JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTAPUR

Course Structure and Syllabi for Pre Ph.D
MATHEMATICS (2009-10)

PART - I
Choose any **one** subject of the following

S. NO.	PAPER	PAPER CODE
1	**Topics in Analysis**	**09PH54101**
2	**Mathematical Methods**	**09PH54102**

PART - II
Choose any **one** subject of the following

S. NO	PAPER	PAPER CODE
1	**Advanced Topics in Differential Equations**	**09PH54201**
2	**Analytical Number Theory**	**09PH54202**
3	**Discrete Mathematics and Graph Theory**	**09PH54203**
4	**Applied Algebra**	**09PH54204**
5	**Fluid Mechanics**	**09PH54205**
6	**Mathematical Modeling**	**09PH54206**
7	**Operations Research**	**09PH54207**
8	**Discrete Dynamical Systems**	**09PH54208**
9	**Reliability**	**09PH54209**
10	**Number Theory and Cryptology**	**09PH54210**
11	**Complex Analysis**	**09PH54211**

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Pre-Ph.D MATHEMATICS

(09PH54101) TOPICS IN ANALYSIS

UNIT – I

Abstract Integration: Set-theoretic notations and terminology – The concept of measurability – Simple functions – Elementary properties of measures – Arithmetic in $[0, \infty]$ – Integration of positive functions – Integrations of complex functions – The role played by sets of measure zero

UNIT – II

Positive Borel Measures: Vector spaces – Topological preliminaries – the Riesz representation theorem – Regularity properties of Borel measures – Lebesgue measure – Continuity properties of measurable functions.

UNIT – III

L^p-Spaces: Convex functions and inequalities – The L^p-spaces – Approximation by continuous functions.

UNIT - IV

Elementary Hilbert Space Theory: Inner products and linear functionals – Orthonormal sets – Trigonometric series.

UNIT - V

Examples of Banach Space Techniques: Banach spaces – Consequences of Baire's theorem – Fourier series of continuous functions – Fourier coefficients of L^1 – functions – The Hahn-Banach theorem – An abstract approach to the Poisson integral.

UNIT – VI

Approximation by Rational Functions: Preparation – Runge's theorem – The Mittag-Leffler theorem – Simply connected regions

UNIT-VII

Zeros of Holomorphic Functions: .Infinite products – The Weierstrass factorization theorem – An interpolation problem – Jensen's formula – Blaschke products – The Muntz-Szasz theorem

UNIT-VIII

Analytic continuation: Regular points and singular points – Continuation along curves – The monodromy theorem – Construction of a modular function – The Picard theorem

References:

1. **Walter Rudin, Real & Complex Analysis**, Third Edition, Tata McGraw-Hill Edition (Chapters 1, 2, 3, 4, 5, 13, 15 and 16)

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Pre-Ph.D MATHEMATICS

(09PH54102)MATHEMATICAL METHODS

UNIT – I

Harmonic Functions: Basic properties of harmonic functions – Harmonic functions on a disk – sub harmonic and super harmonic functions – the Dirichlet problem – Green's functions

UNIT - II

Entire Functions: Jonsen's Formula – The genus and order of oan entire function – Hadamard factorization theorem Steady Temperatures. Steady Temperatures in a Half Plane. A Related problem. Temperatures in a Quadrant with part of One Boundary Insulated. Electrostatic Potential. Potential in a Cylindrical space. Two-dimensional Fluid Flow. The stream Function. Flow around a Corner. Flow around a Cylinder.

UNIT-III

Laplace Transforms – Inverse Laplace Transforms – Error functions – Application to boundary value problems (Heat equation-Laplace equation) – Fourier transform – Fourier integral formula – Finite &infinite Fourier sine and cosine transforms – Application to integral equations and Boundary Value problems.

UNIT - IV

Special function: Bessel functions : recurrence relations for the Bessel co-efficients – Series expansion for Bessel co-efficients – Integral expression for the Bessel co-efficients. The additions formula for the Bessel co-efficients.

UNIT - V

Numerical solution of partial differential equations – Introduction – Finite difference approximation to derivatives – Finite difference methods – Laplace's equation - parabolic equations – Cranice – Nicholson Method – Jacobi Method - Gauss Siedel method.

UNIT - VI

Finite Element Methods - Integral formulation and Variational Methods: Need for Weighted-Integral forms – Some mathematical concepts and formulas – Boundary, Initial and Eigen value problems – Integral relations – Functionals – The Variational Symbol – Weak formulation of Boundary Value problems – Weighted – Integral and Weak formulations – Linear and Bilinear forms and Quadratic Functional – examples. Variational methods of approximation – The Rayleigh – Ritz Method – Petrov – Galerkin method.

UNIT - VII

Maxima and Minima The Simplest Case, Illustrative Examples, Natural Boundary Conditions and transition conditions, The Variational notation, The more general case, Constraints.

UNIT - VIII

Lagrange Multipliers, Variable end points, Sturm-Liouville problems. integral equations: Introduction, Relations between Differential and Integral Equations, The Green's function, Alternative Definition of the Green's function, Linear Equations in Cause and Effect-The influence function.

References:

1. **Functions of one complex variable, Second edition**, John B. Conway, Springer International Student Edition. (Chapter X and XI)
2. **Integral Transforms** Goyal and Gupta
3. **Introductory Methods of Numerical Analysis** by S. S. Sastry, Printis Hall Publication.
4. **Standard and treatment "AN INTRODUCTION TO THE FINITE ELEMENT METHOD**" G.N.REDDY McGraw-Hill Inc. (Second Edition) (Chapters 1 and 2).
5. **"Methods of Applied Mathematics",** FRANCIS B. HILDEBRAND,Second Edition, PHI Ltd, New Delhi.
6. **"Special functions of Mathematical physic and Chemistry"** I.N. Sneddon, of Longman Publications. (Chapter 4)

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Pre-Ph.D MATHEMATICS

(09PH54201) ADVANCED TOPICS IN DIFFERENTIAL EQUATIONS

UNIT – I

Uniqueness and Lipschitz and conditions for Ordinary Differential Equations – Boundary Value Problems – Linear Ordinary differential systems some general properties.

UNIT – II

constant coefficients oscillations and damping in application variation of Parameters, matrix norms, Matrix exponential, existence of solutions.

UNIT – III

Introduction to delay differential equations, examples.

UNIT – IV

Method of steps, Lipschitz conditions and Uniqueness.

UNIT – V

Existence theory : Ordinary differential systems, systems with bounded delays, notation and Uniqueness.

UNIT – VI

existence Linear delay differential systems, Superposition, constant coefficients, variation of parameters.

UNIT – VII

Stability : Definition and examples Liapunov method for uniform stability, Asymptotic stability linear and quasilinear ordinary differential systems.

UNIT – VIII

Autonomous Ordinary differential systems, trajectories and critical points, linear systems of second order critical points of quasilinear systems of second order.

References:

1. **Theory of Ordinary and delay differential equations** by R.D.Driver Kingston R.I., Nov, 1976(Springs Verlag).

2. **Theory of ordinary differential equations** by E.A. coddington and N.Levinson.

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Pre-Ph.D MATHEMATICS

(09PH54202) ANALYTICAL NUMBER THEORY

UNIT-I:
Prime numbers – The fundamental theorem of arithmetic the series of reciprocals of the primes. The Euclidean algorithm. The greatest common divisor of more than two numbers.
Arithmetical Functions and Dirichlet multiplication:The Mobius function – The Euler quotient function – A relation connecting and – A product formula for the Dirichlet product of arithmetical functions – The Mangoldt function – Multiplicative functions – Multiplicative functions and Dirichlet multiplications – The inverse of a completely multiplications – The inverse of a completely multiplicative function – Liouville's function.

UNIT-II:
Definition and basic properties of congruence – Residue classes and complete residue system – Linear congruence – Residue systems and the Euler Fermat theorem – Polynomial congruence module/Lagrange's theorem – applications of Lagrange' theorem – Simultaneous linear congruence – The Chinese remainder theorem – Applications of the Chinese remainder theorem – Polynomial congruence with prime power module.

UNIT-III:
Averages of Arithmetical Functions: The big oh notation, Asymptotoic equality of functions – Euler's summation formula – Some elementary asymptotic formulas – The average order of d(n)- The average order of the divisor functions $\sigma_k(n)$ – An application to the distribution of lattice points visible form the origin – The average order of $\mu(n)$ and of (n) – the partial sums of a Dirichlet product – Applications to $\mu(n)$ and of Λ (n) – Another identity for the partial sums of a Dirichlet product.

UNIT- IV
Some Elementary Theorems on the Distribution of Prime Numbers: Introduction – Chebyshev's functions $\psi(x)$ and $\theta(x)$ – Relations connecting $\theta(x)$ and $\pi(x)$ – Some equivalent forms of the prime number theorem – Inequalities for $\pi(n)$ and p_n – Shapiro's Tauberian theorem – Applications of Shapiro's theorem – An asymptotic formula for the partial sume - The partial sums of the Mobius function – Selberg's asymptotic formula.

UNIT- V
Finite Ableian Groups and Their Characters: Definitions – Examples of groups and subgroups – Elementary properties of groups – Construction of subgroups – Characters of finite abelian lgroups – The character group – The orthogonality relations for characters – Dirichlet characters – Sums involving Dirichlet characters – The nonvanishing of $L(1, \chi)$ for real nonprincipal χ - Dirichlet's Theorem on Primes in Arithmetic Progressions – Introduction – Direichlet's theorem for primes of the form 4n – 1 and 4n + 1 – The plan of the proof of Dirichlet's theorem and its proof.

UNIT- VI
Analytic properties of Dirichlet series – Dirichlet series with nonnegative coefficients – An integral formula for the partial sums of a Dirichlet series

UNIT – VII
The Functions $\xi(S)$ and $L(S, \chi)$ – Introduction – Properties of the gamma function – Integral representation for the Hurwitz zeta function – A countour integral representation for the Hurwitz zeta function – The analytic continuation of the Hurwitz zeta function – Analytic continuation of $\xi(s)$ and $L(s, \chi)$ – Hurwitz's formula for $\zeta(s, a)$ – the functional equation for the Riemann zeta function – A functional equation for the Hurwitz zeta function – The functional equation for L-functions – Evaluation of $\zeta(-N, a)$.

UNIT – VIII
Analytic Proof of the Prime Number Theorem: The plan of the proof – Lemmas – A contour integral representation for $\psi_1(x)/x^2$ – Upper bounds for $|\zeta(s)|$ and $|\zeta(s)|$ near the line $\sigma = 1$ – Inequalilties of r $|\zeta(s)|$ and $|\zeta(s)|/|\zeta(s)|$ - Completion of the proof of the prime number theorem

References:

Tom M.Apostol, Introduction to Analytic Number Theory, Springer International Student Edition, USA

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Pre-Ph.D MATHEMATICS

(09PH54203) DISCRETE MATHEMATICS AND GRAPH THEORY

UNIT-I:

Statements & Notation – Connectives - Well formed formulas – Duality law – Functionally complete sets of connectives – Normal forms and principal normal forms.

UNIT-II:

Theory of Inference for the statement calculus – Rule of inference – Automatic theorem proving – Predicate calculus.

UNIT-III:

Representation of Discrete Structures – Relations and ordering – Functions – Composition of functions and inverse functions – Recursive functions, sets and predicates

UNIT-IV:

Lattices and Boolean algebra – Lattices as a partially ordered sets – Some properties of lattices, lattices as algebraic systems – Sublattices – Direct product and Homomorphism – special Lattices – Boolean algebra – Boolean functions, - Representation and minimization of Boolean functions.

UNIT-V

Graphs – Isomorphism – Sub graphs – Euler Graphs – Hamiltonian paths and Circuits – Travelling salesman problem – Trees – Properties of trees – Spanning trees – Minimal spanning trees – Kruzkal's algorithm – Premis algorithm – Dijkstra's algorithm.

UNIT-VI

Cut-sets and cut-vertices – Planar graph duality in planner graphs – Matrix representation of graphs – incidence matrix – Adjacent matrix path matrix – Circuit matrix – Cut set matrix – Transitive closur or a graph – Warshall's algorithm.

UNIT-VII

Coloring covering and partitioning – Chromatic number – Chromatic partitioning – Chromatic polynomial – Matching – Coverings the four color problem.

UNIT-VIII

Directed graphs – Digraphs – Types of Digraphs – Directed paths and connectedness – Euler digraphs – Trees with directed edges – Fundamental circuits in digraphs – Adjacency matrix of a digraphs – Acyclic digraphs & decyclization.

References:

1. **Discrete Mathematical structures with Applications to Computer Science**, J.P. Tremblay & R. Manohar, TATA McGraw-Hill Edition (Chapter 1.1 to 1.5, 2.2 to 2.6 and 4.1 to 4.4)
2. **Graph Theory with applications to Engineering and Computer Science**. Narsingh Deo,PHI Prentice-Hall India.

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Pre-Ph.D MATHEMATICS

(09PH54204) APPLIED ALGEBRA

UNIT-I

Rings: Definitions and Examples, Elementary properties of rings, Types of rings, Subrings And characteristic of a ring, Additional examples of rings.

UNIT-II

Ideals and homomorphisms: Ideals, Homomorphisms, Sum and direct sum of ideals.

UNIT-III

Maximal and prime ideals, Nilpotent and nil ideals, Zorn's lemma.

UNIT-IV

Unique factorization domains and Euclidean domains: Unique factorization domains, Principal ideal domains, Euclidean domains, polynomial rings over UFD.

UNIT-V

Noetherian and artinian modules and rings: Hom_R ($\oplus M_i \oplus M_i$), Noetherian and artinian modules, Wedderburn-Artin theorem, Uniform modules, primary modules, and Noether-Lasker theorem.

UNIT-VI

Smith normal form over a PID and rank: Preliminaries, Row module, Column module, and Rank, Smith normal form.

UNIT-VII

Finitely generated modules over a PID: Decomposition theorem, Uniqueness of the decomposition, Application to finitely generated abelian groups.

UNIT-VIII

Rational canonical form, Generalized Jordan form over any field.

References:

1. **Basic Abstract Algebra. Published in India** by Foundation Books, P.B.Bhattacharya, S.K.Jain, S.R.Nagpaul,Cambridge.

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Pre-Ph.D MATHEMATICS

(09PH54205) FLUID MECHANICS

UNIT - I

Kinematics of fluids in motion: Real fluid and ideal fluids - Velocity of fluid at a point - Stream lines and path lines - Steady flow and unsteady flow, velocity potential, velocity vector ,local and partical of fluid, conditions at a rigid boundary, general analysis of fluid motion.

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 boundary of two inviscid in compressive fluids - Euler's equation of motion - Bernoulli's equation.

UNIT - III

Three dimensional flows: Sources – Sinks – Doublets - Images in a rigid infinite plane - Images in solid spheres - Axisymmetric flows - Stokes stream function for axisymmetrical irrotational motions.

UNIT - IV

Two dimensional flows: Meaning of two dimensional flow - Use of cylindrical polar coordinates - stream function, complex potential for two dimensional irrotational incompresive flow - Complex velocity potentials for standard two dimensional flow - Uniform stream line sources and line sinks - Line doublets line vortices.

UNIT - IV

Milne Thompson circle theorem - application s of circle theorems extensions of circle theorem - theorem of blassius,

UNIT – VI

Stress components in a real fluid – Relations between Cartesian components of stress – Translational motion of fluid element - The rate of strain quadric and principal stresses – Some further properties of the rate of strain quadric – Stress analysis in fluid motion – Relations between stress and rate of strain – The coefficient of viscosity and laminar flow.

UNIT – VII

The Navier-Stokes equations of motion of a viscous fluid – Some solvable problems in viscous flow – Steady motion between parallel planes – Steady flow through tube of uniform circular cross-section – steady flow between concentric rotating cylinders – Steady viscous flow in tubes of uniform cross-section – Tube having equilateral triangular cross-section.

UNIT – VIII

Diffusion of vorticity – Energy dissipation due to viscosity – steady flow past a fixed sphere – Dimensional analysis; Reynolds number Prandti's boundary layer.

References:

1. **F. Chorlton, Textbook of Fluid Dynamics**, CBS Publishers & Distributors.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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Pre-Ph.D MATHEMATICS

(09PH54206) MATHEMATICAL MODELING

UNIT - I: Mathematical Modelling Through Ordinary Differential Equations of First Order

Mathematical Modelling Through differential equations, Linear Growth and Decay Models, Non-Linear Growth and Decay Models, Compartment Models, Mathematical Modelling in Dynamics Through Ordinary Differential Equations of First Order, Mathematical Modelling of Geometrical Problems Through Ordinary Differential Equations of First Order.

UNIT - II: Mathematical Modelling Through Systems of Ordinary Differential Equations of the First Order

Mathematical Modelling in Population Dynamics, Mathematical Modelling of Epidemics Through Systems of Ordinary Differential Equations of First Order, Compartment Models Through Systems of Ordinary Differential Equations, Mathematical Modelling in Economics through Systems of Ordinary Differential Equations of First Order, Mathematical Models in Medicine, Arms Race, Battles, and International Trade in Terms of Systems of Ordinary Differential Equations, Mathematical Modelling in Dynamics Through Systems of Ordinary Differential Equations of First Order.

UNIT - III: Mathematical Modelling Through Ordinary Differential Equations of Second Order

Mathematical Modelling of Planetary Motions, Mathematical Modelling of Circular Motion and Motion of Satellites, Mathematical Modelling through Linear Differential Equations of Second Order, Miscellaneous Mathematical Models through Ordinary Differential Equations of Second Order.

UNIT - IV: Mathematical Modelling Through Difference Equations

The Need of Mathematical Modelling through Difference Equations: Some Simple Models, Basic Theory of Linear Difference Equations with Constant Coefficients, Mathematical Modelling Through Difference Equations in Economics and Finance, Mathematical Modelling Through Difference equations in Population Dynamics and Genetics, Mathematical Modelling Through Difference Equations in Probability Theory, Miscellaneous Examples of Mathematical Modelling Through Difference Equations.

UNIT - V: Mathematical Modelling Through Partial Differential Equations

Situations giving rise to Partial Differential Equations Models, Mass Balance Equations: First Method of Getting PDE Models, Momentum-Balance Equations: The Second Method of Obtaining PDE Models, Variational Principles: Third Method of Obtaining PDE Models, Probability Generating Function, Fourth Method of obtaining PDE Models, Model for Traffic flow on a Highway, Nature of Partial Differential Equations, Initial and Boundary Conditions.

UNIT - VI: Mathematical Modelling Through Graphs

Situations that can be Modelled Through Graphs, Mathematical Models in Terms of Directed Graphs, Mathematical Models in Terms of Signed Graphs, Mathematical Modelling in terms of Weighted Digraphs, Mathematical Modelling in terms of Unoriented Graphs.

UNIT - VII: Mathematical Modelling Through Functional Integral, Delay-Differential and Differential-Difference Equations

Mathematical Modelling Through Functional Equations, Mathematical Modelling Through Integral Equations, Mathematical Modelling Through Delay-Differential and Differential-Difference Equations.

UNIT - VIII: Mathematical Modelling Through Calculus of Variation, Dynamic Programming, Mathematical Programming, Maximum Principle and Maximum Entropy Principle

Optimization Principles and Techniques, Mathematical Modelling Through Calculus of Variation, Mathematical Modelling Through Dynamic Programming, Mathematical Modelling Through Linear Programming, Mathematical Modelling Through Non-Linear Programming, Mathematical Modelling Through Maximum Principle, Mathematical Modelling Through the use of Principle of Maximum Entropy.

References:

1. **Mathematical Modelling**, J N KAPUR, Willey Eastern Limited

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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Pre-Ph.D MATHEMATICS

(09PH54207) OPERATIONS RESEARCH

UNIT - I

Simplex Method: introduction – Some more definitions and notations – Computational procedure of simplex method – Simple way for simplex method computations – Artificial variable techniques – Disadvantages of big-M-method over two-phase method – What is degeneracy problem – Special cases: Alternative solutions, unbounded solutions and non-existing solutions
Dual Simplex method: Introduction – Computational procedure of dual simplex method – Illustrative examples – Advantage of dual simplex method over simplex method – Difference between simplex and dual simplex methods.

UNIT - II

Transportation problems: introduction – Mathematical formulation – Matrix form of transportation problem – Feasible solution, basic feasible solution and optimum solution – Tabular representation – Special structure of transportation problem – Loops in transportation table and their problems – Moving towards optimality – Transportation algorithm for minimization problem – Degeneracy in transportation problems – Unbalanced transportation problems.

UNIT – III

Assignment models: Introduction – Mathematical formulation of assignment problem – Fundamental theorems – Hungarian method for assignment problem – More illustrative examples – Unbalanced assignment problem – Variations in the assignment problem – Variations in the assignment problem - Sensitivity in assignment problems – The traveling salesman (Routing) Problem.

UNIT – IV

Markov Analysis: Introduction – Stochastic (Random) process – Markov process – Transition probability – Transition probability matrix – First order and higher order Markov process – n-Step transition probabilities – Markov chain – Steady state (Equilibrium) condition – Markov Analysis.

UNIT – V

Competition Strategies: Introduction- Characteristics and Games theory – Basic definitions – Minimax (Maximin) Criterion and optimal strategy – Saddle point, optimal strategies and the value of game – Solution of games with seddle point(s) – Illustrative examples – Rectangular games without seddle point – Minimax-Maximin principle for mixed strategy games – Equivalence of Rectangular game and Linear programming – Minimax Theorem (Fundamental theorem of game theory) – solution of m x n games by linear programming – Two by-two (2 x 2) games – Principle of dominance to reduce the size of the game – Graphical method for (2 x n) and (m x 2) games – Matrix method for m x n games

UNIT – VI

Deterministic Inventory models: Introduction – What is inventory – Types of inventory models – Inventory decisions – How to develop an inventory model – Costs involved in inventory problems – Variables in inventory problem – Classification of characteristics of inventory systems – A list of symbols used – Classification of inventory models.
Deterministic Elementary inventory models: Concept of average inventory – Concept of economic ordering quantity(EOQ) – the EOQ model without shortage – The EOQ model with shortages – Multi-item deterministic models (The EOQ with constraints).

UNIT – VII

Waiting Line models: Introduction – Queueing system – Queueing problem – Transient and steady states – A list of symbols – Traffic intensity (or utilization factor) – Probability distributions in queueing systems – Some qualitative assumptions – Kendall's notation for representing queueing models – Classification of queueing models – Solution of queueing models and limitations for the applications – Model (M |M |1) : FCFS) : Birth and Death model – Model ii (A) General Erlang queueing model (Birth-Death process) – Model III, (M |M |1) : (N | FCFS) – Model IV (A), (M |M |s) : (∞ |FCFS) – Non-Poisson queueing model.

UNIT – VIII

Job sequencing: Introduction – Terminology and notations – Principal assumptions – Solution of sequencing problem – Processing n jobs through 2 machines – Processing n jobs through 3 machines – Processing 2 jobs through m machines – Processing n jobs through m machines.

References:

1. **Operations Research,** S. D. Sharma, Kedar Nath Ram Nath & Co. Publishers,

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Pre-Ph.D MATHEMATICS

(09PH54208) DISCRETE DYNAMICAL SYSTEMS

UNIT – I

Phase Portraits, Periodic Points and Stable Sets, Sarkovskii's Theorem, Hyperbolic, Attracting and Repelling Periodic Points.

UNIT – II

Families of Dynamical Systems, Bifurcation, Topological Conjugacy

UNIT – III

The Logistic Function, Cantor Sets and Chaos, Period-Doubling Cascade.

UNIT – IV

Symbolic Dynamics.

UNIT – V

Newton's Method

UNIT – VI

Numerical Solutions of Differential Equations

UNIT – VII

Complex Dynamics, Quadratic Family, Julia Sets, Mandelbrot Set

UNIT – VIII

Topological Entropy, Attractors and Fractals, Theory of Chaotic Dynamical systems.

References:

1. **A First Course in Discrete Dynamical Systems**, Richard M. Holmgren Springer Verlag (1996). For (I) to (VII)
2. **Introduction to Chaotic Dynamical Systems** Devaney,.

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Pre-Ph.D MATHEMATICS

(09PH54209) RELIABILITY

UNIT – I

Partially redundant systems-Standby redundant systems-redundancy concepts-perfect switching-imperfect switching-standby redundancy calculations-Component versus unit redundancy-Weakest-Link Technique-Mixed Redundancy-Redundancy Optimization-Double Failures and Redundancy.

UNIT – II

Systems Model-Statement of the various optimization problems- Heuristic Methods applied to optimal systems reliability-A heuristic method : Sharma And Venkateswran's Approach, Aggrawal's Approach, Mishra's Approach, Ushakov's Approach, Nakagawa and Nakashima's Approach.

UNIT – III

Dynamic programming applied to optimal systems reliability-Basic dynamic programming approach-Dynamic programming approach using Lagrange multipliers-The discrete maximum principle applied to optimal systems reliability-Sequential unconstrained minimization technique (SUMT) applied to optimal systems reliability-Generalized reduced gradient method (GRG) applied to optimal Systems reliability.

UNIT - IV

Method of Lag range multipliers-single constraint problem-single linear constraint problem-two linear constraint problem-Generalized Lagrangian function method applied to optimal systems reliability-Generalized Lagrangian problem-computational procedures.

UNIT – VI

KUHN-TUCKER conditions in optimal systems reliability- KUHN-TUCKER conditions- KUHN-TUCKER conditions for the two linear constraint problem.

UNIT – VII

The geometric programming applied to optimal systems reliability-Introduction-Formulation of the problem-Stochastic Programming-Sequential, Non-Sequential and Chance- Constrained Stochastic Programming-Examples.

UNIT – VII

Integer programming applied to optimal systems reliability-Introduction-The partial Enumeration method-The Gomory Cutting plane method-The branch and bound method-The Geoffrion Implicit Enumeration method.

UNIT – VIII

Other methods applied to systems reliability optimization problems-Introduction-A classical approach-Parametric method-Linear programming-Separable Programming.

References:

1. **Optimization of Systems Reliability**, 1. F. A. Tillman, C. V. Hwang & W. Kuo,Marcel Dekker Inc.
2. **Engineering Optimization Theory and Practice**, S. S Rao, New Age International Publications, Third edition.
3. **Reliability Engineering,** E. Balagurusamy, Tata McGraw-Hill Publishing Company Limited.
4. **Operations Research Theory and Appliactions,** J. K. Sharma,Macmillan Publications, 4th Edition.

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Pre-Ph.D MATHEMATICS

(09PH54210) NUMBER THEORY AND CRYPTOLOGY

UNIT – I

Divisibility and Euclidean algorithm, congruences, applications to facoting

UNIT – II

Finite fields, Legendre symbol and quadratic reciprocity, Jacobi symbol.

UNIT – III

Cryptosystems, diagraph transformations and enciphering matrices, RSA Cryptosystem.

UNIT – IV

Primality and Factoring, Pseudoprimes, Carmichael no, Primality tests

UNIT – V

Strong Pseudoprimes, Monte Carlo method, Fermat factorization, Factor base, Implication for RSA, Continued fraction method.

UNIT – VI

Elliptic curves - basic facts, Elliptic curves over R, C, Q

UNIT – VII

Finite fields. Hasse's theorem (without proof), Weil's conjectures (without proof)

UNIT – VIII

Elliptic curve cryptosystems, Elliptic curve factorization - Lenstra's method

References:

1. **A Course in Number Theory and Cryptology**, Neal Koblitz Graduate Texts in Mathematics, Springer (1987).
2. **Rosen M. and Ireland K., A Classical Introduction to Number Theory**, Graduate Texts in Mathematics, Springer (1982).
3. **Factorization and Primality Testing, Undergraduate Texts in Mathematics**, David Bressoud: Springer (1989).

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Pre-Ph.D MATHEMATICS

(09PH54211) COMPLEX ANALYSIS

UNIT – I

Space of continuous functions, space of analytic functions.

UNIT – II

Space of meromorphic functions, the Riemann mapping theorem and normal facilities

UNIT – III

Runge's theorem, simple connectedness, Mittag Leffler's theorem. .

UNIT – IV

Analytic continuation, analytic continuation along path, Monodromy theorem.

UNIT – V

Harmonic functions.

UNIT – VI

Entire functions

UNIT – VII

Elliptic functions

UNIT – VIII

Range of analytic functions and both big and small Picard theorems.

References:

1. **Functions of one Complex Variable**, Conway Springer International Student Edition.
2. **Complex Analysis**, Ahlfors,