(For the candidates admitted from the academic year 2018 onwards)

CORE I : ALGEBRA

Semester: I **Subject Code:**
Hours : 6 **Credits: 5**

Objectives:

1. To give a detailed knowledge about the counting Principle, Euclidean Rings and dual spaces.
2. To develop the concept of extension fields and algebra of linear transformations.

Unit I : Group Theory : Another Counting Principle - Sylow's Theorem – Finite Abelian Groups.

Unit II: Ring Theory : Polynomial Rings - Polynomials over the Rational Field Polynomial Rings over Commutative Rings.

Unit III: Vector Spaces and Modules : Dual Spaces - Inner Product Spaces – Modules.

Unit IV: Fields : Extension Fields - Roots of Polynomials - More About Roots.

Unit V: Linear Transformations : The Algebra of Linear Transformations – Characteristic Roots – Matrices - Canonical Forms : Triangular Form, Jordan Form and Real Quadratic Forms..

Text Book: "Topics in Algebra" by I.N.Herstein, II Edition*, **Reprint 2016,*** John Wiley & Sons.

Unit I : Chapter 2 - Sections 2.11, 2.12 & 2.14

Unit II : Chapter 3 - Sections 3.9 to 3.11

Unit III : Chapter 4 - Sections 4.3 to 4.5

Unit IV : Chapter 5 - Sections 5.1, 5.3 & 5.5

Unit V : Chapter 6 - Sections 6.1 to 6.4, 6.6 and 6.11.

Reference Books:

1. "Modern Algebra" by Surjeet Singh & Quasi Zameerudi.
2. "A First Course in Abstract Algebra" by J.B.Fraleigh Addison-Wesley Publishing Company 1970.

(For the candidates admitted from the academic year 2018 onwards)

CORE II : REAL ANALYSIS

Semester: I **Subject Code:**
Hours : 6 **Credits : 5**

Objectives:

1. To provide a comprehensive idea about the principles of real analysis.
2. To understand the concepts of Metric spaces, Differentiation and Riemann Steiltjes integrals.
3. To apply the above concepts to new situations.
4. To develop the right approach towards research in analysis.

Unit I : Basic Topology : Metric Spaces - Compact Sets.

Unit II: Continuity : Limits of functions-Continuous functions-Continuity and Compactness - Continuity and Connectedness.

Unit III: Differentiation : The derivative of a real function –Mean value theorems- The continuity of Derivatives - L'Hospital's Rule – Derivates of Higher Order – Taylor's theorem.

Unit IV: The Riemann-Stieltjes integral: Definition and Existence of the integral – Properties of the Integral - Integration and Differentiation.

Unit V : Sequences and series of functions: Discussion of the main problem Definition –Uniform Convergence – Uniform Convergence and Continuity – Uniform Convergence and Integration, Uniform Convergence and Differentiation.

Text Book: "Principles of Mathematical Analysis" by Walter Rudin, III Edition, **2013**, McGraw Hill Company, New York.

Unit I : Chapter 2 - Sections 2.15 to 2.42

Unit II : Chapter 4 - Sections 4.1 to 4.10, 4.13 to 4.19, 4.22 & 4.23

Unit III : Chapter 5 - Sections 5.1 to 5.15

Unit IV : Chapter 6 - Sections 6.1 to 6.17, 6.20 to 6.22

Unit V : Chapter 7 - Sections 7.1 to 7.13, 7.16 to 7.18

Reference Books:

1. "Mathematical Analysis" by Tom M.Apostol, Addison-Wesley Publishing company.
2. "Methods of Real Analysis" by Goldberg, Oxford and IBH Publishing company.

(For the candidates admitted from the academic year 2018 onwards)

CORE III : ORDINARY DIFFERENTIAL EQUATIONS

Semester: I **Subject Code:**

Hours : 6 **Credits : 4**

Objectives:

1. To learn various concepts in ordinary differential equations.
2. To increase their capability to perform better in UGC-CSIR/SLET examinations.

Unit I : Introduction-Linear equations of the first order :Linear equations of the first order – the equation y'+ay=0 – the equation y'+ay=b(x) – the general linear equation of the first order.

Linear equations with constant coefficients : Introduction- the second order homogeneous equation – initial value problems for second order equations – linear dependence and independence – a formula for the wronskian.

Unit II: Linear equations with constant coefficients : The non-homogeneous equation of order two - The homogeneous equation of order n – Initial value problems for n-th order equations – equations with real constants - a special method for solving the non-homogeneous equation.

Unit III : Linear equations with variable coefficients: Introduction – initial value problems for the homogenous equation – solutions of the homogeneous equation – the wronskian and linear independence - Homogeneous equations with analytic coefficients – the Legendre equation – justification of the power series method.

Unit IV : Linear equations with regular singular points : Introduction – The Euler equation – second order equation with regular singular points – an example - second order equation with regular singular points – the general case –the exceptional cases – the Bessel equation – the Bessel equation (contiued) – regular singular points at infinity.

Unit V : Existence and Uniqueness of Solutions to first order equations : Introduction – Equations with variables separated – exact equations – the method of successive approximations – the Lipchitz condition – Convergence of the successive approximations.

Text Book: "**An Introduction to Ordinary Differential Equations**",
by **Earl. A. Coddington**, PHI Learning Private Limited, 2012.

Unit I : Chapter 1 - Sections 1.4 to1.7
Chapter 2 - Sections 2.1 to 2.5

Unit II : Chapter 2 - Sections 2.6 to 2.9, 2.11

Unit III: Chapter 3 - Sections 3.1 to 3.9

Unit IV: Chapter 4 - Sections 4.1 to 4.4, 4.6 to 4.9

Unit V : Chapter 5 - Sections 5.1to 5.6.

(For the candidates admitted from the academic year 2018 onwards)

CORE IV : OPERATIONS RESEARCH AND PROBABILITY DISTRIBUTIONS

Semester: I **Subject Code:**
Hours : 6 **Credits: 4**
Objectives:

1. To acquire and develop knowledge in operations research.
2. To make students gain in- depth knowledge in probability and statistics
3. To learn about limiting distributions and central limit theorem.

Unit I : Integer Programming : Introduction – Gomory's mixed integer method – Branch and Bound method.

Unit II : Dynamic Programming : Introduction – Need of Dynamic Programming – Bellman's Principle of Optimality – Characteristics of Dynamic Programming problems – Applications of Dynamic Programming Problem – Solution of LPP by DPP – Solving a least cost route problem by DPP.

Unit III: Non- Linear Programming Algorithms : Unconstrained Algorithms – Direct search method – Gradient method- constrained Algorithms – Separable programming – Quadratic programming.

Unit IV: Distributions of Functions of Random Variables : The Gamma and Chi-Square Distributions - Sampling Theory – Transformations of Variables of the Discrete type – Transformations of Variables of the Continuous type- The t and F Distributions –The Moment–Generating function Technique.

Unit V: Limiting Distributions : Limiting Distributions – Stochastic Convergence – Limiting Moment – Generating Functions – The Central Limit Theorem – Some Theorems on Limiting Distributions.

Text Books:

1. **"Resource Management Techniques(Operations Research) by Prof. V. Sundaresan, K.S. Ganapathy Subramanian and K. Ganesan, 2011,** A.R. Publications.
   Unit I : Chapter 9
   Unit II : Chapter 10
2. **"Operations Research - An Introduction" by Hamdy A. Taha** , **Ninth Edition, Sixth Impression**, MacMillan Publishing Co.,
   Unit III: Chapter 21 - Sections 21.1 (21.1.1 and 21.1.2)
   Sections 21.2 (21.2.1 and 21.2.2).
3. **"Introduction to Mathematical Statistics" by Robert V.Hogg and Allen T.Craig, Fourth Edition**, MacMillan Publishing Co.
   Unit IV: Chapter 3 - Section 3.3
   Chapter 4 - Sections 4.1 to 4.4 and 4.7
   Unit V: Chapter 5 - Sections 5.1 to 5.5

Reference Books:

1."An Introduction to Probability Theory and Mathematical Statistics" by *V.K.Rohatgi,*Wiley Eastern Limited.

2."Probability and Statistics" by *KadarkkaraiThangam K. and Subas Chandra Bose,* A. Jeyalakshmi Publishers, Tuticorin.

(For the candidates admitted from the academic year 2018 onwards)

CORE V: NUMERICAL ANALYSIS

Semester: I **Subject Code:**
Hours : 6 **Credits: 4**

Objective:

1. To develop skills in the concepts related to polynomials, matrices, interpolation, initial value problems
2. To give a strong base to take up advanced level courses in numerical analysis.

UNIT I : Trancendental and Polynomial Equations : Iteration method based on Second degree equations –Muller method – Chebyshev Method – Multipoint Iteration Methods – Polynomial Equations – BirgeVieta Method – Baristow Method – Direct Method – Graeffe's root Squaring Method.

UNIT II : System of Linear Algebraic Equations and Eigen value Problems : Iteration Methods - Jacobi Iteration Method - Gauss Seidel Iteration Method - Successive Over Relaxation (SOR) Method – Convergence Analysis of Iterative Methods – Optimal Relaxation Parameter for the SOR Method – Iterative Method for A^{-1} — Jacobi Method for symmetric Matrices - Power Method.

UNIT III : Interpolation and Approximation : Introduction – Hermite Interpolation – Piecewise and Spline interpolation – Bivariate interpolation – Lagrange and Newton's Bivariate interpolation – Approximation.

UNIT IV : Differentiation and Integration: Numerical Differentiation – Methods Based on Interpolation – Methods Based on Undetermined Coefficients – Numerical Integration – Methods Based on Interpolation – Methods Based on Undetermined Coefficients – Gauss Quadrature methods - Gauss Legendre and Gauss Chebyshev Integration Methods.

UNIT V: Ordinary Differential Equations: Initial Value Problems : Numerical Methods – Local Truncation Error – Euler Method – Backward Euler Method – Mid-Point Method – Taylor Series Method – Second order Runge-Kutta Methods – Stability Analysis of Euler, Backward Euler and Runge-Kutta Second Order Methods.

Text Book: "Numerical Methods for Scientific and Engineering Computation" by M.K. Jain, S.R.K. Iyengar, R.K. Jain, , Fifth Edition (2007).

UNIT I : Chapter II - Sections 2.4, 2.9
UNIT II : Chapter III - Sections 3.4, 3.7, 3.11
UNIT III : Chapter IV - Sections 4.1, 4.5, 4.6, 4.7, 4.8
UNIT IV : Chapter V - Sections 5.2, 5.6, 5.7, 5.8
UNIT V : Chapter VI - Sections 6.3, 6.4, 6.5

REFERENCES

1. Numerical Solution of Differential Equations, M.K. Jain, Third Edition, New Age International Pvt Ltd., 2014.

2. Elementary Numerical Analysis , Samuel. D. Conte, Carl. De Boor, , McGraw-Hill International Edn., 1983.

(For the candidates admitted from the academic year 2018 onwards)

CORE VI : COMPLEX ANALYSIS

Semester: II **Subject Code:**
Hours : 6 **Credits : 5**

Objectives:

1. To understand analytic functions, Cauchy's theorems and Residue theory and solve problems in these areas.

2. To know about Harmonic and entire Functions.

Unit I: Fundamental Theorems : Line Integrals - Rectifiable Arcs – Line Integrals as Functions of Arcs – Cauchys' theorem for a Rectangle, Cauchys' theorem in a Disk

Cauchy's Integral Formula : Index of a point with respect to a closed curve – Integral Formula – Higher Derivatives

Unit II : Local Properties of Analytic Functions : Removable Singularities – Zeros and Poles – The Local mapping - The Maximum Principle.

The General form of Cauchy's Theorem: Chains and Cycles – simple connectivity- homology

Unit III: 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

Unit IV: Harmonic Functions : Definition and Basic Properties – Mean Value Property – Poisson's Formula – Schwarz's Theorem – the reflection Principle

Unit V: Partial Fractions and Factorization : Partial Fractions - Infinite Products – Canonical Products – The Gamma function- Stirling's formula.

Entire Functions: Jensen's formula – Hadamard's Theorem.

Text Book: "Complex Analysis" by L.V.Ahlfors, III Edition, 2014 (Fourth Reprint) ISE McGraw – Hill Publishing Company Limited.

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Unit I : Chapter 4 - Sections 1.1 to 1.5, Sections 2.1 to 2.3
Unit II : Chapter 4 - Sections 3.1 to 3.4, 4.1 to 4.3
Unit III : Chapter 4 - Sections 4.4 to 4.7, Sections 5.1 to 5.2
Unit IV : Chapter 4 - Sections 6.1 to 6.5
Unit V : Chapter 5 - Sections 2.1 to 2.5, 3.1 to 3.2

Reference Books:

1. "Analysis of Functions" Vol. I & II by E.Hille
2. "Functions of One Complex Variable" by J.B.Conway.
3. "Complex Analysis" by Nevellina & Parto

(For the candidates admitted from the academic year 2018 onwards)

CORE VII: ADVANCED GRAPH THEORY

Semester :II **Subject Code:**
Hours : 6 **Credits :5**

Objectives :

1. To enable the students to formulate real life problems into graph theoretic models.
2. To acquire knowledge in the topics of research.
3. To understand the different types of digraphs.

Unit I: Graphs and Subgraphs: Paths and connection – cycles – The shortest path problem.
Trees: Trees – Cut Edges and Bonds – Cut vertices – Cayley 's Formula.

Unit II: Connectivity: Connectivity – Blocks.
Euler Tours And Hamilton Cycles : Euler tours – Hamilton cycles.

Unit III: Matchings: Matchings –Matchings and Coverings in Bipartite Graphs – Perfect Matchings.
Edge Colourings: Edge Chromatic Number – Vizing's Theorem.

Unit IV: Vertex Colourings : Chromatic Number – Brooks' Theorem – Hajos' Conjecture – Chromatic Polynomials.
Planar Graphs: Plane and Planar Graphs –Euler's Formula.

Unit V: Kuratowski 's Theorem – The Five Colour Theorem and Four Colour Conjecture.
Directed Graphs: Directed graphs – Directed Paths – Directed Cycles.

Text Book: J.A. Bondy And U.S.R. Murty, Graph Theory with Applications, 1976, The MacMillan Press Ltd.

Unit I : Chapter 1 - Sections 1.6 to 1.8
Chapter 2 - Sections 2.1 to 2.4
Unit II : Chapter 3 - Sections 3.1, 3.2
Chapter 4 - Sections 4.1, 4.2
Unit III: Chapter 5 - Sections 5.1 to 5.3
Chapter 6 - Sections 6.1, 6.2
Unit IV: Chapter 8 - Sections 8.1 to 8.4
Chapter 9 - Sections 9.1 and 9.3
Unit V: Chapter 9 - Sections 9.5, 9.6
Chapter 10 - Sections 10.1 to 10.3

References :

1. **"A Text Book of Graph Theory" by R. Balakrishnan and K.Ranganathan,** Springer International Edition, New Delhi**, 2008.**
2. **"Graph Theory" by F. Harary,** Narosa Publishing House, New Delhi, **1988.**

(For the candidates admitted from the academic year 2018 onwards)

CORE VIII : NUMBER THEORY

Semester: II **Subject Code:**
Hours : 6 **Credits: 5**

Objectives:

1. To know about Congruence's, Quadratic residues and partition generating function.
2. To enjoy the technique of the proof of some beautiful results like Mobius Inversion forumula, Euler's partition theorem etc.,
3. To motivate the students towards research in number theory

Unit I: Fundamentals of Congruence's: Basic properties of congruence's – Residue Systems – Riffling.
Solving Congruence's: Linear congruence's – The theorems of Fermat and Wilson revisited – The Chinese Remainder theorem – Polynomial Congruence's.

Unit II: Arithmetic Functions: Combinatorial study of $\phi(n)$ – Formulae for $d(n)$ and $\sigma(n)$ – Multiplicative Arithmetic functions – The Mobius Inversion formula.
Primitive Roots: Properties of reduced Residue Systems – Primitive roots Modulo p.

Unit III: Quadratic Residues: Euler's Criterion – The Legendre symbol – The Quadratic reciprocity law – Applications of the Quadratic reciprocity law.
Distribution of Quadratic residues: consecutive Residues and non-residues – Consecutive Triples of Quadratic Residues.

Unit IV: Sums of Squares: Sums of two squares – Sums of Four Squares.
Elementary Partition Theory: Introduction – Graphical representation – Euler's partition theorem.

Unit V: Partition Generating Functions: Infinite Products as Generating functions – Identities between Infinite series and products.
Partition Identities: History and Introduction – Euler's Pentagonal Number Theorem – The Roger's Ramanujan Identities.

Text Book: "Number Theory" by E. Andrews, Edition 1984, Hindustan Publishing Corporation, New Delhi.

Unit I : Chapters 4 & 5

Unit II : Chapters 6 & 7

Unit III : Chapters 9 & 10

Unit IV : Chapters 11 & 12 (Omit 12.4)

Unit V : Chapters 13 & 14 (Omit 14.4 & 14.5)

(For the candidates admitted from the academic year 2018 onwards)

CORE IX : PARTIAL DIFFERENTIAL EQUATIONS

Semester: II **Subject Code:**
Hours : 6 **Credits : 4**

Objectives:

1. Learn various concepts in partial differential equations.
2. Increase their capability to perform better in UGC-CSIR/SLET examinations.

Unit I: **Partial differential equations of the first order**: 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 – Nonlinear partial differential equations of the first order.

Unit II: Cauchy's method of characteristics – compatible systems of first-order equations – Charpit's method – Jocobi' method – applications of first-order equations.

Partial differential equations of the second order : the origin of second order equations – second order equations in physics – linear partial differential equations with constant coefficients – equations with variable coefficients - characteristic curves of second order equations.

Unit III: The solution of linear hyperbolic equations – separation of variables – Nonlinear equations of the second order .

Laplace's equation : The occurrence of Laplace's equation in physics – elementary solutions of Laplace's equation – families of equipotential surfaces.

Unit IV: Boundary value problems – separation of variables – problems with axial symmetry – Kelvin's inversion theorem - the theory of Green' function for Laplace's equation – the two-dimensional Laplace equation – Green's function for the two-dimensional equation.

Unit V: **The wave equation**: The occurrence of the wave equation in physics – elementary solutions of the one-dimensional wave equation – general solution of the wave equation – Green's function for the wave equation.

The diffusion equation: The occurrence of the diffusion equation in physics – elementary solutions of the diffusion equation – separation of variables – the use of Green's functions.

Text Book: "Elements of Partial Differential Equations",by Ian Sneedon,
Mcgraw-Hill International Editions, **1985**

Unit I: Chapter 2 - Sections 2.1 to 2.7
Unit II: Chapter 2 - Sections 2.8 to 2.10, 2.13 to 2.14
Chapter 3 - Sections 3.1,3.2, 3.4 to 3.6
Unit III: Chapter 3 - Sections 3.8,3.9 and 3.11
Chapter 4 - Sections 4.1 to 4.3
Unit IV: Chapter 4 - Sections 4.4 to 4.8, 4.11,4.13
Unit V: Chapter 5 - Sections 5.1, 5.2, 5.6, 5.7
Chapter 6 - Sections 6.1,6.3 to 6.4, 6.6.

(For the candidates from the academic year 2018 onwards)

CORE X : PRACTICAL I – C++ PROGRAMMING LAB

Semester : II **Subject code :**
Hours : 6 **Credits : 4**

Objectives :

1. To develop a computer code for a given mathematical problem.
2. To develop independent programming skills.
3. To introduce programming language.

Programs :

1. To find the simple interest using functions in C++.
2. To find the sum of the digits of a given number using classes.
3. Inversion of a non-singular square matrix using arrays of objects.
4. To find the area and volume using function overloading.
5. To find the sum of two complex numbers using operator overloading.
6. To generate the result of students using Inheritance.
7. To create stock data using files.
8. To solve a system of linear equations by Gauss Elimination method.
9. To solve the initial value problems by Runge Kutta's second order method.
10. To solve the Boundary value problems by Shooting method.

Internal : 40 Marks		**External : 60 Marks**	
Continuous performance	: 15 Marks	Program	: 30 Marks
Model Examination	: 10 Marks	Output	: 20 Marks
Attendance	: 5 Marks	Viva	: 10 Marks
Record	: 10 Marks		
Total	: 40 Marks	Total	: 60 Marks

(For the candidates admitted from the academic year 2018 onwards)

CORE XI : TOPOLOGY

Semester: III **Subject Code:**
Hours : 6 **Credits: 5**

Objectives:

1. To understand the concepts of various terms involved in Topology.
2. To introduce various spaces namely complete metric spaces, compact, connected, regular spaces and their properties.
3. To solve problems in these areas.
4. To participate in various competitive examinations.

Unit I : Topological Spaces : Topological spaces – Basis for a topology – The order topology – The product topology on XxY – The subspace topology.

Unit II : Continuous Functions : Closed sets and limit points – Continuous functions – The product topology.

Unit III: The metric topology.

Connectedness and Compactness: Connected spaces - Compact spaces.

Unit IV: Countability And Separation Axioms: The countability axioms – The Separation axioms – The Urysohn's Lemma.

Unit V : The Tychonoff Theorem : The Tychonoff Theorem.

Complete Metrics Spaces : Complete metric spaces – Compactness in metric spaces.

Text Book: "Topology " by James R. Munkres, Second Edition, **2013,** PHI Private Ltd. New Delhi.

Unit I : Chapter 2 - Sections 12 to 16.

Unit II : Chapter 2 - Sections 17 to 19.

Unit III : Chapter 2 - Sections 20;
Chapter 3 - Sections 23 & 26.

Unit IV : Chapter 4 - Sections 30, 31 & 33.

Unit V : Chapter 5 - Section 37
Chapter 7 - Sections 43 & 45.

Reference Book:

1. "Introduction to Topology and Modern Analysis" by G.F.Simmons, Tata McGraw Hill Edition 2009.

(For the candidates from the academic year 2018 onwards)

CORE XII: MEASURE THEORY AND INTEGRATION

Semester : III **Subject Code:**
Hours : 6 **Credits : 5**

Objectives:

1. To provide a concrete knowledge in measure theory and an ability to apply them.
2. To study measure theory for real line and generalize them for general measure spaces.

Unit I: **Measure on the Real Line :** Lebesgue Outer Measure – Measurable Sets – Regularity - Measurable Functions.

Unit II: **Integration of Functions of a Real variable :** Integration of Non-negative Functions – The General Integral – Integration of Series - Riemann and Lebesgue Integrals.

Unit III: **Abstract Measure Spaces :** Measures and Outer Measures – Extension of a Measure – Uniqueness of the Extension – Completion of a Measure.

Unit IV: Measure Spaces – Integration with respect to a Measure
Signed Measures and their Derivatives : Signed Measures and Hahn Decomposition – The Jordan Decomposition.

Unit V: **Measure and Integration in a Product Space :** Measurability in a product space – The product measure and Fubini's Theorem.

Text Book: "Measure Theory and Integration" by G. de Barra, Second Edition, 2013, New Age International publishers, New Delhi.

Unit I : Chapter 2 - Sections 2.1 to 2.4

Unit II : Chapter 3 - Sections 3.1 to 3.4

Unit III : Chapter 5 - Sections 5.1 to 5.4

Unit IV : Chapter 5 - Sections 5.5 & 5.6
Chapter 8 - Sections 8.1 & 8.2

Unit V : Chapter 10 - Sections 10.1 & 10.2

Reference Books:

1. "Real Analysis" by Royden H.L., Second Edition, Macmillan. 1968
2. "Principles of Mathematical Analysis" by Rudin.W., Third edition, McGraw–Hill, NewYork, 1976.

(For the candidates from the academic year 2018 onwards)

CORE XIII: PRACTICAL II - Scilab

Semester: III **Subject Code:**
Hours : 6 **Credits : 5**

Objectives:

1. To apply computer theory and algorithmic aspects in various situations.
2. To design and debug the programs.
3. To develop independent program skills.

LIST OF PRACTICALS

1. Matrix Manipulations.
2. Solution of a Quadratic Equation.
3. Solution of a system of linear equations using Matrix Inversion Method.
4. Solution of a system of linear equations using Gauss Jordan Method.
5. Drawing 2D graphs and 3D graphs.
6. Solution of an algebraic equation using Bisection Method.
7. Solution of an algebraic equation using Newton-Raphson Method.
8. Evaluation of an integral using Trapezoidal Rule.
9. Evaluation of an integral using Simpson's 1/3 Rule.
10. Solving Initial Value Problems.

Internal : 40 Marks		**External : 60 Marks**	
Continuous performance	: 15 Marks	Program	: 30 Marks
Model Examination	: 10 Marks	Output	: 20 Marks
Attendance	: 5 Marks	Viva	: 10 Marks
Record	: 10 Marks		
	Total : 40 Marks	Total	: 60 Marks

(For the candidate admitted from academic year 2018 onwards)

CORE BASED ELECTIVE I : STOCHASTIC PROCESSES

Semester: III **Subject Code:**
Hours : 6 **Credit : 4**

Objectives

1. To study the renewal process and related results and their application by introducing the concept of Markov chains and their properties

Unit I: Stochastic processes: An Introduction **-** Specification of Stochastic Processes.
Markov Chains: Definitions and Examples – Higher Transition probabilities.

Unit II: Classification of States and Chains – Determination of Higher Transition probabilities – Stability of a Markov System – Graph Theoretic Approach

Unit III: Markov processes with Discrete state space: Interarrival Time - Pure birth process – Birth immigration process – Time-dependent Poisson processes.

Unit IV: Birth and Death process.
Renewal Processes and Theory : Renewal processes in continuous time – Renewal equation

Unit V: Stopping time - Wald's equation – Renewal Theorems - Elementary Renewal Theorem – Applications – Renewal theorems (Blackwell's and Smith's).

Text Book: 1.''Stochastic Processes'' by J.Medhi, **Third Edition, Reprint 2013,** New Age International (P) Limited.

Unit I : Chapter 1 - Section 1.5, Chapter 2 - Sections 2.1 and 2.2

Unit II : Chapter 2 - Sections 2.4 to 2.7

Unit III : Chapter 3 - Sections 3.2(3.2.1), 3.3 (3.3.3, 3.3.4 and 3.3.5)

Unit IV : Chapter 3 - Sections: 3.4
Chapter 6 - Sections: 6.2 and 6.3

Unit V : Chapter 6 - Sections: 6.4 (6.4.1 and 6.4.2), 6.5 (6.5.1, 6.5.2 and 6.5.4)

(For the candidates admitted from the academic year 2018 onwards)

CORE BASED ELECTIVE II : CLASSICAL DYNAMICS

Semester : III **Subject Code:**
Hours : 6 **Credits: 4**

Objectives:

1. To learn various concepts in classical dynamics.
2. To understand the Lagrange's function of classical dynamics and its applications.
3. To acquire and develop knowledge in applied mathematics.
4. To Increase the capability to perform better in UGC, CSIR, and SLET.

Unit I: Introductory Concepts: The Mechanical System – Generalised co-ordinates – Constraints – Virtual Work – Energy and Momentum.

Unit II: Lagrange's Equations: Derivation of Lagrange's Equations – Examples – Integrals of the Motion.

Unit III: Hamilton's Equations: Hamilton's Principle – Hamilton's Equations – Other Variational Principles.

Unit IV: Hamilton-Jacobi Theory: Hamilton's Principal Function – The Hamilton - Jacobi Equation.

Unit V: Canonical Transformations: Differential Forms and Generating Functions – Special Transformations.

Text Book: Content and treatment as in **"Classical Dynamics" by Donald T. Greenwood**, **Edition 1997,** Dover Publications, Inc. New York.

Unit I : Chapter 1 - Sections 1.1 to 1.5

Unit II : Chapter 2 - Sections 2.1 to 2.3

Unit III : Chapter 4 - Sections 4.1 to 4.3

Unit IV : Chapter 5 - Sections 5.1 & 5.2

Unit V : Chapter 6 - Sections 6.1 & 6.2

(For the candidates admitted from the academic year 2018 onwards)

CORE XIV : FUNCTIONAL ANALYSIS

Semester: IV **Subject Code:**
Hours : 6 **Credits: 5**

Objectives:

1. To understand the basic concepts and theorems in functional analysis.
2. To know the concepts of Banach Spaces, Hilbert Spaces and Bounded linear functional.
3. To acquire knowledge in operator theory and projections for the above spaces.
4. To develop right approach towards research in Functional Analysis.

Unit I : Banach Spaces: The definition and some examples – Continuous linear transformations – The Hahn-Banach Theorem.

Unit II : The natural imbedding of N in N** - The Open Mapping Theorem – The conjugate of an operator.

Unit III : Hilbert Spaces: The definition and some simple properties – Orthogonal complements – Orthonormal sets - The conjugate space H*.

Unit IV : The adjoint of an operator – Self-adjoint operators – Normal and **Unit**ary Operators – Projections.

Unit V : General Preliminaries on Banach Algebras: The definition and some examples – Regular and singular elements – Topological divisors of zero – The spectrum – The formula for the spectral radius – The radical and semi-simplicity.

Text Book: "Introduction to Topology and Modern Analysis", G. F. Simmons, **Edition 2004,** Tata McGraw-Hill Publishing Company Ltd., New Delhi.

Unit I : Chapter 9 - Sections 46 to 48

Unit II : Chapter 9 - Sections 49 to 51

Unit III : Chapter 10 - Sections 52 to 55

Unit IV : Chapter 10 - Sections 56 to 59

Unit V : Chapter 12 - Sections 64 to 69

(For the candidates from the academic year 2018 onwards)

CORE XV : DIFFERENTIAL GEOMETRY

Semester: IV **Subject Code:**
Hours : 6 **Credits: 5**

Objectives:

1. To help the students to understand the use of differential calculus in the field of genetics.
2. To help the students to distinguish between plane curves and space curves using differentiations.

Unit I: **Theory of Space curves:** Definitions – Arc length-Tangent,Normal and binormal – Osculating Plane – Curvature – Torsion – Serret – Frenet formulae.

Unit II: Contact between curves and surfaces – Tangent surface, involutes and evolutes – Intrinsic equations, fundamental existence theorem for space curves – Helices.

Unit III: **The metric : Local Intrinsic properties of a surface:** Metric – Direction coefficients – Families of Curves – Isometric correspondence – Intrinsic properties.

Unit IV: Geodesics – Canonical geodesic equations – Normal property of geodesics – Existence theorems – Geodesic parallels.

Unit V: **The Second Fundamental form : Local Non – Intrinsic properties of a surface:** The second fundamental form – Principal curvatures – Lines of curvature – Developables – developables associated with space curves, developables associated with curves on Surfaces – Minimal surfaces.

Text Book: "An Introduction to Differential Geometry" by .J.Willmore, 2011 (Indian Print),Oxford University press(27th impression), New Delhi.

Unit I : Chapter I - Sections 2 to 4

Unit II : Chapter I - Sections 6 to 9

Unit III : Chapter II - Sections 5 to 9

Unit IV : Chapter II - Sections 10 to 14

Unit V : Chapter III - Sections 1 to 7

Reference Books:

1. "Differential Geometry A first course" by D.Somasundaram, , Narosa Publishing House 2005.
2. "Lectures On Classical Differential Geometry" by Dirk J.Struick, , Addison – Wesley publishing company, 2nd Edition.

(For the candidates admitted from the academic year 2018 onwards)

CORE BASED ELECTIVE III : FLUID DYNAMICS

Semester : IV **Subject Code:**

Hours : 6 **Credits: 4**

Objectives:

1. To introduce basic ideas of fluid velocity, streamlines, vortex motion, rotational and irrotational flows.
2. To understand the general analysis and treatment of fluids in motion. Special mathematical methods involving complex variables are treated.

Unit I: **Kinematics of fluids in motion:** Real fluids and Ideal fluids – Velocity of a fluid at a point – streamlines and Pathlines - The Velocity potential – The Vorticity vector – Local and particle rates of change – The equation of Continuity – Worked examples.

Unit II: Equations of motion of a fluid: Pressure at a point in a fluid at rest – Pressure at a point in a moving fluid – Conditions at a Boundary of Two invisicid Immisscible fluids – Euler's equations of motion – Bernoulli's equation – Worked examples – Discussion of the case of Steady Motion under Conservative Body forces.

Unit III:Some flows involving axial symmetry.

Some three dimensional flows: Sources, sinks and doublets – Images in a rigid infinite plane – Images in Solid spheres.

Unit IV: **Some two dimensional flows:** Meaning of Two-Dimensional flow – Use of Cylindrical polar coordinates – The stream function – The complex potential for two dimensional, irrotational, incompressible flow – Complex velocity potentials for standard two dimensional flows – Some worked examples.

Unit V: Two dimensional image systems – The Milne-Thomson circle theorem – The theorem of Blasius.

Viscous flow: Stress Components in a Real Fluid – Relations between Cartesian components of stress – Translational Motion of Fluid element – The Coefficient of Viscosity and Laminar Flow – The Navier-Stokes equations of Motion of a Viscous Fluid – Steady motion between parallel planes.

Text Book : "Text book of Fluid Dynamics" by Chorlton.F, First Edition, 1985, CBS Publishers Distributors, New Delhi.

Unit I : Chapter 2 - Sections 2.1 to 2.8
Unit II : Chapter 3 - Sections 3.1 to 3.7
Unit III : Chapter 3 - Section 3.9
Chapter 4 - Section 4.2 to 4.4
Unit IV : Chapter 5 - Section 5.1 to 5.6
Unit V : Chapter 5 - Section 5.7 to 5.9
Chapter 8 - Section 8.1 to 8.3, 8.8, 8.9 & 8.10.1

Reference Book:

1. "Boundary Layer Theory" by H. Schlichting, McGraw Hill Company, New York, 1979.

(For the candidates from the academic year 2018 onwards)

CORE BASED ELECTIVE IV: CALCULUS OF VARIATIONS AND INTEGRAL EQUATIONS

Semester : IV **Subject Code:**
Hours : 6 **Credits : 5**

Objectives:

1. To solve differential equations using variational methods.
2. To introduce Fredhlom & Volterra Integral equations and to study the methods of solving the above equations.
3. To introduce Fourier transform.

Unit I : **Calculus of Variations and Applications:** Maxima and Minima – The Simplest Case – Illustrative examples – Natural Boundary Condtions and Transition Conditions – The Variational Notation – The more general case – Constraints and Lagrange multipliers – Variable end points – Sturm – Liouville Problems.

Unit II: Hamilton's Principles – Lagranges equations - Generalized dynamical entities – Constraints in dyanamical systems – Small Vibrations about equilibrium, Normal coordinates – Numerical Example – Rayleigh Ritz method.

Unit III: **Integral equations:** Introduction - Relations between differential and integral Equations - The Green's function.

Unit IV: Fredholm equations with separable kernals - Illustrative example - Hilbert-Schmidt Theory - Iterative methods for solving equations of the second kind.

Unit V: The Neumann series - Fredholm theory-Singular integral equations - Special Devices - Iterative approximation to characteristic functions.

Text Books:

1. **"Methods Of Applied Mathematics" by Francis B. Hildebrand, Second edition, 1992,** Prentice-Hall of India Private Limited, New Delhi.

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Unit I : Chapter 2 - Sections 2.1 to 2.9
Unit II : Chapter 2 - Sections 2.10 to 2.15 and 2.19
Unit III : Chapter 3 - Sections 3.1 to 3.3
Unit IV : Chapter 3 - Sections 3.6 to 3.9
Unit V : Chapter 3 - Sections 3.10 to 3.14

(For the candidates admitted from the academic year 2018 onwards)

CORE BASED ELECTIVE : DISCRETE MATHEMATICS

Semester: **Subject Code:**
Hours : 6 **Credits : 4**

Objectives:

1. To know the concepts needed to test the logic of a program
2. To gain knowledge about application in expert systems and database.

Unit I : Computability and Formal Languages : Russell's Paradox and Non computability - Ordered Sets – Languages – Phrase Structure Grammars – Types of Grammars and Languages.

Unit II : Finite State Machines : Finite State Machine as Models of Physical Systems – Equivalent Machines.

Unit III: Finite State Machines as Language Recognizers – Finite State Languages and Type – 3 Languages.

Unit IV: Discrete Numeric Functions and Generating Functions : Introduction Manipulation of Numeric Functions Asymptotic Behavior of Numeric Functions.

Unit V: Recurrence Relations and Recursive Algorithms : Introduction – Recurrence Relations – Linear Recurrence Relations with Constant Coefficients – Homogeneous Solutions – Particular Solutions – Total Solutions – Solutions by the Method of Generating Functions.

Text Book: "Elements of Discrete Mathematics " by C.L.Liu, Second Edition, 2000, Tata McGraw – Hill Publishing Company Limited, New Delhi.

Unit I : Chapter 2 - Section 2.2 to 2.6

Unit II : Chapter 7 - Section 7.2 to 7.4

Unit III : Chapter 7 - Section 7.5 to 7.6

Unit IV : Chapter 9 - Section 9.1 to 9.3

Unit V : Chapter 10 - Section 10.1 to 10.7

(For the candidates admitted from the academic year 2018 onwards)

CORE BASED ELECTIVE : FUZZY SET THEORY

Semester: **Subject Code:**

Hours: 6 **Credits: 4**

Objectives:

1. To learn the basic concepts of fuzzy set theory
2. To link the crisp sets with fuzzy set theory and know how and where these two theories concur as well as differ.

Unit I **:** **Fuzzy Set Theory:** Concept of a Fuzzy Set – Relations between Fuzzy Sets – Operations on Fuzzy Sets - Properties of the Standard Operations – Certain Numbers Associated with a Fuzzy Set – Certain Crisp Sets Associated with a Fuzzy Set – Certain Fuzzy Sets Associated with a Given Fuzzy Set – Extension Principle.

Unit II: **More Concepts Of Fuzzy Sets:** Index of Fuzziness – Remarks on Extension Principle – Fuzzy Sets of Type –K and Level-K – Non Standard Operations on Fuzzy Sets - Generation of Membership Functions.

Unit III: **Fuzzy Relations:** Introduction - Fuzzy Relations – Operations on Fuzzy Relations – α –Cuts of a Fuzzy Relations - Compositions of Fuzzy Relations - Projections of Fuzzy Relations – Cylindric Extensions – Cylindric Closure - Fuzzy Relation on a Domain.

Unit IV: **Fuzzy Logic:** Introduction - Three -valued Logics – N-valued Logics for $N \geq 4$ – Infinite – valued Logics – Fuzzy Logics – Fuzzy Propositions and Their Interpretations in Terms of Fuzzy Sets – Fuzzy Rules and Their Interpretations in Terms of Fuzzy Relations – Fuzzy Inference or Approximate Reasoning – More on Fuzzy Inference - Generalizations of Fuzzy Logics.

Unit V: **Fuzzy Analysis:** Fuzzy Functions on Fuzzy Sets- Extrema of Fuzzy Functions –Integration of Fuzzy Functions – Integration of a Fuzzy Function over a Crisp Interval - Integration of Real-Valued Function over a Fuzzy Interval – Fuzzy Differentiation.

Text Books:

1. **"Introduction to Fuzzy Sets And Fuzzy Logic" by M.Ganesh, 2012** PHI Learning Private Limited, New Delhi**.**
   Unit I : Chapter 6 - Sections 6.2 to 6.9
   Unit II : Chapter 6 - Annexure 6.1 to 6.5
   Unit III : Chapter 7 - Sections 7.1 to 7.9
   Unit IV : Chapter 8 - Sections 8.1 to 8.10
2. **"Fuzzy Set Theory And Its Applications" by H.J . Zimmermann, Fourth Edition, 2006, Springer**, New Delhi.
   Unit V: Chapter 7 - Sections 7.1 to 7.4

Reference Books:

1. "Introduction to the theory of fuzzy subsets" by Kaufmann.A. Vol.1,Academic Press,NewYork,1975.
2. "Fuzzy sets and Fuzzy Logic: Theory and Applications" by Klir .G.J. and B. Yuan, Prentice Hall , Upper Saddle River, N.J.,1995.

(For the candidates from the academic year 2018 onwards)
CORE BASED ELECTIVE : INTEGRAL EQUATIONS AND TRANSFORMS

Semester : **Subject Code:**
Hours : 6 **Credits : 4**
Objectives:

4. To solve differential equations using variational methods.
5. To introduce Fredhlom & Volterra Integral equations and to study the methods of solving the above equations.
6. To introduce Fourier transform

Unit I: **Integral equations:** Introduction - Relations between differential and integral Equations - The Green's function.

Unit II: Fredholm equations with separable kernals - Illustrative example - Hilbert-Schmidt Theory - Iterative methods for solving equations of the second kind.

Unit III: The Neumann series - Fredholm theory-Singular integral equations - Special Devices - Iterative approximation to characteristic functions.

Unit IV: **Fourier Transforms:** Fourier Integral formula - Complex Fourier Transform - Inversion Theorem for complex Fourier transform - Fourier sine transform - Inversion formula for Fourier sine transform - Fourier cosine transform - Inversion formula for Fourier cosine transform - Linearity property of Fourier transform-Change of scale property - Shifting property-Modulation theorem.

Unit V: **Finite Fourier Transforms:** Finite Fourier sine transforms - Inversion formula for sine Transform - Finite Fourier cosine transform- Inversion formula for cosine transform.

Text Books:

2. **"Methods Of Applied Mathematics" by Francis B. Hildebrand, Second edition, 1992,** Prentice-Hall of India Private Limited, New Delhi.

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   Unit I : Chapter 3 - Sections 3.1 to 3.3

   Unit II : Chapter 3 - Sections 3.6 to 3.9

   Unit III : Chapter 3 - Sections 3.10 to 3.14

2. **"Integral Transforms" by Vasishtha Gupta,** Krishna Prakashan Media (P) Ltd., Meerut.

   Unit IV : Chapter 6 - Sections 6.3 to 6.13

   Unit V : Chapter 7 - Sections 7.1 to 7.4