Course-Curriculum

M. Sc. Mathematics- Department of Mathematics

Rayalaseema University KURNOOL - 518007

Choice Based Credit System

w.e.f. (2022-2023)

Board of Studies Meeting 27th August 2022

<table>
<tr><th>YEAR</th><th>SEMESTER</th><th>Marks</th><th>NO OF CREDITS</th></tr>
<tr><td rowspan="2">I Year</td><td>I Semester</td><td>Theory-5X100 Marks = 500 Marks
Lab - 1X100 Marks = 100 Marks</td><td>20 (5x4)
4 (1X 4)
Total 24 credits</td></tr>
<tr><td>II Semester</td><td>Theory- 5X100 Marks = 500 Marks
Lab- 1X100 Marks = 100 Marks
Comprehensive Viva - 1X50 Marks = 50 Marks</td><td>20 (5x4)
4 (1X 4)
1 (1X1)
Total 25 credits</td></tr>
<tr><td rowspan="2">II Year</td><td>III Semester</td><td>Theory- 5X100 Marks = 500 Marks
Lab- 1X100 Marks = 100 Marks</td><td>20 (5x4)
4 (1X 4)
Total 24 credits</td></tr>
<tr><td>IV Semester</td><td>4X100 Marks = 400 Marks
1X100 Marks = 100 Marks (Project)
1X 50 Marks = 50 Marks (Comprehensive Viva)</td><td>16 (4x4) Theory
4(1X4) Project
1(1X1) Comprehensive Viva</td></tr>
<tr><td colspan="2">Total credits</td><td>2200 Marks</td><td>80</td></tr>
</table>

Course structure

SEMISTER I				
S.No	**Course Code**	**Name of the Paper**	**Number of credits**	**Number of hours per week**
1	MA 101	Numerical Methods – Core	4	4+1=5
2	MA 102	Real Analysis – Core	4	4+1=5
3	MA 103	Linear Algebra and Abstract Algebra – Foundations Course	4	4+1=5
4	MA 104	Ordinary Differential Equations and Stability Analysis – Core	4	4+1=5
5	MA 105	Programming in Python – Skilled	4	3+1 =4 Theory
6	MA 106	Python with Numerical Methods	4	2 Lab for each batch
	Audit	History of Mathematics		
		Total	**24**	
SEMISTER II				
S.No	**Course Code**	**Name of the Paper**	**Number of credits**	**Number of hours per week**
1	MA 201	Topology -Core	4 (2+2)	4+1=5
2	MA 202	Complex Analysis -Core	4	4+1=5
3	MA 203	Artificial Intelligence – Skill	4	4+1=5
4	MA 204	1. Probability and Statistics(Elective) 2. Fuzzy Sets &Fuzzy Logic 3. Numerical Simulation and Difference Equations	4	4+1=5
5	MA 205	1.Mathematical Methods -Open Elective 2.Differential Geometry 3.Homtopy Methods	4	3+1 =4
6	MA 206	Artificial Intelligence using with python Lab	4	2 Lab for each batch
7	MA 207	Comprehensive Viva(1 credit and 50 marks)	1	
	Audit	Research Methodology		
		Total	25	

SEMISTER III				
S.No	**Course Code**	**Name of the Paper**	**Number of credits**	**Number of hours per week**
1	**MA 301**	Functional Analysis - Core	4	4+1=5
2	**MA 302**	Principles of Continuum Mechanics – Core	4	4+1=5
3	**MA 303**	1.Discrete Mathematics (Open Elective) 2.Automata Theory and Formal Language 3.Number Theory for Computational Sciences	4	3+1=4
4	**MA 304**	Partial Differential Equations – Core	4	4+1=5
5	**MA 305**	1. Calculus of Variations and Integral Equations – (Elective) 2. Stochastic Process and Markov Chains 3. Fluid Mechanics	4	4+1=5
6	MA306	Programming in C Lab	4	2 Lab hours for each batch
		Total	24	

SEMISTER IV				
S.No	**Course Code**	**Name of the Paper**	**Number of credits**	**Number of hours per week**
1	MA 401	Galois Theory – Core	4	4+1=5
2	MA 402	Analytical Number Theory – Core	4	4+1=5
3	MA 403	1.Operations Research (Elective) 2.Mathematical Modeling 3. Mathematical Control Theory	4	4+1=5
4	MA 404	Graph Theory (MOOCS/ Online/ class) – Can register for the course Course from SWAYAM/NPTEL	4	4+1=5
5	MA 405	Project	4	
	MA 406	Mat Lab - Skilled	4	
6	MA 406	Comprehensive Viva	1	
		Total	25	

RAYALASEEMA UNIVERSITY::KURNOOL
DEPARTMENT OF MATHEMATICS
Semester – I: Syllabus
(w.e.f. 2022-2023)

PAPER MA 101: NUMERICAL METHODS
(Core)

Learning Objectives:

i To apply the knowledge of Numerical Mathematics to solve problems arising in science, engineering and biology.

ii To formulate and model the real-world problems

iii To design, analyze and implement of numerical methods for solving various types of problems, (IVP and BVPs associated with ODEs and PDEs)

iv Create, select and apply appropriate numerical techniques with the understanding of their limitations pertaining to their applications.

v Identify the challenging problems which are difficult to deal with analytically and find their solutions accurately and efficiently.

vi To explore complex systems, physicists, engineers, financiers and mathematicians require computational methods since mathematical models are only rarely solvable algebraically. Numerical methods, based upon sound computational mathematics, are the basic algorithms underpinning computer predictions in modern systems science.

UNIT-I

Solving of algebraic and transcendental equations: Bisection Method, Regula Falsi Method, Iteration Method, Newton-Raphson.

UNIT – II

Interpolation: Newtons Forward Difference, NewtonsBackward Difference, Lagrange's Method, Hermit and Spline Interpolation.

Numerical Integration: Trepezoidal, Simpson's 1/3 and 3/8.

UNIT III

Solving system of equations by using Gauss elimination and Gauss- Seidal Iterative Technique.

Eigen Values and Eigen Vectors : The eigenvalue problem – The power method – Jacobi's method – Eigen values of symmetric matrices.

UNIT - IV

Solution of Differential equations – Taylor's series method, Euler's method –Modified Euler's method, – Runge-Kutta Methods, Predictor-corrector methods – Solving systems of differential equations.

UNIT - V

Finite Difference methods for two point Boundary value problems, Partial Differential equations – Hyperbolic equations – Parabolic equations – Elliptic equations .

Course Outcomes:

i Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems

ii Apply numerical methods to obtain approximate solutions to mathematical problems.

iii Derive numerical methods for various mathematical operations and tasks, such as interpolation, integration, the solution of linear and nonlinear equations, and the solution of differential equations and partial differential equations

iv Analyse and evaluate the accuracy of common numerical methods.

Text Book

1. Numerical Methods For Scientific and Engineering Computation, MK Jai, SRK Iyyangar and RK Jain, New Age International (P) Ltd Publishers, 7^{th} Edition, 2019

References

1. Numerical Methods For Mathematics, Science And Engineering, by John H. Mathews(Second edition), Prentice Hall of India Pvt. Ltd. New Delhi, 1994.
2. Introductory Methods of Numerical Analysis, S.S. SASTRY, PHI, Fifth Edition.
3. Numerical Methods for Science and Engineering, Stanton, Ralph G, Prentice-Hall; 2^{nd} edition
4. Numerical Mathematical Analysis, Scarborough J B,Oxford University Press.
5. Stoer, J. and Bulirsch, R., Introduction to Numerical Analysis, Texts in Applied Mathematics, Springer, 2002.

Paper 102: REAL ANALYSIS
(Core)

Learning Objectives:

To learn the concepts of basic topological objects such as open sets, closed sets, compact sets and the concept of convergence and also to work comfortably with continuous, differentiable, Riemann integrable functions and Uniform convergence. Knowledge and understanding basic concepts of measure and integration theory. Students acquire basic knowledge of measure theory needed to understand probability theory, statistics and functional analysis

UNIT – I

Reimann – Steiltje's Integral: Definition and Existence of the Integral – Properties of the Integral – Integration and differentiation – Rectifiable Curves.

UNIT – II

Sequences and Series of Functions: Uniform convergence – Uniform convergence and continuity – Uniform convergence and Integration – Uniform convergence and Differentiation – The stone Weierstrass Theorem.

UNIT – III

Multivariable Differential Calculus: The directional derivative – Directional derivatives and continuity – The total derivative expressed in terms of the partial derivatives – The Jacobian matrix – The chain rule – The matrix form of the chain rule.

UNIT – IV

The mean value theorem for differentiable functions – A sufficient condition for differentiability – A sufficient condition for equality of mixed partial derivatives – Taylor's formula for function from $R^n \rightarrow R^1$.

UNIT – V

Implicit functions and Extremum Problems: Functions with non – zero Jacobian determinant – The Inverse function theorem – The Implicit function theorem – Extremum of real valued functions of several variables – Extremum problem with side conditions.

Course Outcomes

After completing this course, the student will be able to:

1. Locate Sequence and Series comprising convergence sequences, upper and lower limits.
2. Enumerate the limits of functions, infinite limits and limit at infinity.
3. Describe the Riemann integral.

4. Multivariable Differential Calculus is a part of the basic curriculum since it is crucial for understanding the theoretical basis of probability and statistics.
5. Understanding of the theory on the basis of examples of application.
6. Ability to use abstract methods to solve Extrema problems. Ability to use a wide range of references and critical thinking on implicit and inverse function theorems.
7. After completing this subject, students will understand the fundamentals of Multivariable Differential Calculus and be acquainted with the proofs of the fundamental theorems underlying the theory of differentialtion.

Text Books: Standard and treatment as in

Chapters 6 and 7 (Excluding articles 7.19 to 7.25) of "PRINCIPLES OF MATHEMATICAL ANALYSIS" by Walter Rudin, McGraw Hill International Edition, (Third Edition). (Units 1 and 2)

Chapters 12 and 13 of "MATHEMATICAL ANALYSIS" BY TOM M APOSTOL Narosa Publishing House. (Units 3 and 4)

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Paper M103: LINEAR ALGEBRA AND ABSTRACT ALGEBRA
(Foundation Course)

Learning Objectives: i. Understanding Systems of linear equations and vector spaces.
ii. Knowledge about characteristic values and Cayley Hamilton theorem
iii. Understanding about simultaneous diagonaliaation with problems
iv. Basics of algebraic structures, group, types of groups, G-stes, Normal Series, solvable groups nilpotent groups concepts and their applications.
v. Application of Permutation Groups and Alternating group A_n

UNIT – I Systems of linear equations - Vector spaces - subspaces - Characteristic values and vectors - Cayley Hamilton theorem.

UNIT – II Annihilating polynomial - invariant subspaces, Simultaneous triangularisation - simultaneous diagonalisation.

UNIT – IV Conjugacy and G-Sets – Normal Series – Solvable groups – Nilpotent group.

UNIT – III Permutation Groups: Cyclic Decomposition – Alternating group An - Simplicity of A_n.

UNIT – V Direct Products – Finitely generated abelian groups – Invariants of finite abelian group – Sylow theorems.

Learning Outcomes:

i Secure knowledge of understanding systems of linear equations and vector spaces.
ii The student will understand how to find characteristic values and applications of Cayley Hamilton theorem.
iii Understanding about simultaneous diagonaliaation with problems
iv The student will understand the algebraic structures, group, types of groups, G-stes, Normal Series, solvable groups nilpotent groups.
v Understand the application of Permutation Groups and Alternating group An. Understand various concepts of finite abelian group.

Text Books :

1. Hoffman and Kunze, Linear Algebra, Prentice Hall of India, New Delhi, 2003.
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Publishers, 2011
3. Standard and treatment as in Section 4 of Chapter 5, Chapter 6, Chapter 7, and Chapter 8 of " Basic Abstract Algebra" by P.B.Bhattacharya, S.K.Jain and S.R. Nagpal, Cambridge University press, Second edition, 1995. (For Abstract Algebra)

Paper M104: ORDINARY DIFFERENTIAL EQUATIONS
(Core)

Learning Objectives:

i. Identify essential characteristics of ordinary differential equations
ii. Regular singular points
iii. Develop essential methods of obtaining closed form solutions.
iv. Solution of Bessels equation
v. Explore the use of differential equations as models in various applications.
vi. Explore methods of solving ordinary differential equations
vii. Understand various stabilities
viii. Explore the necessary and sufficient and conditions for these stabilities
ix. Understanding Liapunov second method
x. Construction of Liapunov Function

UNIT – I Linear Equations with Regular Singular points – The Euler Equation – Second order equations with regular singular points – an example – the general case – A convergence Proof – The exceptional cases – The Bessel Equation – Regular Singular points at infinity.

UNIT – II Existence and Uniqueness of solutions to first order equations – Equations with variables separated – Exact Equations – The Method of successive approximations – The Lipschitz condition – convergence of the Successive approximations

UNIT – III Stability of linear and weakly non-linear systems, continuous dependence and stability properties of linear, non-linear and weakly non-linear systems. Two dimensional systems. (chapter III of text book-2)

UNIT – IV Stability by Liapunov second method, Autonomous systems, quadratic forms, Krasovski's Method.

UNIT – V Construction of Liapunov functions for linear systems with constant coefficients. Selection of total energy function as a Liapunov Function, Stability based on first approximation (Chapter V of text book-2)

Learning Outcomes: Students will be able to:

i Classify ordinary differential equations according to order and linearity, as well as distinguish between initial value problems and boundary value problems.

ii Formulate and solve application problems.

iii Find series solutions about regular-singular points.

iv Effectively write mathematical solutions in a clear and concise manner.

v Locate and use information to solve first and second order ordinary differential equations.

vi Demonstrate ability to think critically by determining and using appropriate techniques for solving a variety of differential equations.

vii Demonstrate an intuitive and computational understanding of differential equations by solving a variety of application problems arising from biology, chemistry, physics, engineering and mathematics. viii Demonstrate the ability to integrate knowledge and ideas of differential equations in a coherent and meaningful manner for solving real world problems.

ix Demonstrate the ability to integrate knowledge and ideas of differential equations by analyzing their solution to explain the underlying physical processes.

x Develops familiarity with stability, asymptotically stability and unstable concepts.

xi Develops familiarity with various stability properties and necessary and sufficient conditions for local stability analysis.

xii Acquires the knowledge and concepts on stability based on Liapunov second method and ability to apply these to various problems.

xiii Acquires the ability to construct Liapunov functions and explore stability through them.

Text Books :

1. Standard and treatment as in Chapter 4, Articles 1 to 6 of Chapter 5 of "An Introduction To Ordinary Differential Equations " by E.A.Coddington.
2. M.Rama Mohan Rao, Ordinary Differential equations, Theory methods and applications, Affiliated East-West Press Pvt.Ltd., New Delhi. (1980).

MA 105 : Programming in Python
(Skilled)

Course Objectives: The course is designed to provide an introduction to the Python programming language. The focus of the course is to provide students with an introduction to programming, I/O, and visualization using the Python programming language.

UNIT - I

Basics: comments, character set, tokens, core data types, inbuilt functions. Operators: Arithmetic operators and their properties, Bitwise operators, compound assignment operator.

UNIT - II

Decision statements: Boolean operators and their uses, if, if-else, nested if statements, conditional expressions. Loop control statements: The while, for and nested loops, break and continue statement. Functions: Syntax and basics, parameters and arguments, The local and global scope of a variable.

UNIT - III

Strings: The str class, inbuilt string functions, the string operators. Lists and List processing: Creating lists and accessing them, slicing, inbuilt list functions, comprehensions, searching techniques, sorting.

UNIT - IV

Object-Oriented Programming: Defining class, the self-parameter and adding methods, class attributes, overloading, inheritance, overriding. Tuples, sets and dictionaries.

UNIT - V

Graphic programming: Turtle module and uses, drawing with colors and iterations, Bar charts. File handling: Need of file handling, text input and output, the seek() function and Binary files.

Course Outcomes : Upon completion of this course, the student will be able to:

1. Explain basic principles of Python programming language.
2. Implement object oriented concepts.
3. Design and implement a program to solve a real world problem.
4. Implement conditions and loops for Python programs.
5. Use functions and represent compound data using Lists, tuples and dictionaries .

REFERENCE BOOKS:

1. A.N. Kamthane & A.A. Kamthane, Programming and Problem Solving with Python, McGraw Hill (2020). 2. M. Lutz, Programming Python, O`Reilly Media (2013).

3. M. Lutz, Learning Python - Powerful Object Oriented Programming, O'Reilly Media (2013).

4. M. Urban & J. Murach, Python Programming - Beginner to Pro, Murach & Associates (2016).

5. R. Gupta, Making Use of Python, Wiley Publishing House (2002).

6. Jaan Kiusalaas, Numerical Methods in Engineering with Python, Cambridge University Press (2013)

MA 106 : Python with Numerical Methods (LAB)
Audit Course: History of Mathematics

RAYALASEEMA UNIVERSITY::KURNOOL
DEPARTMENT OF MATHEMATICS
Semester – II: Syllabus
(w.e.f. 2022-2023)

Paper M201: TOPOLOGY
(Core)

Learning Objectives:

i. To understand and learn Basic notions of metric and topological spaces
ii. To understand Methods and techniques of proving basic theorems on topological spaces and continuous mappings
iii. To understand equivalent methods of introducing topology in a set

UNIT – I Metric spaces – Open sets – closed sets – convergence – completeness, and Baire's theorem – continuous mapping – spaces of continuous functions – Euclidean and Unitary spaces.
UNIT – II Topological Spaces – Definition Examples – open bases and open subbases – weak topologies.
UNIT – III Compact spaces – Product spaces – Tychonoff's theorem and lacally compact spaces – Compactness in Metricspaces – Ascoli's Theorem.
UNIT – IV Separation – T1- Spaces and Hausdorff Spaces – completely Regular spaces and Normal spaces – Urysohn's lemma – Urysohn's imbedding theorem – Stone-cech compactification –
UNIT – V Connected spaces – Components of a space – Totally Connected spaces – Locally Connected spaces.

Course Outcomes: Upon completion of the course, students should acquire the following skills: i Define real numbers, identify the convergence and divergence of sequences, explain the limit and continuity of a function at a given point.
ii Construct the geometric model of the set of real numbers.
iii Define the existence of a sequence's limit, if there exists, find the limit.
iv Explain the notion of limit of a function at a given point and if there exists estimate the limit. Define the notion of continuity and obtain the set of points on which a function is continuous.
v Express the notion of metric space, construct the topology by using the metric and using this topology identify the continuity of the functions which are defined between metric spaces.

Text Book: 1. Standard and treatment as in Chapter 2, Articles16-19 of Chapter III, Articles 21-25 of Chapter IV, Articles 26-30 of Chapter V and Articles 31 and 32 of Chapter VI of "Introduction To Topology And Modern Analysis" BY G.F.Simmons, McGraw Hill book company, Inc., International Student edition. (New Editions)

Reference Book:

1. Topology: James R. Munkres, Second Edition, Pearson publishers. 2. General Topology, Stephen Willard, Third edition, Barnes & Noble publishers.

PAPER MA 202: COMPLEX ANALYSIS
(Core)

Learning Objectives:

To understand the modulus of a Complex valued function and results regarding that

i. To understand and develop manipulation skills in the use of Rouche's theorem, Inverse Function theorem, Hardmards three circle theorem.
ii. To understand and learn to use Argument Principle.
iii. To understand the principal of Analytic Continuation and the concerned results and Gamma and Zeta functions, their properties and relationships.
iv. To understand the Harmonic functions on a disc and concerned results, factorization of entire functions having infinite zeros, range of analytic functions and concerned results and univalent functions.

UNIT – I

Complex functions – Basic concepts – continuity of a complex function – Differentiation in the complex plane –Analytic functions - The Cauchy Reimann equations – **Conformal mapping** – Fractional linear transformation- Critical points - fixed points

UNIT – II

Integration in the complex plane: The Integral of a complex function – Basic properties of the integral – Integrals along polygonal curves – Cauchy's Integral theorem – Indefinite complex Integrals Cauch's Integral formula – Infinite differentiability of Analytic functions - Harmonic functions.

UNIT – III

Complex series – convergence vs divergence – Absolute vs conditional convergence – Uniform convergence – Power series – Basic theory – Determination of the radius of convergence.

UNIT – IV

Taylor series – The Taylor expansion of an analytic function – Uniqueness theorems – The Maximum modulus principle and its implications. Laurent Series – The Laurent expansion of an analytic function. Singularities: – Isolated singular points.

UNIT – V

Residue Theory: Residues. Cauchy residue theorem - logarithmic residues and the Argument Principle – Rouche's Theorem and its implications. Evaluation of improper integrals

Learning Outcomes:

Upon completing the course, students will be able to:

i To learn to recognize the fundamental properties of normed spaces and of the transformations between them.
ii Understand the notions of dot productand Hilbert space and apply the spectral theorem to the resolution of integral equations.
iii Corelate Functional Analysis to problems arising in Partial Differential Equations, Measure Theory and other branches of Mathematics.

Text Book:

Standard and treatment as in Chapter III, Chapter IV, Chapter V, Chapter VI, Chapter VII, Chapter VIII and Chapter X, Chapter XI and article 12.1, 12.2, 12.3 of Text book 1 of the Text "Complex Analysis With Applications" by Richard A. Silverman, Printice – Hall Inc. Englewood cliffs, New Jersey, 1974.

References:

1. Ahlfors, Lars V., Complex Analysis: An Introduction to the Theory of Analytic Functions of One Complex Variable, third edition. International Series in Pure and Applied Mathematics, McGraw-Hill Book Co., New York, 1978.
2. Churchill, Ruel V. and Brown, James Ward, Complex Variables and Applications, fourth edition, McGraw-Hill Book Co., New York, 1984.
3. Conway, John B., Functions of One Complex Variable, II, Graduate Texts in Mathematics, 159, Springer-Verlag, New York, 1995.
4. Narasimhan, Raghavan and Nievergelt, Yves, Complex Analysis in One Variable, second edition, Birkh¨auser Boston, Inc., MA, 2001

MA 203: ARTIFICIAL INTELLIGENCE
(Skill Course)

Learning Objectives: AI is an introductory course in Artificial Intelligence. The goal is to acquire knowledge on intelligent systems and agents, formalization of knowledge, reasoning with and without uncertainty, machine learning and applications at a basic level.

UNIT – I

Introduction: History Intelligent Systems, Foundations of Artificial Intelligence, Sub areas of Al, Applications.

Problem Solving - State - Space Search and Control Strategies: Introduction, General Problem-Solving Characteristics of problem, Exhaustive Searches, Heuristic Search Techniques, Iterative-Deepening A*, Constraint Satisfaction.

UNIT – II

Logic Concepts and Logic Programming: Introduction, Propositional Calculus Propositional Logic, Natural Deduction System, Axiomatic System, Semantic Table, A System in Propositional Logic, Resolution, Refutation in Propositional Logic, Predicate Logic, Logic Programming.

Knowledge Representation: Introduction, Approaches to knowledge Representation, Knowledge Representation using Semantic Network, Extended Semantic Networks for KR, Knowledge Representation using Frames.

UNIT – III

Expert System and Applications: Introduction, Phases in Building Expert Systems Expert System Architecture, Expert Systems Vs Traditional Systems, Truth Maintenance Systems, Application of Expert Systems, List of Shells and tools.

Uncertainty Measure - Probability Theory: Introduction, Probability Theory, Bayesian Belief Networks, Certainty Factor Theory, Dempster - Shafer Theory.

UNIT – IV

Machine - Learning Paradigms: Introduction, Machine learning System, Supervised and Unsupervised Learning, Inductive Learning, Learning Decision Trees, Deductive Learning, Clustering, Support Vector Machines.

UNIT – V

Artificial Neural Networks: Introduction Artificial Neural Networks, Single - Layer Feed Forward Networks, Multi - Layer Feed Forward Networks, Radial - Basis Function Networks, Design Issues of Artificial Neural Networks, Recurrent Networks.

Course Outcomes: After completion of this course, students will be able to

1. Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.
2. Understanding about the basic concepts of Software agents ad representation of Knowledge.
3. Demonstrate awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.

4. Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.

Reference Book:

Saroj Kaushik, *Artificial Intelligence*, Cengage Learning India, First Edition, 2011.

2. Russell, Norvig, *Artificial Intelligence: A Modern Approach*, Pearson Education, 2nd Edition, 2004.

3. Rich, Knight, Nair, *Artificial Intelligence*, Tata McGraw Hill, 3rd Edition 2009.

PAPER MA 204: PROBABILITY AND STATISTICS
(Elective)

Learning Objectives: The objective of this course is to make the students to:

i Solve problems related to conditional,

ii Baye'stheorem and joint probability.

iii Learn about Poission, Exponential and Normal to compute probabilities.

iv Apply the concept of sampling distribution of the means in general situations and how to use the Central Limit Theorem.

v Learn about one tail and two tail tests and how to give conclusion about null or alternative hypotheses using the suitable test statistic.

vi Apply the regression analysis to fit the curves.

vii Learn classification and various random processes.

UNIT-I

Probability: Sample spaces and Events, Basic set theory, Definition of probability, Axioms of probability, Addition theorem, Multiplication theorem, conditional probability, Baye'sTheorem.
Random Variables: Introduction, Types of random variables, Continuous and Discrete Random variables, Probability distribution function, Probability density function, Joint distribution function, Joint density function, Conditional distribution and density functions, Independent random variables.

UNIT-II

Discrete Probability Distributions: Discrete Uniform distribution , Binomial distribution, Geometric distribution, Poisson distribution
Continuous Probability Distributions: Continuous Uniform distribution, Normal distribution, Gamma distribution, Exponentional distribution, and Weibul distribution.

UNIT-III

Theory of Estimation: Introduction, Properties of estimators, Neymanns factorization theorem, Methods of Estimation, Maximum likelihood estimation.

UNIT-IV

Test of Statistical hypothesis(Large sample tests): Introduction, Statistical hypothesis, Procedure of testing hypothesis, Type I and Type II errors, Two tailed and one tailed tests of hypothesis, Large sample tests.

UNIT-V

Test of Statistical hypothesis (Small sample tests): Introduction, Students t -distribution. F-test for equality of population variances, Chi-square distribution, – Z-test, t-test, F-test, $\chi 2$test.

Learning Outcomes: After completion of this course, students will be able to

- i Understand basic probability axioms and apply Baye's theorem related to engineering problems.
- ii Identify the suitable distribution among poission, exponential, normal to compute probabilities.
- iii Make use of the sampling distribution of the sample mean in general situations, using the Central Limit Theorem.
- iv Decide the null or alternative hypotheses using the suitable test statistic.
- v Apply the regression analysis to fit the curves.

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Text Books:

1. Sheldon M Ross, Introduction to Probability and Statistics for Engineers and Scientists, Elsevier Academic Press.
2. Richard A. Johnson, Miller and Freund's Probability and Statistics for Engineers, 7^{th} Edition, , PHI

References:

1. Ronald E Walpole, Reymond H Myers, Sharon L Myers, Keying Ye, Probability and Statistics for Engineers and Scientists, Pearson Education.
2. Kishore S Trivedi, Probability & Statistics with Reliability, Queing, and Computer Science Applications, Eastern Economy Edition.
3. Miller and Freund's Probability and Statistics for Engineers, 7 th Edition, Richard A. Johnson, PHI
4. S.C. Gupta and V.K. Kapoor, "Fundamentals of Mathematical Statistics", Ninth Revised Edition , Sultan Chand & Sons Educational Publishers, 2007.
5. Peter J Brockwell and Johan A Davis, "Time Series: Theory and Methods", Springer Science + Business Media, LLC,

PAPER MA 204: FUZZY SETS &FUZZY LOGIC
(Elective)

Learning Objectives : The objective of this course is to teach the students the need of fuzzy sets , operations on fuzzy sets, arithmetic operations on fuzzy sets and fuzzy relations.

UNIT I :

Fuzzy Sets : An overview – Basic Types and Concepts – Characteristics and significance of the Paradigm – Properties of □- Cuts – representation of Fuzzy sets – Extension Principle for Fuzzy Sets.

UNIT II :

Operations on Fuzzy Sets : Types of Operations – Fuzzy complements – t-norms, t- conforms – combinations of operations- aggregation of Operations – Fuzzy Arithmetic – Fuzzy Nembers- Linguistic Varibles – Arithmetic Operations on Intervals – Arithmetic Operations on Fuzzy Numbers – Lattice of Fuzzy Numbers – Fuzzy Equations.

UNIT III

Fuzzy Relations : Crisp versus Fuzzy Relations – Projections and Cylindric Extensions – binary Fuzzy Relations – Binary Relations on a Single Set- fuzzy Equivalence Relations – Fuzzy Compatibility Relations - Fuzzy Ordering Relations – Fuzzy Morphisms – Sup – I Compositions of Fuzzy Relations – inf- wi Compositions of Fuzzy Relations – Fuzzy Relation Equations - General Discussion – Problem Partitioning – Solution Method – fuzzy Relation Equations Based on sup – I compositions – Fuzzy Relation Equations Based on inf- wi Compositions – Approximate Solutions – The use of Neural Networks.

UNIT IV

Possibility Theory : Fuzzy Measures – Evidence Theory- Possibility Theory – Fuzzy sets and Possibility Theory – Possibility Theory Versus – Orobability Theory – Fuzzy logic – Classical Logic – Multivalued Logics.

UNIT V

Fuzzy Propositions – Fuzzy Quantifiers – Linguistic hedges – Inference from Conditional Fuzzy Propositions – Inference from Conditional and Qualified Propositions – Inference from quantified propositions.

Course Outcome: After completing this course, the student shall be able to: Understand the basic concepts of fuzzy sets, fuzzy arithmetic and fuzzy relations. Construct the appropriate fuzzy numbers corresponding to uncertain and imprecise collected data and also determine the concepts of fuzzy compatibility relations, fuzzy ordering relations and fuzzy morphisms.

Text Book: Scope and standard as in "Fuzzy sets and Fuzzy logic Theory and Applications" by George J. Klir / Bo Yuan, PHI, 2001. Chapters 1 to 8.

Reference Books:

1. George J.Klir, Bo Yuan, Fuzzy Sets and Fuzzy logic – Theory and Applications, Prentice Hall India, New Delhi, 1997.
2. H.J Zimmermann, Fuzzy sets, Decision making and expert systems, Kluwer, Bosten, 1987.
3. S.J. Chen and C.L.Hwang, Fuzzy Multiple Attributes Decision Making, Springer verlag, Berlin Heidelberg, 1992.

PAPER MA 204: DIFFERENCE EQUATIONS
(Elective)

Learning Objectives: The aim of the course is to present the basic facts of the theory of difference equations. Students will understand theoretical and practical methods for solving difference equations.

Unit –I

Dynamics of First-Order Difference Equations ; Introduction, Linear First-Order Difference Equations, Important Special Cases, Equilibrium Points, The Stair Step (Cobweb) Diagrams, The Cobweb Theorem of Economics, Numerical Solutions of Differential Equations, Euler's Method, A Nonstandard Scheme, Criterion for the Asymptotic Stability of Equilibrium Points, Periodic Points and Cycles, The Logistic Equation and Bifurcation, Equilibrium Points , Cycles, Cycles, The Bifurcation Diagram, Basin of Attraction and Global Stability.

Unit – II

Linear Difference Equations of Higher Order, Difference Calculus, The Power Shift, Factorial Polynomials, The Anti difference Operator, General Theory of Linear Difference Equations, Linear Homogeneous Equations with Constant Coefficients, Non homogeneous Equations: Methods of Undetermined Coefficeints, The Method of Variation of Constants (Parameters), Limiting Behavior of Solutions, Nonlinear Equations Transformable to Linear Equations . Applications; Propagation of Annual Plants, Gambler's Ruin, National Income, The Transmission of Information

Unit III

Systems of Linear Difference Equations; Autonomous (Time-Invariant) Systems The Discrete Analogue of the Putzer Algorithm, The Development of the Algorithm for A^n The Basic Theory.

Unit IV

The Jordan Form: Autonomous (Time-Invariant) Systems Revisited, Diagonalizable Matrices, The Jordan Form, Block-Diagonal Matrices, Linear Periodic Systems, Applications ; Markov Chains, Regular Markov Chains, Absorbing Markov Chains, A Trade Model, The Heat Equation.

Unit V

Stability Theory; A Norm of a Matrix, Notions of Stability, Contents, Stability of Linear Systems, Nonautonomous Linear Systems, Autonomous Linear Systems, Phase Space Analysis, Liapunov's Direct, or

Second, Method, Stability by Linear Approximation, Applications, One Species with Two Age Classes, Host–Parasitoid Systems, A Business Cycle Model, The Nicholson–Bailey Model, The Flour Beetle Case Study.

Course Outcomes: After studying this course, you should be able to:

- recognise differencel equations that can be solved and Analyse The Cobweb Theorem of
- use an initial condition to find a particular solution of a differential equation, given a general solution
- check a solution of a differential equation in explicit or implicit form, by substituting it into the differential equation
- understand the Linear Homogeneous Equations , Non homogeneous Equations that can be solved by The Method of Variation of Constants
- understand the The Jordan Form, Linear Periodic Systems, Markov Chains, and The Heat Equation
- understand Stability Theory; Nonautonomous Linear Systems, Autonomous Linear Systems, Stability by Linear Approximation, Applications.

Text Book:
Standard and treatment as in Chapter 1, Chapter 2, Chapter 3, and Chapter 4, of Text book of the "An Introduction to Difference Equations" by Saber Elaydi, Third Edition, springer.

PAPER MA 205: MATHEMATICAL METHODS
(Open Elective)

Learning Objectives:

i. Understand the Laplace Transform and its existence
ii. Know the relation between Fourier Transform and Laplace Transform
iii. Compare the Fourier Transform and Laplace Transform

UNIT – I

Z- Transforms: Definitions-Some standard Z- transforms-linear property- Damping rule- Some standard results-Two basic theorems- Convolution theorem- Evaluation of inverse Z- transforms-Applications to difference equations

UNIT – II

Laplace transformations – inverse transformation – applications to Differential Equations – Applications to integral equations.

UNIT – III

The Fourier transform – The infinite Fourier transform – The finite Fourier transform – Fourier integral formula.

UNIT – IV

Parseval's identity for Fourier series – Problems related to Fourier transform. Applications of Laplace transform to boundary value problems.

UNIT – V

Applications of infinite Fourier transform to boundary value problems – Applications of finite Fourier transform to boundary value problems.

Learning Outcomes: Upon completion of the course, students should possess the following skills:

1. Discuss the advantages, limitations and applications of Laplace Transform
2. Acquaint yourself with region of convergence and its properties

3. Define the poles and zeros
4. Know the linearity theorem of Laplace Transform
5. Understand the Unilateral Laplace Transform of some commonly used signals
6. Students will gain a range of techniques employing the Laplace and Fourier Transforms in the solution of ordinary and partial differential equations.
7. They will also have an appreciation of generalized functions, their calculus and applications.
8. Determine the solution of difference equation problems by *z*-transform methods and differential equation problems by Laplace Transform methods.

References:

1. Standard and treatment as in Chapter-24 of "Higher Engineering Mathematics" by Grawel. Khanna Publications.
2. Chapters 1,2,5&6 of "INTEGRAL TRANSFORMS" by Goyal and Gupta, Pragathiprakasan publications, Meerut.

PAPER MA 205: DIFFERENTIAL GEOMETRY

(Open Elective)

COURSE OBJECTIVES:

i **To Understand the concept of curvature of a space curve and signed curvature of a plane curve.**
ii **To be able to understand the fundamental theorem for plane curves.**
iii **To get introduced to the notion of Serret-Frenet frame for space curves and the involutes and evolutes of space curves with the help of examples.**
iv **To be able to compute the curvature and torsion of space curves.**
v **To be able to understand the fundamental theorem for space curves.**
vi **To get introduced to the concept of a parameterized surface with the help of examples.**
vii **To Understand the idea of orientable/non-orientable surfaces.**
viii **To get introduced to the idea of first fundamental form/metric of a surface.**

UNIT – I

Vector space, Euclidean space R3. Tangent vectors and vectors fields, Frame fields, Natural frame fields, Directional derivative , Curves in R3 and reparametrization of curves, standard curves, Speed of curve, length of curve. 1- forms, differential forms.

UNIT – II

The Frenet Formulae for unit speed curve. Frenet approximation of curves, Arbitrary speed curves, Frenet

formulas for arbitrary speed curve, Covariant Derivative.

UNIT – III

Isometries of R3, Orthogonal transformations.Coordinate patches, surface in R3, simple surface, cylinder surface, surface of revolution, parametrization of a region.

UNIT – IV

Parametrization of cylinder and surface of revolution, smooth overlapping patches, tangent and normal vector fields on a surface, The shape operator of surface M in R3, normal curvature, principal curvatures, Gaussian and mean curvatures.

UNIT – V

Umbilic points, fundamental forms of a surface, computational techniques, special curves on surface, asymptotic and geodesic curves.

Learning Outcomes:

After completing this course, the student shall be able to:

i. find the derivative map of an isometry.
ii. analyse the equivalence of two curves by applying some theorems.
iii. defines surfaces and their properties
iv. express definition and parametrization of surfaces.
v. express tangent spaces of surfaces.
vi. explain differential maps between surfaces and find derivatives of such maps.
vii. integrate differential forms on surfaces.

References Books:

1. D. Somasundaram: Differential Geometry- First Course, Narosa Publishing House, New Dehli, 2010.
2. Nirmala Prakash: Differential Geometry, Tata Mcgraw Hill, 1981.
3. K. S. Amur and etl.: Differential Geometry,Narosa Publishing House, 2010.
4. Millman, R. and Parker, G. D. Elements of Differential Geometry, Prentice-Hall of India Pvt. Ltd. 1977.
5. Hicks, N. : Notes of differential geometry, Princeton University Press (1968)

6. O'Neill, B.: Elementary Differential geometry, Academic Press, Revised Edition 2006.

PAPER MA 205: HOMTOPY METHODS

(Open Elective)

Learning Objectives : The objective of this course is to teach the students the need of Homotopy analysis methods logically contains some previous techniques such as Adomian's decomposition method, Lyapunov's artificial small parametermethod, and the δ-expansionmethod.

UNIT – I

Perturbation method, Lyapunov's artificial small parameter method, Adomian's decomposition method, The δ -expansion method.

UNIT – II

Homotopy analysis solution; zeo-order deformation equation, Higher – order deformation equation, convergence theorem.

UNIT – III

Some fundamental rules, solution expressions, the role of the auxiliary parameter $\hbar$, Homotopy-Pade method.

UNIT - IV

Systematic description; zeo-order deformation equation, Higher – order deformation equation, convergence theorem, fundamental rules, control of convergence region and rate, the $\hbar$ curve and the valid region of $\hbar$, Homotopy-Pade technique, Further generalization.

UNIT V

Relations to some previous analytic methods; Relation to Adomain's decomposition method, Relation to artificial small parameter method, Relation to δ -expansion method, Unification of nonperturbution methods.

Learning Outcomes: After completion of this course, students will be able to

- i Understand Perturbation method Adomian's decomposition method, The δ -expansion method..
- ii Identify the zeo-order deformation equations, Higher – order deformation equations , convergence problems.
- iii Make use of the $\hbar$ curve and the valid region of $\hbar$, Homotopy-Pade technique
- iv Describe the fundamental rules, control of convergence region and rate.
- v Determine the Relation to Adomain's decomposition, Relation to artificial small parameter, Relation to δ -expansion methods.

Text Book:

Standard and treatment as in Chapter 2, Chapter 3, and Chapter 4, of Text book of the "Introduction to the Homotopy Analysis Methods" by Shijun Liao, CHAPMAN &HALL/CRC , A CRC Press Company, NEW YORK.

APER MA 206 ARTIFICIAL INTELLIGENCE (LAB)

AUDIT COURSE : RESEARCH METHODOLOGY

RAYALASEEMA UNIVERSITY::KURNOOL
DEPARTMENT OF MATHEMATICS
Semester – III: Syllabus
(w.e.f. 2022-2023)

PAPER MA 301: FUNCTIONAL ANALYSIS
(Core)

Learning Objectives:

i To study certain topological-algebraic structures and the methods by which the knowledge of these methods can be applied to analytic problems.

ii The objectives of the course is the study of the main properties of bounded operators between Banach and Hilbert spaces, the basic results associated to different types of convergences in normed spaces and the spectral theorem and some of its applications

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 Unitary operators – Projections.

UNIT – V

Finite dimensional spectral theory : Determinants and the spectrum of an operator – The spectral theorem.

Course Outcomes: Upon completion of the course, students should possess the following skills:

i Understand the basic concepts of graphs, directed graphs, and weighted graphs and able to present a graph by matrices.

ii Understand the properties of trees and able to find a minimal spanning tree for a given weighted graph. Understand Eulerian and Hamiltonian graphs.

Text Books:

Standard and treatment as in Chapter 9,10 and Sections 2 and 3 of Chapter 11 of “Introduction To Topology And Modern Analysis” byG.F.Simmons,

Mc Graw – Hill book company, Inc., International student edition.

Reference:

1. **Limaye, Balmohan V., Functional Analysis, second edition, New Age International Publishers Limited, New Delhi, 199**

2. **Kesavan, S., Functional Analysis, Trim series, Hindustan Book Agency, 2009**

Paper V: MA 302 Principle of Continuum Mechanics
(Core)

Learning Objectives:

- The purpose of the course is to expose the students to the basic elements of continuum mechanics in a sufficiently rigorous manner.
- The students should be able to appreciate a wide variety of advanced courses in solid and fluid mechanics.
- The main objective of this course is to familiarize students with a range of mathematical methods that are essential for solving advanced problems in theoretical physics.

UNIT – I

Legendre Transformations and the Hamilton equations of motion – cyclic coordinates and conservation theorems – Routh's Procedure and Ocilations about steady motion – The Hamiltonian formulation of relativistic mechanics – Derivation of Hamilton's equations from a variational Principle – The Principle of least action.

UNIT – II

The equations of canonical transformation – Examples of canonical transformations – The symplectic approach to canonical transformations – Poisson Brackets and other canonical Invariants.

UNIT – III

Kinematics of fluids: Methods of describing Fluid motion – Lagrangian method – Eulerian method – Translation, Rotation, and rate of deformation – Stream lines – Path lines and Streak lines – The Material Derivative and Acceleration – Vorticity in Polar coordinates – Vorticity in Orthogonal Curvi-linear Coordinates.

UNIT – IV

One dimensional Inviscid Incompressible Flow: Equation of continuity – Stream tube flow – Equations of motion – Euler's Equation – The Bernoulli's equation – Applications of Bernoulli's equation.

UNIT-V

Two and three Dimensional Inviscid Incompressible flow:

Basic Equations and concepts of Flow-Equations of Continuity–Eulerian Equations of motion – Circulation theorems – Circulation concepts – Stoke's Theorem – Kelvin's Theorem, Constnacy of Circulation.

Simple flows – Laplace's equation in different systems –Boundary Conditions – Stream Function in two dimensional motion- Boundary layers

Course Outcomes: Upon completion of the course, students should possess the following skills:

1. Basic laws of Continuum mechanics – read and write expressions
2. How to describe motion and deformation of body
3. Different stress measures and how and where to use them
4. Possion and Lagranges Brackets
5. Types of Fluids and the equation of continuity
6. Applications of Bernoulliseqaution
7. Derivation of Eulers equation of motion, momentum and moment of momentum equations

References:

1) Standard and Treatment as in Chapter 8 and articles 9.1 to 9.4 of "Classical Mechanics" by Herbert Goldstein, Narosa Publishing House, Second Edition.

2) Standard and Treatment as in Chapter 3, Articles 6.1 to 6.4 of Chapter 6 and Articles 7.1 to 7.9 of Chapter 7 of "Foundations of Fluid Mechanics" by S.W. Yuwn, Prentice Hall of India Pvt., Ltd., 1969.

Paper III MA 303: DISCRETE MATHEMATICS
(Open Elective)

Learning Objectives

- Objective of this paper is to gain some knowledge on reflexive, symmetric, or transitive or is an equivalence relation; functions.
- Simplify and evaluate basic logic statements including compound statements.
- Express a logic sentence in terms of predicates, quantifiers, and logical connectives algebraic structure.
- Acquire the knowledge of Lattices, Boolean Algebras, Irreducibility and minimization of Boolean functions.

UNIT-I

Propositional logic:

Mathematical of logic- Statements-connectives-Tatuologies-Theory of inference for statement calculus-rules of inference, Normla forms.

UNIT-II

Relations- properties-Equivalence Relations – Partial order and partially ordered sets.

UNIT III

Semigroups and Monoids-Sub semigroups and Sub Monoids- Homomorphism of Monoids and Semi groups.

UNIT-IV

Lattices-Lattices as Partially ordered sets-Complete, Complimented and distributive Lattices-Sub Lattices-Direct Products and Homomorphisms.

UNIT-V

Boolean Algebra – Boolean Algebras as Lattices- Examples-Join Irreducible Elements-Min terms-Boolean Forms and their equivalences-Sum of Products-Canonical forms.

Course Outcomes:

1. Students completing this course will be able to express a logic sentence in terms of predicates, quantifiers, and logical connectives.
2. Students completing this course will be able to apply the methods of proof including direct and indirect proof forms, proof by contradiction, and mathematical induction.
3. Students completing this course will get the ability of understanding Lattices, Boolean Algebra, Algebraic Structures and Homomorphism.
4. Students will get the technique of minimizing the Boolean functions using Karnaugh maps.

TEXT BOOK:

Standard treatment as in the articles 1.2, 1.3, 1.4, 1.5 and 1.6 of Chapter 1, Article 2.3 of Chapter 2, Article 3.2 of Chapter 3, Articles 4.1, 4.2, 4.3 and 4.4 Chapter 4 of Reference 1.

1. Trembley, J.P. and Manohar R.P.: Introduction to Discrete Mathematical structures with Applications to Computer Science, McGraw Hill, 1997.
2. Kenneth H Rosen, Discrete Mathematics and its Applications, Fourth Edition
3. Joe L. Mott,AbrahamKandel,Theodore P. Baker, Discrete Mathematics for Computer Scientists and Mathematicians, Reston Pub Co
4. Ronald L. Graham, Donald E. Knuth, and Oren Patashnik, Concrete Mathematics: A Foundation for Computer Science, (Reading, Massachusetts: Addison-Wesley, 1994)
5. Lew: Computer Science: Mathematical Introduction, Prentice Hall International.

Paper III MA 303: AUTOMATA THEORY AND FORMAL LANGUAGE (Open Elective)

Learning Objectives:

1. Understand basic properties of formal languages and formal grammars.
2. Understand basic properties of deterministic and nondeterministic finite automata
3. Understand the relation between types of languages and types of finite automata
4. Understanding the Context free languages and grammers, and also Normalising CFG.
5. Understanding the minimization of deterministic and nondeterministic finite automata.
6. Understand basic properties of Turing machines and computing with Turing machines. \
7. Understand the concept of Pushdown automata and its application.
8. Know the concepts of tractability and decidability, the concepts of NP-completeness and NP-hard problem.
9. Understand the challenges for Theoretical Computer Science and its contribution to other sciences.

UNIT – I

Introduction to Finite Automata: Introduction to Finite Automata; Thecentral concepts of Automata theory; Deterministic finite automata; Nondeterministic finite automata.

UNIT – II

Finite Automata, Regular Expressions: An application of finite automata; Finite automata with Epsilon-transitions;

UNIT –III

Regular expressions; Finite Automata and Regular Expressions; Applications of Regular Expressions.

UNIT – IV

Regular Languages, Properties of Regular Languages: Regularlanguages; Proving languages not to be regular languages; Closure properties of regular languages; Decision properties of regular languages; Equivalence and minimization of automata.

UNIT – V

Context-Free Grammars And Languages : Context –free grammars; Parsetrees; Applications; Ambiguity in grammars and Languages.

Learning Outcomes:

- Prove properties of languages, grammars and automata with rigorously formal mathematical methods;
- Design automata, regular expressions and context-free grammars accepting or generating a certain language;
- Describe the language accepted by an automata or generated by a regular expression or a context-free grammar;
- Transform between equivalent deterministic and non-deterministic finite automata, and regular expressions;
- Simplify automata and context-free grammars;
- Determine if a certain word belongs to a language;
- Define Turing machines performing simple tasks.

Paper III MA 303: Number Theory For Computer Science
(Open Elective)

Learning Objectives: Course Objectives

- To understand fundamental number theoretic algorithms such as the Euclidean algorithm, the Chinese Remainder algorithm, binary powering, and algorithms for integer arithmetic.
- To understand the Division Algorithm, Non decimal Bases, Composite Numbers Fibonacci and Lucas Numbers, Fermat Numbers.
- To understand the number theoretic foundations of congruence's and the principles behind their security.
- To implement and analyze Modular Designs and Check Digits.
- To be able to understand the Eule r's P hi Functions, Sigma Functions, and Perfect Numbers

UNIT – I

Fundamentals: Fundamental Properties, The Summation and Product Notations Mathematical Induction Recursion, The Binomial Theorem m Polygonal Numbers, Pyramidal Numbers, Catalan Numbers.

UNIT – II

Divisibility: The Division Algorithm Base-b Representations (optional), Operations in Non decimal Bases (optional) umber Patterns Prime and Composite Numbers Fibonacci and Lucas Numbers, Fermat Numbers.

UNIT III

Greatest Common Divisor, The Euclidean Algorithm, The Fundamental Theorem of Arithmetic Least Common Multiple Lin ear Diophantine Equations.

UNIT –IV

Congruence's, Linear Congruence's , The Pollard Rho Factoring Method, Applications of Congruence's, Divisibility Tests, Modular Designs, Check Digits.

UNIT –V

Eule r's P hi Function Revisited, The Tau and Sigma Functions, Perfect Numbers
Mersenne Primes The Möbius Function.

Learning Outcomes: Students would be able to:

1.Understand the Mathematical Induction Recursion, Binomial Theorem m Polygonal Numbers, Pyramidal Numbers, Catalan Numbers.

2.Categorise and solve Patterns Prime and Composite Numbers Fibonacci and Lucas Numbers, Fermat Numbers.
using various techniques.

3.Describe importance of The Euclidean Algorithm, The Fundamental Theorem of Arithmetic.

4. Learn methods to solve various Congruence's, Linear Congruence's and Eule r's P hi functions.

Reference text Books;

1. Thomas Koshy, Elementary Number Theory with Applications, Second Edition, Academic Press is an imprint of Elsevier.
2. Kenneth H. Rosen, Discrete Mathematics and Its Applications Seventh Edition, Published by McGraw-Hil, 2007.

Paper IV MA 304: PARTIAL DIFFERENTIAL EQUATIONS
(Core)

Learning Objectives:

i. Explore the use of differential equations as models in various applications.
ii. Explore methods of solving partial differential equations.
iii. Method of separation of variables

UNIT - I

Ordinary Differential Equations In More Than Two Variables: Methods of solutions of dx/P = dy/Q = dz/R – Orthogonal Trajectories of a system of Curves on a SurfacePfaffian Differential Forms and Equations – Solution of Pfaffian Differential Equations in Three Variables.

UNIT - II

Partial Differential Equations Of The First Order : Partial Differential Equations – Origins of First- Order Partial Differential Equations – Linear Equations of First Order – Integral Surfaces Passing Through a Given Curve – Surfaces Orthogonal to a Given System of Surfaces – Charpit's Method – Jocobi's Method.

UNIT - III

Partial Differential Equations of the Second Order : The Origin of Second- Order Equations – Linear Partial Differential Equations With Constant Coefficients – Equations With Variable Coefficients.

UNIT - IV

Laplace's Equation : Elementary Solutions of Laplce's Equation – Families of Equipotential Surfaces –Boundary Value Problems –Separation of Variable.

UNIT-V

Reference book:

1. "Ordinary And Partial Differential Equations" By M.D.Raisinghania, Published By S.Chand & Co, New Delhi.

2. Advanced Differential Equations by M.D.Raisinghania, S. Chand Company Limited, New Delhi, 2021.

3. An elementary course to P.D.E by T.Amarnath, Second Edition, Narosa publishing House.

4.Elements Of Partial Differntial Equations by I.N.Sneddon.

Learning Outcomes: Students will be able to:

1. Classify ordinary differential equations according to order and linearity, as well as distinguish between initial value problems and boundary value problems.
2. Formulate and solve application problems.
3. Effectively write mathematical solutions in a clear and concise manner.
4. Demonstrate ability to think critically by determining and using appropriate techniques for solving a variety of differential equations.
5. Demonstrate an intuitive and computational understanding of differential equations by solving a variety of application problems arising from biology, chemistry, physics, engineering and mathematics.
6. Demonstrate the ability to integrate knowledge and ideas of differential equations in a coherent and meaningful manner for solving real world problems.

Demonstrate the ability to integrate knowledge and ideas of differential equations by analyzing their solution to explain the underlying physical processes.

Paper V: MA 305 CALCULUS OF VARIATIONS AND INTEGRAL EQUATIONS

(**Elective Paper)**

Learning Objectives: The aim of this course is to learn the different type of variation problem and necessary and sufficient conditions. Introduce to integral equation and different type of kernels. Solution approach of Volterra and Fredholm integral equations.

UNIT-I

Calculus of Variations: Maxima and Minima – Examples – Natural boundary conditions – and transition conditions – The variational notation – The more general case.

UNIT II

Constraints and Lagrange multipliers – variable end points – Sturm-Li0uville Problem – Hamilton's Principle – Lagrange's equations.

UNIT - III

Integral Equations: Introduction – Relation between differential equations and Integral equations – The Green's function – Alternative definition of Green's function – Linear equations in cause and effect , the influence function

UNIT - IV

-Fredholm equations with separable kernels – Examples – Hilbert-Schmidt theory – Methods for solving equations of the second kind – The Neumann Series – Fredhom theory .

UNIT- V

Singular Integral Equations – Special devices – Iterative methods for solving equations of the second kind – Special devices – Iterative approximations to characteristic functions - Approximation of Fredholm equations by sets of algebraic equations – Aproximate methods of undetermined coefficients .

Learning Outcomes: Students would be able to:
1.Understand the methods to reduce Initial value problems associated with linear differential equations to various integral equations.
2.Categorise and solve different integral equations using various techniques.
3.Describe importance of Green's function method for solving boundary value problems associated with nonhomogeneous ordinary and partial differential equations, especially the Sturm-Liouville boundary value problems.
4. Learn methods to solve various mathematical and physical problems using variational techniques.

Standard and treatment as in
1). Sections 2.1 to 2.11 of Chapter 2, Sections 3.1 to 3.17 of Chapter 3 in "METHODS OF APPLIED MATHEMATICS" (second Edition) by Francis B. Hilderbrand , Prentice Hall of India, New Delhi,1972.

Paper V: MA 305 STOCHASTIC PROCESS AND MARKOV CHAINS
(Elective Paper)

Course Objectives: The main objective of this course is to develop awareness for the use of stochastic models for representing random phenomena evolving in time such as inventory or queueing situations or stock prices behavior.

UNIT - I

Review of Basic Probability Concepts. Introduction to Stochastic Processes. Deterministic and Stochastic Exponential Growth Models. Stationary and Evolutionary Processes.

UNIT -II

Poisson Processes: Poisson distribution and Poisson Process. Arrival, Interarrival and Conditional Arrival Distributions. Nonhomogeneous Processes. Law of Rare Events and Poisson Process. Poisson Point Process. Distributions associated with Poisson Process. Compound Poisson Processes.

UNIT - III

Markov Chains : Transition Probability Matrices, Chapman- Kolmogorov equations, Some Examples and Classification of States, Regular Chains and Stationary Distributions, Periodicity, Limit theorems. Fundamental Matrix. Some Applications. Patterns for recurrent events: One-dimensional, two-dimensional and three-dimensional random walks.

UNIT - IV

Brownian Motion: Limit of Random Walk, Its Defining Characteristics and Peculiarities. Its Variations: Standard Brownian Motion, Brownian Bridge, Brownian Motion Reflected at Origin, Geometric Brownian Motion, Brownian Motion with Drift. Reflection Principle. Some Applications.

UNIT - V

Renewal Processes: Preliminaries, Elementary Renewal Theorem, Delayed Renewal Processes. Limit Theorems. Martingales: Definitions and Some Examples, Stopping Times, Martingale Stopping Theorem, Wald Equation.

Learning Outcomes: After successful completion of this course, student will be able to: 1. Use notions of long-time behaviour including transience, recurrence, and equilibrium in applied situations such as branching processes and random walk.

2. Construct transition matrices for Markov dependent behaviour and summarize process information

3. Use selected statistical distributions for modeling various phenomena.

4. Understand the principles and objectives of model building based on Markov chains, Poisson processes and Brownian motion.

References Books:

1. Bhat, B.R. (2000). Stochastic Models- Analysis and Applications, New Age International Publishers.
2. Feller, William (1968). An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Edn., John Wiley & Sons.
3. Karlin, S. and Taylor, H.M. (1975). A first course in Stochastic Processes, Second ed. Academic Press
4. Medhi, J. (1994). Stochastic Processes, Seconded Wiley Eastern Ltd.
5. Prabhu, N.U. (2007). Stochastic Processes: Basic Theory and its Applications, World Scientific
6. Ross, S. M. (1996). Stochastic Processes, John Wiley and Sons, Inc
7. Taylor, H.M. and Karlin, S. (1998). An Introduction To Stochastic Modelling, 3rd ed., Academic Press.

Paper V: MA 305 FLUID MECHANICS
(Elective Paper)

Learning Objectives:

- To give a comprehensive overview of basic concepts of fluid mechanics.
- To introduce the concepts of kinematics and kinetics in fluid flows.
- To enable the students understand the two-dimensional flows in various geometries.
- To introduce the hydrodynamical aspects of conformal transformation.
- To demonstrate various viscous fluid flows.

UNIT I

KINEMATICS OF FLUIDS IN MOTION

Real and Ideal fluids – Velocity - Acceleration – Streamlines – Path lines – Steady & unsteady flows –Velocity potential – Vorticity vector – Local and particle rates of change – Equation of continuity – Conditions at a rigid boundary.

UNIT II

EQUATIONS OF MOTION OF A FLUID

Pressure at a point in a fluid – Boundary conditions of two inviscid immiscible fluids – Euler's equations of motion – Bernoulli's equation – Some potential theorems – Flows involving axial symmetry.

UNIT III

TWO DIMENSIONAL FLOWS

Two-Dimensional flows – Use of cylindrical polar co-ordinates – Stream function, omplex potential for two-dimensional flows.

UNIT IV

Irrotational, incompressible flow – Complex potential for standard twodimensional flows – Two dimensional image systems – Milne-Thomson circle theorem – Theorem of Blasius.

UNIT V

VISCOUS FLOWS

Stress – Rate of strain – Stress analysis – Relation between stress and rate of strain – Coefficient of viscosity – Laminar flow – Navier-Stokes equations of motion – Some problems in viscous flow.

Learning Outcomes:

At the end of the course, the students will be able to

- understand the concepts of kinematics and kinetics of fluid flows.
- derive the governing equations of fluid flows.
- solve the fluid flows in two-dimensional and axisymmetric geometries.
- apply conformal transformation to fluid flows.
- solve the viscous fluid flow problems in different geometries.

REFERENCES

1. Batchelor G.K., "An Introduction to Fluid Dynamics", Cambridge University Press, Cambridge, 2000.
2. Frank Chorlton, "Textbook of Fluid Dynamics", CBS Publishers, New Delhi, 1985
3. Milne Thomson L.M., "Theoretical Hydrodynamics", Macmillan, New York, 1967.
4. White F.M., "Fluid Mechanics", McGraw-Hill, Seventh Edition, New York, 2011.
5. White F.M., "Viscous Fluid Flow", McGraw-Hill, New York, 1991.

Paper MA306 : PROGRAMMING IN C

RAYALASEEMA UNIVERSITY::KURNOOL
DEPARTMENT OF MATHEMATICS
Semester – IV: Syllabus
(w.e.f. 2022-2023)

Paper I: MA 401 GALOIS THEORY

(Core)

Learning Objectives: To have understood the Algebraic Extensions of Fields, Normal and Separable Extensions, Fundamental Theorem of Galois Theory and how, together with some results of group theory, this sheds light to solubility of polynomial equations.

UNIT – I

Unique factorization domains – Principal ideal domains – Euclidean domains – Polynomial rings over UFD.

UNIT - II

Algebraic Extensions of Fields : Irreducible polynomials and Eisenstein criterion – Adjunction of roots – Algebraic Extensions – Algebraically closed fields.

UNIT – III

Normal and Separable Extensions : Splitting fields - Normal Extensions - Multiple roots – finite fields – separable Extensions.

UNIT – IV

Galois theory : Automorphism groups and fixed fields - Fundamental theorem of Galois theory - Fundamental theorem of Algebra.

UNIT – V

Applications of Galois theory to Classical Problems: Roots of Unity and cyclotomic polynomials - cyclic extensions - polynomials solvable by radicals - symmetric functions.

Learning Outcomes: From this subject , students will obtane the knowledge and skills to:

1. Explain the fundamental concepts of field extensions and Galois theory and their role in modern mathematics and applied contexts
2. Demonstrate accurate and efficient use of field extensions and Galois theory.
3. Demonstrate capacity for mathematical reasoning through analyzing, proving and explaining concepts from field extensions and Galois theory.
4. Apply problem-solving using field extensions and Galois theory applied to diverse situations in physics, engineering and other mathematical contexts

Standard and treatment as in Chapter 11, Chapter 15, Chapter16, Chapter 17 and Sections 1,2,3 & 4 of Chapter 18 of BASIC ABSTRACT ALGEBRA by P.B. Bhattacharya, S.K.Jain and S.R. Nagpal, Cambridge University press, Second edition 1995.

PAPER MA 402: ANALYTICAL NUMBER THOERY
(Core)

Learning Objectives:

- i The aim of this course is to give understanding of analytic Number Theory.
- ii The students will be able to apply the techniques of big O – notations and the problems of O – notations with the Arithmetic functions.
- iii To understand on properties of Congruence's and to salvation of and the proof of their theorems.
- iv To understand the Quadratic Residuesand learn techniques of the Jacobi's symbol and Primitive roots.

UNIT-I

Averages of Arithmetical Functions and Dirichlet Multiplication Introduction – The Mobius Function– The Euler totient function– A relation connecting □ and - A product formula for– The Dirichlet product of Arithemetical functions – Dirichlet inverses and the Mobius inversion formula – The Mangoldt function– Multiplicaive functions and Dirichler Multiplication – The inverse of a completely Multiplicatve functions – Livouville's function – The divisor function u(n) - Generalised convolutions – Formal power Series – The Bell Series of an arithmetical functions – Bell Series and Dirichelt multiplication – Derivatives of arithmetical functions – The Selbergindentity.

UNIT-II

Average order of Arithmetical functions introduction – The big O notation – Asymptotic equality of functions – Euler's summation formula Some elementary asymptotic formulas – The average order of d(n) – The average order of the divisor function - The average order – An application to the distribution of lattice points visible from the origin – The average order of $\mu(n)$ and of A(n) – The partial sums of a Dirichelt product – Applications to $\mu(n)$ and A(n) – Another identity for the partial sums of Dirichlet Product.

UNIT-III

Congruences Definition and basic properties of congruencies – Residue classes and complete residue systems – Linear congruences – Reduced residue system and the Euler fermat theorem – Polynomial congruences modulo p Lagranges theorem – Application of lagranges theorem –.

UNIT-IV

Simulataneous linear congruences – The Chinese remainder theorem – Polynomial congruences with prime power moduli The Principle of cross classification – A decomposition property of reduced residue system.

UNIT-V

Quadratic Residues – Legender Symbol – and its properties Evaluation (-1/P) and (2/P) – Gauss lemma, Quadratic reciprocity Law – Applications of reciprocity law – The Jacobi's symbol. Primitive roots the exponent of a number mod m – Primitve roots and reduced residue system – The non existence of Primitive roots mod 2nd for $\alpha \geq 3$.

Course Outcomes: At the end of the course students will to be able to

i. Analyze and prove results presented in analytic number theory.
ii. They will also be able to prove results similar to the ones presented in the course and apply the basic techniques, results and concepts of the course to concrete examples and exercises.
iii. Further will be able understand the interdisciplinary nature with other mathematical branches.
iv. Having the knowledge of partition theory they will be able to understand theoretical physics and combinatorics.

Text Book:
Standard and treatment as in Chapter2.Articles 3.1 to 3.10 of Chapter 3.Chapter 5.Articles 9.1 to 9.7 of chapter 9.Articles 10.1 to 10.3 of Chapter 10. Of the Text **An Introduction to Analyical Number Theory** by Tom M Apostol. Springer verlag International Student edition.

References:

1. 1.George E. Andrews ; Number Theory, W. B. Saunders Company, Philadelphia , London, Toronto.
2. 2.Koblitz, Neal, A Course in Number Theory and Cryptography, Graduate Texts in Mathematics, Springer, 1987.
3. Rosen, M. and Ireland, K., A Classical Introduction to Number Theory, Graduate Texts in Mathematics, Springer, 1982.
4. Bressoud, David, Factorization and Primality Testing, Undergraduate Texts in Mathematics, Springer, 1989.

Paper III MA 403: OPERATIONS RESEARCH
(Elective)

Learning Objectives: The objective of this course is to make the students to:
- Identify and develop operational research models from the verbal description of the real system
- Understand the mathematical tools that are needed to solve optimization problems.
- Understand the theoretical workings of the simplex method for linear programming and perform iterations.
- Understand the relationship between a linear program and its dual and complementary slackness
- Solve specialized linear programming problems like the transportation and assignment problems.
- Learn to recognize strategic environments and to use Game Theory to gain a better understanding of interactions and outcomes within them.
- Solve network scheduling models by PERT/CPM like the shortest path, minimum spanning tree, and maximum flow problems.

UNIT-I

Linear programming Problem Introduction – Mathematical Formlation of the Problem – Graphical solution Method – General Linear Programming Problem – canonical and Standard forms of LPP – The Simplex Method Introduction – Fundamental properties of solutions.

UNIT-II

The computational procedure – Artificial variable Techniques – Problems of degeneracy. Concepts of Duality Formulation of Primal – Dual Problems – Duality theorems – Complimentary slack variables – Duality and Simplex method – Dual Simplex Algorithm .

UNIT-III

The transportation Problem – Mathematical formulation of the Transportation problem – Finding Initial Basis feasible solution – Moving towards optimality – Degeneracy in Transportation problems – Unbalanced Transportation problems – Transhipment problems – Assignment problem – Assignment Algorithm- A Typical Assignment problem.

UNIT-IV

Games and Startegies – Introduction – Two- person Zero Sum games – The Maximin – Minimax Principle – Games without saddle point – Mixed strategies – Solution of 2 X 2 rectangular games – Graphical Method – Dominance property – Algebraic Method for m X n Games – Sequencing problems – Problems of Degeneracy Problems with n Jobs and 2 machines – Problems with n Jobs and K machines – Problems with 2 jobs and K machines.

UNIT-V

Network Scheduling by PERT/CPM Introduction – Network and basic components – Rules of Network construction – Time calculations of Network – Critical path method (CPM) – PERT- PERT – Calculatins – Negtive float and Negative slack – Advantages of Network (PERT/CPM).

Learning Outcomes: After completion of this course, students will be able to

1. Formulate Linear Programming Problems of the real world problems.
2. Solve optimization problems by understanding the mathematical tools their limitations
3. Solve linear programming by simplex method.
4. Exploit the advantage of Duality in solving the primal dual systems.
5. Solve specialized linear programming problems like the transportation and assignment problems.
6. Recognize strategic environments and use Game Theory to design strategies by using the concepts like two person zero sum games, MiniMax Principle.

Give recommendations by modeling various network scheduling problems using the concepts like PERT/CPM, shortest path, minimum spanning tree, and maximum flow problems

References

Standard and treatment as in Sections 2.1 to 2.6 of Chapter 2.Sections 3.1 to 3.6 of Chapter 3.Sections 4.1 to 4.7 of Chapter 4.Sections 6.1 to 6.10 of Chapter 6.Sections 7.1 to 7.4 of Chapter 7.Sections 9.1 to 9.10 of chapter 21 of "**Operations Research"** by KantiSwarup.P.K.Gupta and Man Mohan Sultan Chand & Sons. New Delhi.

Paper III MA 403: MATHEMATICAL MODELLING
(Elective)

UNIT-I: Mathematical Modelling through Systems of Ordinary differential Equations of the First Order (Chapter 3: 3.1, 3.2, 3.5, and 3.6)
Mathematical modelling in population dynamics, Mathematical modelling of epidemics 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-II: Mathematical Modelling through difference equations (Chapter 5: 5.1 to 5.3)
The need for 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.

UNIT-III: Mathematical Modelling through difference equations (contd.) (Chapter 5: 5.4 to 5.6)
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-IV: Mathematical modelling through Graphs (Chapter 7: 7.1 to 7.4)
Situations that can be modeled through graphs - Mathematical models in terms of directed graphs - Mathematical models in terms of signed graphs - Mathematical models in terms of weighted graphs.

UNIT-V: Mathematical Modelling through calculus of Variations and Dynamic Programming (Chapter 9: 9.1 to 9.3)
Optimization principles and techniques - Mathematical modelling through calculus of variations - Mathematical Modelling through dynamic programming.

Recommended Text Book: J. N. Kapur, Mathematical Modelling, Willey Eastern Limited, Reprint, 2000.

Reference Books:

1. D. J. G. James and J. J. Macdonald, Case studies in Mathematical Modelling, Stanly Thames, Cheltonham.
2. J.N. Kapur, Mathematical entropy Models.
3. M. Crossand A. O. Moscrcadini, The art of Mathematical Modelling, Ellis Harwood and John Wiley.
4. C. Dyson, Elvery, Principles of Mathematical Modelling, Academic Press, New York.
5. D. N. Burghes, Modelling with Difference Equations, Ellis Harwood and John Wiley.

Paper III MA 403: MATHEMATICAL CONTROL THEORY
(Elective)

Learning Objectives: To introduce basic theories and methodologies required for analyzing and designing advanced control systems.

UNIT – I

Introduction to control theory; General remarks and examples Classical control and transform theory ; Continuous-time systems; Laplace transtform, Discrete-time systems: z-transform

UNIT – II

Preliminary matrix theory Linear dependence and rank Polynonmials, Characteristic roots, Poly nomial matrices, Jordan canonical form, Functions of a matrix, Quadratic and Hermitian forms.

UNIT – III

Matrix solution of linear systems: Solution of uncontrolled system: spectral form, Solution of uncontrolled system: exponential matrix Solution of uncontrolled system: repeated roots. Solution of controlled system Time varying systems Diserete-time systems, Relationships between state space and classical forms.

UNIT – IV

Linear control systems : Controiiability, Observability, Controllability and polynomials Linear feedback, State observers, Realization of constant systems, Discrete-time systems Realization of time varying systems.

UNIT – V

Stabilizability: Algebraie criteria for linear systems, Continuous-time, Discrete-time, Time varying, Nyquist criterion for linear systems, Liapunov theory. Applications of Liapunov theory to linear systems construction of Liapunov funetions Variable gradient method Zubovs method, stability and controlle Input-output stability Linear feedback, Nolinear teedback.

Course Outcomes: The learner will acquire skills to solve observability problems of linear and nonlinear. systems Proficient in solving linear and nonlinear control systems

- Proficient in stability analysis of linear and nonlinear systems
- Proficient in stabilization of control systems
- Proficient in optimal control problems

Text Book: Stephen & Barnett, Introduction to mathematical control theory, Oxford University Press; 2nd edition (1 December 1985).

References Books : 1. K. Balachandran & J. P. Dauer, Elements of Control Theory, Narosa, New Delhi, 1999.

2. Linear Differential Equations and Control by R.Conti, Academic Press, London, 1976.

3. Functional Analysis and Modern Applied Mathematics by R.F.Curtain and A.J.Pritchard, Academic Press, New York, 1977.

4. Controllability of Dynamical Systems by J.Klamka, Kluwer Academic Publisher, Dordrecht, 1991

Paper IV: MA 404: GRAPH THEORY

(MOOCS/ Online/ class) – Can register for the Course from SWAYAM/NPTEL

Learning Objectives: The objective of the course is to introduce students with the fundamental concepts in graph Theory, with a sense of some its modern applications. They will be able to use these methods in subsequent courses in the design and analysis of algorithms, computability theory, software engineering, and computer systems.

UNIT – I

Introduction to Graphs: definition – Graphs as Models – Vertex degrees – Sub graphs – Paths and cycles – The Matrix Representation of Graphs – Fusion.

UNIT – II

Trees and connectivity – Definition and simple properties – Bridges – Spanning trees – Connector problems – Shortest path problems – Cut vertices and connectivity.

UNIT – III

Euler tours and Hamiltonian Cycles : Euler tours – The Chinese Postman Problem – Hamiltonian graphs – The Traveling salesman Problem.

UNIT – IV

Planar Graphs : Plane and Planar graphs – Euler's formula – The platonic bodies.

UNIT – V

Kuratowski's Theorem – Non Hamiltonian plane graphs – The Dual of a plane graph.

Learning Outcomes: Upon completion of the course, students should possess the following skills:

- Understand the basic concepts of graphs, directed graphs, and weighted graphs and able to present a graph by matrices.
- Understand the properties of trees and able to find a minimal spanning tree for a given weighted graph.
- Understand Eulerian and Hamiltonian graphs.

References: *Standard and treatment as in Chapters 1,2,3 and 5* ***"A First Look At Graph Theory"*** *by John Clark and Derek Allan Holton, Allied Publishers Ltd.*

MA 405**: PROJECT**

MA 406 : **Mat Lab - Skilled**

MA 406 : **COMPREHENSIVE VIVA**