenheim-Skolem Theorem, Compactness theorem, Categoricity, Complete Theories	
UNIT-V	**9**
Recursive functions, Arithmatization of first order theories, Decidable Theory, Representability, Godel's first Incompleteness theorem.	

LECTURE	TOTAL
45	45

TEXT BOOKS:

1. Shoenfield J. R. Mathematical logic, Addison-Wesley PublishingCo.
2. Srivastava S. M. A Course on Mathematical Logic, Universitext,Springe

REFERENCES:

1. Mendelson E. Introduction to Mathematical Logic, Chapman & Hall.

COs VS POs Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO 1	3	2		1	1		1	1	1
CO 2	3	2		1			1	1	1
CO 3	3	2		1			1	1	1
CO 4	3	2		1	1		1	1	1
CO 5	3	2		1	1		1	1	1
Total	15	10	0	5	3	0	5	5	5
Scaled Value	3	2		1	1		1	1	1

1-5→1, 6-10→2, 11-15→3

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

SEMESTER II

COURSECODE			COURSENAME	L	T	P	C
YMA201			LINEAR ALGEBRA	4	1	0	5
C	P	A					
5	0	0		L	T	P	H
				4	1	0	5

PREREQUISITE: Group theory and Ring theory

COURSE OUTCOMES:

Course outcomes:	Domain	Level
CO1:Define and Explain Elementary Basic Concepts- Linear Independence and Bases.	Cognitive	Remembering Understanding
CO2: Define and Explain Dual Spaces- Inner Product Space- Modules.	Cognitive	Remembering Understanding
CO3: Solve the Algebra of Linear Transformations to find characteristics roots.	Cognitive	Applying
CO4: Define and Explain Canonical Forms, Triangular form, Nilpotent Transformations, Jordan Form and Rational Canonical form.	Cognitive	Remembering Understanding
CO5: Define and Explain Trace and Transpose, Determinants, Hermitian, Unitary and Normal Transformations, Real Quadratic forms.	Cognitive	Remembering Understanding

UNIT I	**15**
Elementary Basic Concepts- Linear Independence and Bases.	
UNIT II	**15**
Dual Spaces- Inner Product Space- Modules.	
UNITIII	**15**
The Algebra of Linear Transformations- Characteristics Roots- Matrices.	
UNIT IV	**15**
Canonical Forms: Triangular form- Nilpotent Transformations- Jordan Form - Rational Canonical form.	
UNIT V	**15**
Trace and Transpose – Determinants- Hermitian, Unitary and Normal Transformations- Real Quadratic forms.	

LECTURE	TUTORIAL	TOTAL
60	15	75

TEXTBOOK

1. Herstein, I.N.,"Topics in Algebra", Willey Eastern 1975. Unit I - Chapter 4 (Section 4.1 & 4.2)
   Unit II - Chapter 4 (Section 4.4– 4.5) Unit III - Chapter 6 (Section 6.1 –6.3)
   Unit IV - Chapter 6 (Section 6.4– 6.7) Unit V - Chapter 6 (Section 6.8 –6.11)

REFERENCES

1. John B. Fraleigh, "A First Course in Abstract Algebra", Narosa Publication, Third Edition,2013.
2. P. M. Cohn, "Basic Algebra", Springer's Publications, Second Edition,2003.

COs vs POs Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**3**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**
CO2	**3**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**
CO3	**3**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**
CO4	**3**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**
CO5	**3**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**
Total	**15**	**10**	**10**	**5**	**5**	**5**	**5**	**5**	**5**
Scaled Value	**3**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**

1-5→1, 6-10→2, 11-15→3

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

COURSECODE			COURSENAME	L	T	P	C
YMA202			ANALYSIS - II	4	1	0	5
C	P	A					
5	0	0		L	T	P	H
				4	1	0	5

PREREQUISITE: Basic concepts of convergence and uniform convergence

COURSE OUTCOMES:

Course outcomes:	Domain	Level
CO1: Define and Explain Existence, Properties of the Integral, Integration and Differentiation.	Cognitive	Remembering Understanding
CO2: Define and Explain Uniform convergence and Continuity.	Cognitive	Remembering Understanding
CO3: Define and Explain Uniform convergence and Integration and Differentiation.	Cognitive	Remembering Understanding
CO4: Define and Explain Set functions, Construction of Lebesgue Measures, Measurable function, Simple functions in measure.	Cognitive	Remembering Understanding
CO5: Define and Explain Integration Comparison with theRiemann Integral, Integration of Complex functions, Functions of class $\mathbf{J}^2$.	Cognitive	Remembering Understanding

UNIT I	**15**
Definition and Existence of the Integral, Properties of the Integral, Integration and Differentiation.	
UNIT II	**15**
Uniform Convergence, Uniform convergence and Continuity.	
UNITIII	**15**
Uniform convergence and Integration, Uniform convergence and Differentiation.	
UNIT IV	**15**
Set functions, Construction of Lebesgue Measures, Measurable function, Simple functions in measure.	
UNIT V	**15**
Integration Comparison with the Riemann Integral, Integration of Complex functions, Functions of class $\mathbf{J}^2$.	

LECTURE	TUTORIAL	TOTAL
60	15	75

TEXTBOOK

1. Walter Rudin, "Principles of Mathematical Analysis", (3rd Edition), McGraw-Hill, 2016 Unit I - Chapter 6 (Pages: 120-135)Unit II - Chapter 7 (Pages: 143-151) Unit III - Chapter 7 (Pages: 151-154) Unit IV - Chapter 11 (Pages: 300-314) Unit V - Chapter 5 (Section 314-325)

REFERENCES:

1. Shanti Narayan, "A course of Mathematical Analysis", S. Chand & CompanyLtd New Delhi,2005.
2. Apostol, T.M, "Mathematical Analysis", Narosa Book Distributors Pvt Ltd, 2nd Edition, New Delhi,1996.
3. Malik, S.C, "Mathematical Analysis", Wiley Eastern Ltd.2017.

COs vs POs Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**3**	**2**			**1**	**1**	**1**	**1**	**1**
CO2	**3**	**2**			**1**	**1**	**1**	**1**	**1**
CO3	**3**	**2**			**1**	**1**	**1**	**1**	**1**
CO4	**3**	**2**			**1**	**1**	**1**	**1**	**1**
CO5	**3**	**2**			**1**	**1**	**1**	**1**	**1**
Total	**15**	**10**			**5**	**5**	**5**	**5**	**5**
Scaled Value	**3**	**2**			**1**	**1**	**1**	**1**	**1**

1-5→1, 6-10→2, 11-15→3

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

COURSECODE			COURSENAME	L	T	P	C
YMA203			INTEGRAL EQUATIONS, CALCULUS OF VARIATIONS AND TRANSFORMS	3	1	0	4
C	P	A					
4	0	0		L	T	P	H
				3	1	0	4

PREREQUISITE: Multivariable calculus and vector calculus

COURSE OUTCOMES:

Course outcomes:	Domain	Level
CO1: Define and Explain Calculus of variations, Maxima and Minima, the simplest case, Natural boundary and transition conditions , variational notation	Cognitive	Remembering Understanding
CO2: Define and Explain Fourier sine and cosine transforms - Properties Convolution -Solving integral equations - Finite Fourier transform	Cognitive	Remembering Understanding
CO3: Define and Explain Hankel Transform **:** Definition – Inverse formula – Some important results for Besselfunction – Linearity property	Cognitive	Remembering Understanding
CO4: Define and Explain Linear Integral Equations - Definition, Regularity conditions – special kind of kernels –eigen values and eigen functions – convolution Integral	Cognitive	Remembering Understanding
CO5: Define and Explain Volterra Integralequation – examples – some results about the resolvent kernel. Classical Fredholm Theory.	Cognitive	Remembering Understanding

UNIT I	**12**
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 II	**12**
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.	
UNITIII	**12**
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 IV	**12**
Linear Integral Equations - Definition, Regularity conditions – special kind of kernels –eigen values 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.	
UNIT V	**12**
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	TUTORIAL	TOTAL
	45	15	60

TEXTBOOK

[1] Ram.P.Kanwal – Linear Integral Equations Theory and Practise, 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 Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	2			1	1	1	1	1
CO2	3	2			1	1	1	1	1
CO3	3	2			1	1	1	1	1
CO4	3	2			1	1	1	1	1
CO5	3	2			1	1	1	1	1
Total	15	10			5	5	5	5	5
Scaled value	3	1			1	1	1	1	1

1-5→1, 6-10→2, 11-15→3

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

COURSECODE			COURSENAME	L	T	P	C
YMA204			OPERATIONS RESEARCH	3	1	0	4
C	P	A					
4	0	0		L	T	P	H
				3	1	0	4

PREREQUISITE: Nil

COURSE OUTCOMES:

Course outcomes:	Domain	Level
CO1: Define and Explain Decision theory in detail.	Cognitive	Remembering Understanding
CO2: Explain and solve problems in PERT and CPM	Cognitive	Understanding Applying
CO3: Explain deterministic inventory control models and probabilistic Inventory Control Models and **solve** problems by using the methods:	Cognitive	Understanding Applying
CO4: Explain Essential Features of Queueing System, Classification of Queueing Models and find solution of Queueing Models.	Cognitive	Understanding Remembering
CO5: Explain replacement and maintenance models and **solve** problems by using these methods.	Cognitive	Understanding Applying

UNIT I DECISION THEORY **12**

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.

UNITII PROJECT MANAGEMENT : PERT ANDCPM **12**

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 .

UNITIII DETERMINISTIC INVENTORY CONTROLMODELS **12**

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 IV QUEUEING THEORY **12**

Essential Features of Queueing System - Operating Characteristic of Queueing System - Probabilistic Distribution in Queueing Systems - Classification of Queueing Models - Solution of Queueing Models - Probability Distribution of Arrivals and Departures - Erlangian Service times Distribution withk-Phases.

UNIT V REPLACEMENT AND MAINTENANCE MODELS **12**

Failure Mechanism of items - Replacement of Items Deteriorates with Time - Replacement of items that fail completely - other Replacement Problems.

LECTURE	TUTORIAL	TOTAL
45	15	60

TEXTBOOK

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) Unit IV - Chapter-16 (Section 16.1 - 16.9);Appendix 16. A (PP 774-781) Unit V - Chapter-17 (Section 17.1 - 17.5)

REFERENCES

1. F.S. Hillier 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 andSons, New York, 1998.
5. Hamdy A. Taha , "Operations Research" (sixth edition), Prentice - Hall of India PrivateLimited, New Delhi.2007

COs vs POs Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	2	1		1	2		1		1
CO2	2	1		1	2		1		1
CO3	2	1		1	2		1		1
CO4	2	1		1	2		1		1
CO5	2	1		1	2		1		1
Scaled Value	10	5		5	10		5		5

1 - Low , 2 – Medium , 3- high

LIST OF ELECTIVES

COURSE CODE			COURSE NAME	L	T	P	C
YMA2E1			ALGEBRAIC NUMBER THEORY	3	0	0	3
C	P	A		L	T	P	H
3	0	0		3	0	0	3

PREREQUISITE: Nil

COURSE OUTCOMES:

Course outcomes:	Domain	Level
CO1: Define and Explain Primes,Congruences, Fermat's, Euler's and Wilson's Theorems	Cognitive	Remembering Understanding
CO2: Define and Explain Techniques of numerical calculations – Public key cryptography – Prime power Moduli – Primitive roots and Power Residues	Cognitive	Remembering Understanding
CO3: Define and Explain Number theory from an Algebraic Viewpoint, The Legendre symbol (a/r) where r is an odd prime – Quadratic Reciprocity– The Jacobi Symbol (P/q) where q is an odd positive integer.	Cognitive	Remembering Understanding
CO4: Define and Explain Equivalence and Reduction of Binary Quadratic Forms, Sums of three squares, Arithmetic Functions – The Mobius Inversion Formula – Recurrence Functions – Combinatorial number theory	Cognitive	Remembering Understanding
CO5: Define and Explain Diophantine Equations – The equation ax+by=c – Simultaneous Linear Diophantine Equations – Pythagorean Triangles	Cognitive	Remembering Understanding

UNIT-I	**9**
Introduction – Divisibility – Primes – The Binomial Theorem – Congruences – Euler's totient - Fermat's, Euler's and Wilson's Theorems – Solutions of congruences – The Chinese Remainder theorem.	
UNIT-II	**9**
Techniques of numerical calculations – Public key cryptography – Prime power Moduli – Primitive roots and Power Residues –Congruences of degree two.	
UNIT-III	**9**
Number theory from an Algebraic Viewpoint – Groups, rings and fields – Quadratic Residues- The Legendre symbol (a/r) where r is an odd prime – Quadratic Reciprocity – The Jacobi Symbol (P/q) where q is an odd positive integer.	
UNIT-IV	**9**
Binary Quadratic Forms – Equivalence and Reduction of Binary Quadratic Forms – Sums of three squares – Positive Definite Binary Quadratic forms – Greatest integer Function – Arithmetic Functions – The Mobius Inversion Formula – Recurrence Functions – Combinatorial number theory .	
UNIT-V	**9**

Diophantine Equations – The equation ax+by=c – Simultaneous Linear Diophantine Equations – Pythagorean Triangles – Assorted examples.

LECTURE		TOTAL
45		45

TEXT BOOKS:

1. Ivan Niven, Herbert S, Zuckerman and Hugh L, Montgomery, An Introduction to the Theory of Numbers, Fifth edn., John Wiley & Sons Inc, 2004.
UNIT I Chapter 1 and Chapter 2 : Sections 2.1 to 2.3
UNIT II Chapter 2 : Sections 2.4 to 2.9
UNIT III Chapter 2 : Sections 2.10, 2.11 and Chapter 3: Sections 3.1 to 3.3
UNIT IV Chapter 3 : Sections 3.4 to 3.7 and Chapter 4
UNIT V Chapter 5: Sections 5.1 to 5.4.

REFERENCES:

1. Elementary Number Theory, David M. Burton W.M.C. Brown Publishers,Dubuque, Lawa,1989
2. Number Theory, George Andrews, Courier Dover Publications,1994.
3. Fundamentals of Number Theory, William J. Leveque Addison-Wesley Publishing Company, Phillipines,1977.

COs VS POs Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO 1	3	2		1	1		1	1	1
CO 2	3	2		1			1	1	1
CO 3	3	2		1			1	1	1
CO 4	3	2		1	1		1	1	1
CO 5	3	2		1	1		1	1	1
Total	15	10	0	5	3	0	5	5	5
Scaled value	3	2		1	1		1	1	1

1-5→1, 6-10→2, 11-15→3

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

COURSE CODE			COURSE NAME	L	T	P	C
YMA2E2			DATA STRUCTURE AND ALGORITHMS	3	0	0	3
C	P	A		L	T	P	H
3	0	0		3	0	0	3

PREREQUISITE: Discrete Mathematics

COURSE OUTCOMES:

Course outcomes:	Domain	Level
CO1: Understand and apply linear data structures	Cognitive	Understanding Applying
CO2: Understand and apply nonlinear data structures	Cognitive	Understanding Applying
CO3: Understand and apply sorting techniques	Cognitive	Understanding Applying
CO 4: Understand and apply graph algorithms	Cognitive	Understanding Applying
CO 5: Design different algorithmtechniques.	Cognitive	Understanding Applying

UNIT-I	**9**
ADT – List ADT – Stack ADT – Queue ADT.	
UNIT-II	**9**
Trees – Binary Trees – Binary Search Trees – AVL Trees – Splay Trees – Tree Traversal – B Trees- B+ Tree	
UNIT-III	**9**
Insertion sort – Shell sort – Heap sort – Merge sort – Quick sort – Bucket sort – External Sorting.	
UNIT-IV	**9**
Topological sort – Shortest path algorithms – Network Flow problems – Minimum Spanning Tree – Applications of Depth First search – NP completeness.	
UNIT-V	**9**
Greedy Algorithms – Divide and Conquer – Dynamic Programming - Randomized Algorithms – Backtracking algorithms.	

LECTURE	TOTAL
45	45

TEXT BOOKS /REFERENCE BOOKS

1. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, Second Edition, Pearson Education, Reprint 2011.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, “Introductionto Algorithms", Second Edition, Mcgraw Hill,2002
3. ReemaThareja, “Data Structures Using C”, Oxford University Press,2011
4. Algorithms, Data Structures, and Problem Solving with C++”, Illustrated Edition by Mark Allen Weiss, Addison-Wesley PublishingCompany
5. “How to Solve it by Computer”, 2nd Impression by R. G. Dromey, PearsonEducation

COs VS POs Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO 1	3	2	1	1	1		1	1	1
CO 2	3	2	1	1			1	1	1
CO 3	3	2	1	1			1	1	1
CO 4	3	2	1	1	1		1	1	1
CO 5	3	2	1	1	1		1	1	1
Total	15	10	5	5	3	0	5	5	5
Scaled value	3	2	1	1	1		1	1	1

1-5→1, 6-10→2, 11-15→3

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

COURSECODE			COURSENAME	L	T	P	C
YMA2E3			FUZZY SETS AND FUZZY LOGIC	3	0	0	3
C	P	A					
3	0	0		L	T	P	H
				3	0	0	3

PREREQUISITE: Discrete Mathematics

COURSE OUTCOMES:

Course outcomes:	**Domain**	**Level**
CO1: Define and Explain basic definitions of Crisp sets, the notion of fuzzy sets and basic concepts of fuzzy sets.	Cognitive	Remembering Understanding
CO2: Define and Explain operation on Fuzzy Sets**.**	Cognitive	Remembering Understanding
CO3: Define and Explain Fuzzy Relations	Cognitive	Remembering Understanding
CO4: Define and Explain Classical Logic.	Cognitive	Remembering
		Understanding
CO5: Define and Explain Fuzzy logic, fuzzy tautologies - contradictions - equivalence and logical proofs.	Cognitive	Remembering Understanding

UNIT I Crisp Sets and Fuzzy Sets	**9**
Crisp sets basic definitions - the notion of fuzzy sets - basic concepts of fuzzy sets.	
UNITII Operation on FuzzySets	**9**
Fuzzy complement - fuzzy union - fuzzy intersection - combination and general aggregation operations.	
UNIT III Fuzzy Relations	**9**
Crisp and fuzzy relations - binary relation - equivalence and similarity relations - tolerance relations - orderings.	
UNIT IV Classical Logic	**9**
Tautologies - contradictions - equivalence - exclusive OR and exclusive NOR - logical proofs.	
UNIT V Fuzzy Logic	**9**
Fuzzy logic - approximate reasoning - fuzzy tautologies - contradictions - equivalence and logical proofs.	

LECTURE	**TOTAL**
45	**45**

TEXTBOOKS

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 Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO 1	3	2	1	1	1		1	1	1
CO 2	3	2	1	1			1	1	1
CO 3	3	2	1	1			1	1	1
CO 4	3	2	1	1	1		1	1	1
CO 5	3	2	1	1	1		1	1	1
Total	15	10	5	5	3	0	5	5	5
Scaled value	3	2	1	1	1		1	1	1

1-5→1, 6-10→2, 11-15→3

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

SEMESTER III

COURSECODE			COURSETITLE	L	T	P	C
YMA301			FIELD THEORY	3	1	0	4
C	P	A					
4	0	0		L	T	P	H
				3	1	0	4

PREREQUISITE: Algebra

COURSE OUTCOMES:

Course outcomes:	Domain	Level
CO1: Define and Explain Extension fields – Finite Extension – Algebraic Extension - Transcendence of e.	Cognitive	Remembering Understanding
CO2: Define and Explain Roots of Polynomials.- Remainder Theorem – Splitting field - More about roots.	Cognitive	Remembering Understanding
CO3: Define and Explain Elements of Galois Theory- Fixed field – Normal extension- Fundamental Theorem.	Cognitive	Remembering Understanding
CO4: Define and Explain Solvability by radicals – Solvable group – Galois group over the rational.	Cognitive	Remembering Understanding
CO5: Define and Explain Finite fields - Wedderburn's theorem on finite division rings – A Theorem of Frobenius.	Cognitive	Remembering Understanding

UNIT I	**12**
Extension fields – Finite Extension – Algebraic Extension - Transcendence of e.	
UNIT II	**12**
Roots of Polynomials.- Remainder Theorem – Splitting field - More about roots.	
UNITIII	**12**
Elements of Galois Theory- Fixed field – Normal extension- Fundamental Theorem.	
UNIT IV	**12**
Solvability by radicals – Solvable group – Galois group over the rational.	
UNIT V	**12**
Finite fields - Wedderburn's theorem on finite division rings – A Theorem of Frobenius.	

LECTURE	TUTORIAL	TOTAL
45	15	60

TEXTBOOK

1. N. Herstein,"Topics in Algebra", Willey Eastern, 1975.

REFERENCES

1. John B. Fraleigh,"A First Course in Abstract Algebra", Narosa Publication, Third Edition,2013

2. P. M. Cohn,"Basic Algebra", Springers Publications, Second Edition,2003.

COs vs POs Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**3**	**2**			**1**	**1**	**1**	**1**	**1**
CO2	**3**	**2**			**1**	**1**	**1**	**1**	**1**
CO3	**3**	**2**			**1**	**1**	**1**	**1**	**1**
CO4	**3**	**2**			**1**	**1**	**1**	**1**	**1**
CO5	**3**	**2**			**1**	**1**	**1**	**1**	**1**
Total	**15**	**10**			**5**	**5**	**5**	**5**	**5**
Scaled Value	**3**	**2**			**1**	**1**	**1**	**1**	**1**

1-5→1, 6-10→2, 11-15→3

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

COURSECODE			COURSENAME	L	T	P	C
YMA302			TOPOLOGY	4	1	0	5
C	P	A					
5	0	0		L	T	P	H
				4	1	0	5

PREREQUISITE: Analysis

COURSE OUTCOMES:

Course outcomes:	Domain	Level
CO1: Define and Explain Topological Spaces	Cognitive	Remembering Understanding
CO2: Define and Explain Continuous Functions	Cognitive	Remembering Understanding
CO3: Define and Explain Connectedness	Cognitive	Remembering Understanding
CO4: Define and Explain Compactness	Cognitive	Remembering Understanding
CO5: Define and Explain Countability and Separation Axiom	Cognitive	Remembering Understanding

UNIT I Topological Spaces **15**

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

UNIT II Continuous Functions **15**

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

UNIT III Connectedness **15**

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

UNIT IV Compactness **15**

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

UNIT V Countability and Separation Axiom **15**

The Countability Axioms - The separation Axioms - Normal spaces - The Urysohn Lemma - The Urysohn metrization Theorem - The Tietz extension theorem.

LECTURE	TUTORIAL	TOTAL
60	15	75

TEXTBOOK

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.Sinmons, “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 Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**3**	**2**			**1**	**1**	**1**	**1**	**1**
CO2	**3**	**2**			**1**	**1**	**1**	**1**	**1**
CO3	**3**	**2**			**1**	**1**	**1**	**1**	**1**
CO4	**3**	**2**			**1**	**1**	**1**	**1**	**1**
CO5	**3**	**2**			**1**	**1**	**1**	**1**	**1**
Total	**15**	**10**			**5**	**5**	**5**	**5**	**5**
Scaled Value	**3**	**2**			**1**	**1**	**1**	**1**	**1**

1-5→1, 6-10→2, 11-15→3

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

COURSECODE			COURSENAME	L	T	P	C
YMA303			AUTOMATA THEORY	3	1	0	4
C	P	A					
4	0	0		L	T	P	H
				3	1	0	4

PREREQUISITE: Analysis

COURSE OUTCOMES:

Course outcomes:	Domain	Level
CO1: Define and Explain Strings,Alphabets and Languages	Cognitive	Remembering Understanding
CO2: Define and Explain Regular expressions and Properties of Regular sets.	Cognitive	Remembering Understanding
CO3: Define and Explain Context Free grammars	Cognitive	Remembering Understanding
CO4: Define and Explain Pushdown Automata & properties of Context free languages	Cognitive	Remembering Understanding
CO5: Define and Explain Turning Machine and Chomski hierarchy.	Cognitive	Remembering Understanding

UNIT I	**12**
Strings,Alphabets and Languages (Section 1.1 of the Text) Finite Automata (Chapters 2, Sections 2.1 to 2.4)	
UNIT II	**12**
Regular expressions and Properties of Regular sets.(Sections 2.5 to 2.8 and 3.1 to 3.4)	
UNITIII	**12**
Context Free grammars (Section 4.1 to 4.5)	
UNIT IV	**12**
Pushdown Automata & properties of Context free languages Theorem 5.3, 5.4 (without proof), (Section is 5.1 to 5.3 and 6.1 to 6.3)	
UNIT V	**12**
Turning Machine and Chomski hierarchy, (Sections 7.1 to 7.3 and 9.2 to 9.4)	

LECTURE	TUTORIAL	TOTAL
45	15	60

TEXTBOOK

1. J.E. Hopocroft and J.D. Ulman, Introduction to Automata Theory Languages and Computation, Narosa, 1999

REFERENCES

1. G.ERevesz,Introduction to Formal Languages
2. P.Linz,Introduction to Forma Languages and Automata,Narosa2000
3. G.Lallment, Semigroups and Applications

COs vs POs Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**2**	**1**		**1**	**2**		**1**		**1**
CO2	**2**	**1**		**1**	**2**		**1**		**1**
CO3	**2**	**1**		**1**	**2**		**1**		**1**
CO4	**2**	**1**		**1**	**2**		**1**		**1**
CO5	**2**	**1**		**1**	**2**		**1**		**1**
Total	**10**	**5**		**5**	**10**		**5**		**5**
Scaled Value	**2**	**1**		**1**	**2**		**1**		**1**

1-5→1, 6-10→2, 11-15→3

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

COURSECODE			COURSENAME	L	T	P	C
YMA304			MATHEMATICAL STATISTICS	3	1	0	4
C	P	A					
4	0	0		L	T	P	H
				3	1	0	4

PREREQUISITE: Nil

COURSE OUTCOMES:

Course outcomes:	Domain	Level
CO1: Define and Explain Estimation Theory.	Cognitive	Remembering Understanding
CO2: Explain and solve Tests based on normal, t and f distributions for testing of means, variance and proportions – Analysis of r × c tables – Goodness of fit	Cognitive	Understanding Applying
CO3: Explain and solve Correlation And Regression.	Cognitive	Understanding Applying
CO4: Explain and solve Design of Experiments	Cognitive	Understanding Applying
CO5: Explain and solve Statistical Quality Control by X , R charts, p, c and np charts.	Cognitive	Understanding Applying

UNIT I Estimation Theory **12**

Estimators: Un biasedness, Consistency, Efficiency and Sufficiency – Maximum likelihood estimation – Method of moments.

UNIT II Testing Of Hypothesis **12**

Tests based on normal, t and f distributions for testing of means, variance and proportions – Analysis of r × c tables – Goodness of fit.

UNIT III Correlation And Regression **12**

Multiple and Partial correlation – Method of least squares – Plane of Regression – Properties of residuals – Coefficient of multiple correlation – Coefficient of partial correlation - Multiple correlation with total and partial correlation – Regression and Partial correlations in terms of lower order co-efficient.

UNIT IV Design of Experiments **12**

Analysis of variance – One way and two way classifications – Completely randomized design – Randomized block design – Latin square design.

UNIT V Statistical Quality Control **12**

Analysis of variance: Control charts for measurements (X and R charts) – control charts for attributes (p, c and np charts) – Tolerance limits – Acceptance sampling, Introduction to SPSS.

LECTURE	TUTORIAL	TOTAL
45	15	60

TEXTBOOK

1. Gupta. S.C., and Kapoor. V.K., "Fundamentals of Mathematical Statistics", Sultan Chand and sons, Thirteenth Edition, 2014.

REFERENCES

1. J.E. Freund, "Mathematical Statistical", 5th Edition, Prentice Hall of India,2001.
2. Jay L. Devore, "Probability and Statistics for Engineering and the Sciences",5th Edition, Thomas and Duxbury, Singapore,2002.

Mapping of CO's with PO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3			1			1	1
CO2	3	2			1			1	1
CO3	3	3			1			1	2
CO4	3	3			1		1	1	1
CO5	3	3			1		1	1	1
Total	15	15			5		2	5	6
Scaled Value	3	3			1		1	1	2

1-5→1, 6-10→2, 11-15→3

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

LIST OF ELECTIVES

COURSE CODE			COURSE NAME	L	T	P	C
YMA3E1			DATA ANALYSIS USING SPSS	3	0	0	3
C	P	A		L	T	P	H
3	0	0		3	0	0	3

PREREQUISITE: Probability and Statistics

COURSE OUTCOMES:

Course outcomes:	Domain	Level
CO1:Define and Explain Starting SPSS, SPSS Main Menus, Working with the Data Editor, Importing and Exporting data, Plotting of Charts using Bar and Pie diagram.	Cognitive	Remembering Understanding
CO2: Define and Explain measures of central tendencies and measures of dispersion using SPSS	Cognitive	Remembering Understanding
CO3:Define and Explain Type I and Type II error, Basics of one sample t-test, independent sample t-test and paired t-test using SPSS	Cognitive	Remembering Understanding
CO4:Define and Explain One way ANOVA, two way ANOVA and Chi-square test using SPSS	Cognitive	Remembering Understanding
CO5: Define and Explain correlation and regression using SPSS	Cognitive	Remembering Understanding

UNIT I	**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 II	**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 III	**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 IV	**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 V	**9**
Correlation: Karl Pearson's coefficient of Correlation – Spearman's Rank correlation – Simple linear Regression using SPSS with interpretation.	

LECTURE	TOTAL
45	45

TEXTBOOK

1. Ajai J Gaur and Sanjaya 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

Mapping of CO's with PO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	3			1			1	1
CO2	3	2			1			1	1
CO3	3	3			1			1	2
CO4	3	3			1		1	1	1
CO5	3	3			1		1	1	1
Total	15	15			5		2	5	6
Scaled Value	3	3			1		1	1	2

1-5→1, 6-10→2, 11-15→3

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

COURSECODE			COURSENAME	L	T	P	C
YMA3E2			NUMERICAL METHODS	3	0	0	3
C	P	A					
3	0	0		L	T	P	H
				3	0	0	3

PREREQUISITE: Algebra

COURSE OUTCOMES:

Course outcomes:	Domain	Level
CO1: Find the solution by using Bisection method-Newton-Raphson Method-Curve fitting straight line and parabola.	Cognitive	Remembering
CO2: Solve Simultaneous Linear Equations.	Cognitive	Remembering Understanding
CO3: Find the value of y = f(x) using interpolation formula.	Cognitive	Remembering Understanding
CO4: Find the first and second derivative of f(x) and to find the value of integrals using numerical methods.	Cognitive	Remembering Understanding
CO5: Solve ordinary differential equations by using various methods.	Cognitive	Remembering Understanding

UNIT I **9**

Solution of Numerical Algebraic Equations & Curve fitting Bisection method-Newton-Raphson method-Curve fitting straight line and parabola.

UNIT II **9**

Solution of Simultaneous Linear Equations-Gauss-Elimination method-Method of factorization-Gauss Jacobi and Gauss-Seidel methods

UNITIII **9**

Interpolation - Gregory-Newton forward and backward interpolation formulae Sterling's formula-Lagrange's formula.

UNIT IV **9**

Numerical Differentiation and Integration, Numerical differentiation, Trapezoidal rule-Simpson's one-third rule –Simpson's three-eighth rule.

UNIT V **9**

Numerical Solution of Ordinary Differential Equations, Euler's method – fourth order Runge-Kutta method-Milne's predictor corrector method.

LECTURE	TOTAL
45	45

TEXTBOOK

1. Sastry.S.S, "Introductory Methods of Numerical Analysis", Prentice Hall of India, 2000.

REFERENCES

1. Gerald, Curtis and Wheatley, Patrick.O,"Applied Numerical Analysis", (Fifth Edition) Addison-Wesley,1989.
2. Kandasamy.P, Thilakavathy.K, Gunavathy.K-Numerical Methods, S.Chand & Co. Ltd,New Delhi, Reprint 2001.

COs vs POs Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**2**	**1**	**1**	**1**		**2**			**1**
CO2	**2**	**1**	**1**	**1**		**2**			**1**
CO3	**2**	**1**	**1**	**1**		**2**			**1**
CO4	**2**	**1**	**1**	**1**		**2**			**1**
CO5	**2**	**1**	**1**	**1**		**2**			**1**
Total	**10**	**5**	**5**	**5**		**10**			**5**
Scaled Value	**2**	**1**	**1**	**1**		**2**			**1**

1-5→1, 6-10→2, 11-15→3

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

COURSE CODE			COURSE NAME	L	T	P	C
YMA3E3			COMMUTATIVE ALGEBRA	3	0	0	3
C	P	A		L	T	P	H
3	0	0		3	0	0	3

PREREQUISITE: Nil

COURSE OUTCOMES:

Course outcomes:	Domain	Level
CO1: Define and Explain special algebraic structures and their properties.	Cognitive	Remembering Understanding
CO2: Define and Explain proficient in the theory of Modules	Cognitive	Remembering Understanding
CO3: Define and Explain the methods of decomposition of rings.	Cognitive	Remembering Understanding
CO 4: Define and Explain Chain conditions – Primary decomposition in Noetherian rings.	Cognitive	Remembering Understanding
CO 5: Define and Explain Artin rings – Discrete valuation rings – Dedekind domains – Fractional ideals	Cognitive	Remembering Understanding

UNIT-I	**9**
Rings and ring homomorphism's – ideals – Extension and Contraction, modules and module homomorphism – exact sequences.	
UNIT-II	**9**
Tensor product of modules – Tensor product of algebra – Local properties – extended and contracted ideals in rings of fractions.	
UNIT-III	**9**
Primary Decomposition – Integral dependence – The going-up theorem – The going down theorem – Valuation rings.	
UNIT-IV	**9**
Chain conditions – Primary decomposition in Noetherian rings.	
UNIT-V	**9**
Artin rings – Discrete valuation rings – Dedekind domains – Fractional ideals.	

LECTURE	TOTAL
45	45

TEXT BOOKS:

1. Atiyah, M., MacDonald, I.G., Introduction to Commutative Algebra, AddisonWesley, Massachusetts 1969. Unit 1 : Chapter 1, Chapter 2 (up to page 23) Unit 2 : Chapter 2 (pages 24 – 31), Chapter 3. Unit 3 : Chapters 4,5. Unit 4 : Chapters 6,7. Unit 5 : Chapters 8,9.

REFERENCES:

1. H.Matsumura, Commutative ring theory, Cambridge University Press,1986.
2. N.S. Gopalakrishnan, Commutative Algebra, Oxonian Press Pvt. Ltd, New Delhi, 1988. R.Y.Sharp, Steps in Commutative Algebra, Cambridge University Press,1990.

COs VS POs Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO 1	3	2		1	1		1	1	1
CO 2	3	2		1			1	1	1
CO 3	3	2		1			1	1	1
CO 4	3	2		1	1		1	1	1
CO 5	3	2		1	1		1	1	1
Total	15	10	0	5	3	0	5	5	5
Scaled value	3	2		1	1		1	1	

1-5→1, 6-10→2, 11-15→3

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

SEMESTER IV

COURSECODE			COURSENAME	L	T	P	C
YMA401			COMPLEX ANALYSIS	4	1	0	5
C	P	A					
5	0	0		L	T	P	H
				4	1	0	5

PREREQUISITE: Analysis

COURSE OUTCOMES:

Course outcomes:	Domain	Level
CO1: Define and Explain Line Integrals- Rectifiable arc – Line integrals as functions of arc- Cauchy's Theorem for rectangle- Cauchy's Theorem for disc	Cognitive	Remembering Understanding
CO2: Define and Explain Integral Formula – Higher derivatives – Removable singularities – Taylor's theorem – Zeros and Poles – The Local Mapping – The Maximum Principle.	Cognitive	Remembering Understanding
CO3: Define and Explain The General Statement of Cauchy's Theorem – Proof of Cauchy's Theorem – Locally Exact Differentials – Multiply Connected Regions.	Cognitive	Remembering Understanding
CO4: Define and Explain The Residue Theorem – The Argument Principle – Evaluation of Definite Integrals – The Mean – value property – Poisson's formula- Schwarz's Theorem – The Reflection Principle.	Cognitive	Remembering Understanding
CO5: Define and Explain Weierstrass's Theorem – The Taylor Series – The Laurent Series – Partial Fractions- Jensen's Formula Hadamard's Theorem	Cognitive	Remembering Understanding

UNIT I	**15**
Line Integrals- Rectifiable arc – Line integrals as functions of arc- Cauchy's Theorem for rectangle- Cauchy's Theorem for disc.	
UNIT II	**15**
The Index of a point - Integral Formula – Higher derivatives – Removable singularities – Taylor's theorem – Zeros and Poles – The Local Mapping – The Maximum Principle.	
UNITIII	**15**
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 IV	**15**
The Residue Theorem – The Argument Principle – Evaluation of Definite Integrals – The Mean – value property – Poisson's formula- Schwarz's Theorem – The Reflection Principle.	
UNIT V	**15**
Weierstrass's Theorem – The Taylor Series – The Laurent Series – Partial Fractions- Jensen's Formula – Hadamard's Theorem**.**	

LECTURE	TUTORIAL	TOTAL
60	15	75

TEXTBOOK

1.Lars V.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.

REFERENCES:

1. S. Poonusamy, "Complex Analysis", Alpha Science International Ltd; 2nd Revised edition, 2005.

COs vs POs Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**2**	**1**	**1**	**1**		**2**			**1**
CO2	**2**	**1**	**1**	**1**		**2**			**1**
CO3	**2**	**1**	**1**	**1**		**2**			**1**
CO4	**2**	**1**	**1**	**1**		**2**			**1**
CO5	**2**	**1**	**1**	**1**		**2**			**1**
Total	**10**	**5**	**5**	**5**		**10**			**5**
Scaled Value	**2**	**1**	**1**	**1**		**2**			**1**

1-5→1, 6-10→2, 11-15→3

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

COURSECODE			COURSENAME	L	T	P	C
YMA402			FUNCTIONAL ANALYSIS	4	1	0	5
C	P	A					
5	0	0		L	T	P	H
				4	1	0	5

PREREQUISITE: Analysis

COURSE OUTCOMES:

Course outcomes:	Domain	Level
CO1: Define and Explain Normed Spaces – Continued of Linear Maps – Hahn – Banach Theorems.	Cognitive	Remembering Understanding
CO2: Define and Explain Banach Spaces – Uniform Boundedness Principle – Closed Graph and Open Mapping Theorems.	Cognitive	Remembering Understanding
CO3: Define and Explain Bounded Inverse Theorem – Spectrum of a Bounded Operator.	Cognitive	Remembering Understanding
CO4: Define and Explain Inner Product Spaces – Orthonormal Sets – Projection and Riesz Representation Theorems.	Cognitive	Remembering Understanding
CO5: Define and Explain Bounded Operators and adjoint, Normal , Unitary and Self-adjoint Operators.	Cognitive	Remembering Understanding

UNIT I **15**

Normed Spaces – Continued of Linear Maps – Hahn – Banach Theorems.

UNIT II **15**

Banach Spaces – Uniform Boundedness Principle – Closed Graph and Open Mapping Theorems.

UNITIII **15**

Bounded Inverse Theorem – Spectrum of a Bounded Operator.

UNIT IV **15**

Inner Product Spaces – Orthonormal Sets – Projection and Riesz Representation Theorems.

UNIT V **15**

Bounded Operators and adjoint, Normal , Unitary and Self-adjoint Operators.

LECTURE	TUTORIAL	TOTAL
60	15	75

TEXTBOOK

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 Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**2**	**1**	**1**	**1**		**2**			**1**
CO2	**2**	**1**	**1**	**1**		**2**			**1**
CO3	**2**	**1**	**1**	**1**		**2**			**1**
CO4	**2**	**1**	**1**	**1**		**2**			**1**
CO5	**2**	**1**	**1**	**1**		**2**			**1**
Total	**10**	**5**	**5**	**5**		**10**			**5**
Scaled Value	**2**	**1**	**1**	**1**		**2**			**1**

1-5→1, 6-10→2, 11-15→3

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

COURSE CODE			COURSE NAME	L	T	P	C
YMA403			MATHEMATICAL MODELING	3	1	0	4
C	P	A					
3	0	1		L	T	P	H
				3	1	0	4

PREREQUISITE: Probability and Statistics

COURSE OUTCOMES:

Course outcomes:	Domain	Level
CO1:Define and explain Mathematical Modelling through Ordinary Differential Equations of First order	Cognitive Affective	Remembering Understanding Receiving
CO2:Define and explain Mathematical Modelling through Systems of Ordinary Differential Equations of First Order	Cognitive Affective	Remembering Understanding Receiving
CO3:Define and explain Mathematical Modelling through Ordinary Differential Equations of Second Order	Cognitive	Remembering Understanding
CO4:Define and explain Mathematical Modelling through Difference Equations	Cognitive	Remembering Understanding
CO5: Define and explainMathematical Modelling through Graphs	Cognitive	Remembering Understanding

UNIT I: Mathematical Modelling through Ordinary Differential Equationsof First order **9+3**

Linear Growth and Decay Models – Non-Linear Growth and Decay Models –Compartment Models – Dynamics problems – Geometrical problems.

UNIT II:Mathematical Modelling through Systems of OrdinaryDifferential Equations of First Order **9+3**

Population Dynamics – Epidemics – Compartment Models – Economics –Medicine, Arms Race, Battles and International Trade – Dynamics.

UNIT III:Mathematical Modelling through Ordinary Differential Equationsof Second Order **9+3**

Planetary Motions – Circular Motion and Motion of Satellites – MathematicalModelling through Linear Differential Equations of Second Order –Miscellaneous Mathematical Models.

UNIT IV : Mathematical Modelling through Difference Equations **9+3**

Simple Models – Basic Theory of Linear Difference Equations with ConstantCoefficients – Economics and Finance – Population Dynamics and Genetics –Probability Theory.

UNIT V: Mathematical Modelling through Graphs **9+3**

Solutions that can be Modelled through Graphs – Mathematical Modelling inTerms of Directed Graphs, Signed Graphs, Weighted Digraphs and UnorientedGraphs.

LECTURE	TUTORIAL	TOTAL
45	15	60

TEXTBOOKS

1.J.N. Kapur, Mathematical Modelling, Wiley Eastern Limited, New Delhi, 1988.

REFERENCES

1. J. N. Kapur, Mathematical Models in Biology and Medicine, Affiliated East –West Press Pvt Limited, New Delhi, 19

COs vs POs Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**3**	**2**			**1**	**1**	**1**	**1**	**1**
CO2	**3**	**2**			**1**	**1**	**1**	**1**	**1**
CO3	**3**	**2**			**1**	**1**	**1**	**1**	**1**
CO4	**3**	**2**			**1**	**1**	**1**	**1**	**1**
CO5	**3**	**2**			**1**	**1**	**1**	**1**	**1**
Total	**15**	**10**			**5**	**5**	**5**	**5**	**5**
Scaled Value	**3**	**2**			**1**	**1**	**1**	**1**	**1**

1-5→1, 6-10→2, 11-15→3

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