### SEMESTER – 2

### Sub Code: P16MA21

### COMPLEX ANALYSIS

**Objectives**

1. To learn the various intrinsic concepts and the theory of Complex Analysis.
2. To study the concept of Analyticity, Complex Integration and Infinite Products in depth.

### UNIT I

Elementary Point Set Topology: Sets and Elements – Metric Spaces – Connectedness – Compactness – Continuous Functions – Topological Spaces; Conformality: Arcs and Closed Curves – Analytic Functions in Regions – Conformal Mapping – Length and Area; Linear Transformations: The Linear Group – The Cross Ratio – Symmetry

**UNIT II**

Fundamental theorems in complex integration: Line Integrals – Rectifiable Arcs – Line Integrals as Functions of Arcs – Cauchy’s Theorem for a Rectangle – Cauchy’s Theorem in a Disk; Cauchy’s Integral Formula: The Index of a Point with Respect to a Closed Curve – The Integral Formula – Higher Derivatives.

### UNIT III

Local Properties of Analytic Functions - Removable Singularities - Taylor’s Theorem – Integral representation of the nth term - Zeros and Poles – Algebraic order of f(z) – Essential Singularity - The Local Mapping – The Open Mapping Theorem - The Maximum Principle.

**UNIT IV**

The General Form of Cauchy’s Theorem: Chains and Cycles – Simple Connectivity – Homology – The General Statement of Cauchy’s Theorem – Proof of Cauchy’s Theorem

– Locally Exact Differentials – Multiply Connected Regions; The Calculus of Residues: The Residue Theorem – The Argument Principle – Evaluation of Definite Integrals

**UNIT V**

Harmonic Functions: Definition and Basic Properties – The Mean-value Property – Poisson’s Formula – Schwarz’s Theorem – The Reflection Principle; Power series expansions-Weierstrass’s Theorem – The Taylor Series – The Laurent Series;

### TEXT BOOK

Lars V. Ahlfors, Complex Analysis, Third Ed. McGraw-Hill Book Company, Tokyo, 1979.

UNIT – I Chapter 3: 1.1-1.6, 2.1-2.4,3.1-3.3

UNIT – II Chapter 4: 1.1-1.5, 2.1-2.3

UNIT – III Chapter 4: 3.1, 3.2, 3.3,3.4

UNIT – IV Chapter 4: 4.1-4.7, 5.1-5.3

UNIT – V Chapter 4: 6.1-6.5, and Chapter 5: 1.1-1.3

### REFERENCES

1. Serge Lang, Complex Analysis, Addison Wesley, 1977.
2. S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, New Delhi, 1997.
3. Karunakaran, Complex Analysis,Alpha Science international Ltd,Second edition,2005.

### Sub Code: P16MA22

### LINEAR ALGEBRA

**Objectives**

1. To give the students a thorough knowledge of the various aspects of Linear Algebra
2. To train the students in problem-solving as a preparatory for competitive exam.

### UNIT I: Matrices:

Systems of linear Equations - Matrices and Elementary Row operations -Row-reduced echelon Matrices - Matrix Multiplication - Invertible Matrices -Bases and Dimension. (Only revision of Vector spaces and subspaces).

### Unit II: Linear transformations:

The algebra of linear transformations - Isomorphism of Vector Spaces - Representations of Linear Transformations by Matrices - Linear Functionals - The Double Dual - The Transpose of a Linear Transformation.

### Unit III: Algebra of polynomials:

The algebra of polynomials - Lagrange Interpolation - Polynomial Ideals -The prime factorization of a polynomial - Commutative rings – Determinant functions.

### Unit IV: Determinants:

Permutations and the uniqueness of determinants - Classical Adjoint of a (square) matrix - Inverse of an invertible matrix using determinants -Characteristic values - Annihilating polynomials.

### Unit V: Diagonalization:

Invariant subspaces - Simultaneous triangulation and simultaneous Diagonalization Direct-sum Decompositions - Invariant Direct sums – Primary Decomposition theorem.

### TEXTBOOK

1. Kenneth Hoffman and Ray Alden Kunze, Linear Algebra, Second Edition, Prentice Hall of India Private Limited, New Delhi, 1975.

UNIT I Chapter 1 & 2 1.2-1.6 and 2.3 UNIT II Chapter 3

UNIT III Chapter 4 & 5 4.1 - 4.5 and 5.1 - 5.2

UNIT IV Chapter 5 & 6 5.3, 5.4 and 6.1 - 6.3

UNIT V Chapter 6 6.4 - 6.8

### REFERENCES

1. S. Kumaresan, Linear Algebra: A Geometric Approach, Prentice-Hall of India Ltd, 2004.
2. V. Krishnamurthy, V.P. Mainra, J.L. Arora, Introduction to Linear Algebra, East West Press Ltd, 1985.
3. A.R. Rao, P. Bhimashankaram, Linear Algebra, Second Edition, Tata McGraw Hill, 2000.
4. Edgar G.Goodaire, Linear Algebra-Pure & Applied World Scientific, Cambridge University Press India Ltd, 2014

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### Sub Code: P16MA23

### PARTIAL DIFFERENTIAL EQUATIONS

**Objectives**

1. To give an in-depth knowledge of solving partial differential equations and apply them in scientific and engineering problems.
2. To study the other aspects of PDE

**UNIT I**

Partial differential equations- origins of first order Partial differential equations- Cauchy’s problem for first order equations- Linear equations of the first order- Integral surfaces Passing through a Given curve- surfaces Orthogonal to a given system of surfaces -Non linear Partial differential equations of the first order.

### UNIT II

Cauchy’s method of characteristics- compatible systems of first order equations- Charpits method- Special types of first order equations- Solutions satisfying given conditions- Jacobi’s method.

### UNIT III

Partial differential equations of the second order : The origin of second order equations

–second order equations in Physics – Higher order equations in Physics - Linear partial differential equations with constant co-efficient- Equations with variable coefficients- Characteristic curves of second order equations

### UNIT IV

Characteristics of equations in three variables- The solution of Linear Hyperbolic equations-Separation of variables. The method of Integral Transforms – Non Linear equations of the second order.

### Unit V

Laplace equation : Elementary solutions of Laplace’s equations-Families of equipotential Surfaces- Boundary value problems-Separation of variables –Problems with Axial Symmetry.

### TEXT BOOK

**Ian N. Sneddon**,Elements of Partial differential equations**,** Dover Publication –INC, New York, 2006.

UNIT I Chapter II Sections 1 to 7 UNIT II Chapter II Sections 8 to 13 UNIT III Chapter III Sections 1 to 6 UNIT IV Chapter III Sections 7 to 11 UNIT V Chapter IV Sections 2 to 6

### REFERENCES

1. **M.D.Raisinghania**, Advanced Differential Equations , S.Chand and company Ltd., New Delhi,2001.
2. **E.T.Copson,** Partial Differential Equations, Cambridge University Press

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### ELECTIVE I

### Sub Code: P16MAE1C

**FUZZY SETS AND THEIR APPLICATIONS**

**Objectives:**

1. To introduce the concept of fuzzy theory and study its application in real problems
2. To study the uncertainty environment through the fuzzy sets that incorporates imprecision and subjectivity into the model formulation and solution process.

### UNIT I From Classical Sets To Fuzzy Sets, Fuzzy Sets Verses Crisp Sets:

Fuzzy sets: Basic types – Fuzzy sets: Basic Concepts –Additional Properties of α – cuts- Extension Principle for fuzzy sets **.**

### UNIT II Operations On Fuzzy Sets:

Types of operations– Fuzzy complements- Fuzzy Intersections:t-Norms – Fuzzy Unions:t-Conorms - Combinations of Operations**.**

### UNIT III Fuzzy Arithmetic:

Fuzzy numbers - Linguistic variables -Arithmetic operations on intervals –Arithmetic operations on Fuzzy numbers **.**

### UNIT IV Fuzzy Relations:

Binary Fuzzy Relations – Binary Relations on a Single Set – Fuzzy Equivalence Relations – Fuzzy Compatibility Relations –Fuzzy Ordering Relations – Fuzzy Morphisms.

### UNIT V Fuzzy Decision Making:

Individual decision making – Multiperson Decision Making-Ranking methods – Fuzzy Linear programming.

### TEXT BOOK

George J. Klir and Bo Yuan, Fuzzy sets and Fuzzy Logic Theory and Applications, Prentice Hall of India, (2005).

**UNIT I** Chapter 1 Sections 1.3, 1.4, Chapter :2 Sections 2.1 and 2.3

**UNIT II** Chapter 3 Sections 3.1, 3.2, 3.3, 3.4, 3.5.

**UNIT III** Chapter 4 Sections 4.1,4.2, 4.3, 4.4.

**UNIT IV** Chapter 5 Sections 5.3 ,5.4, 5.5, 5.6, 5.7, 5.8.

**UNIT V** Chapter 15 Sections 15.2,15.3, 15.6, 15.7

### REFERENCES

1. H.J. Zimmermann, Fuzzy Set Theory and its Applications, Allied Publishers Limited (1991).
2. M. Ganesh, Introduction to Fuzzy sets and Fuzzy logic, Prentice Hall of India, New Delhi (2006).

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### ELECTIVE II

### Sub Code: P16MAE2A

**STOCHASTIC PROCESSES**

**Objectives**

1. To understand the stochastic models for many real life probabilistic situations.
2. To learn the well known models like birth-death and queuing to reorient the knowledge of stochastic processes.

**UNIT I**

Stochastic Processes: Some notions – Specification of Stochastic processes – Stationary processes – Markov Chains – Definitions and examples – Higher Transition probabilities – Generalization of independent Bernoulli trails – Sequence of chain – Dependent trains.

### UNIT II

Markov chains : Classification of states and chains – determination of Higher transition probabilities – stability of a Markov system – Reducible chains – Markov chains with continuous state space.

### UNIT III

Markov processes with Discrete state space : Poisson processes and their extensions – Poisson process and related distribution – Generalization of Poisson process- Birth and Death process – Markov processes with discrete state space (continuous time Markov Chains).

### UNIT IV

Renewal processes and theory : Renewal process – Renewal processes in continuous time – Renewal equation – stopping time – Wald’s equation – Renewal theorems.

### UNIT V

Stochastic processes in Queuing – Queuing system – General concepts – the queuing model M/M/1 – Steady state Behaviour – transient behaviour of M/M/1 Model – Non- Markovian models - the model GI/M/1.

### TEXT BOOK

1. J. Medhi,Stochastic Processes, New age international pblishers,New Delhi– Second edition.

UNIT I Ch. II & Ch.III Sec 2.1 to 2.3, Sec 3.1 to 3.3 UNIT II Ch III – Sec 3.4 to 3.6, 3.8, 3.9 and 3.11

UNIT III Ch IV : Sec 4.1 to 4.5 UNIT IV Ch VI : Sec 6.1 to 6.5

UNIT V Ch X : Sec 10.1 to 10.3, 10.7 and 10.8 (omit sec 10.2.3 & 10.2.3.1)

### REFERENCES

1. Samuel Karlin, Howard M. Taylor, A first course in stochastic processes, Academic press, Second Edition,1975.
2. Narayan Bhat , Elements of Applied Stochastic Processes,John Wiley ,1972.
3. N.V. Prabhu, Stochastic Processes, Macmillan (NY).

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