SHRI G. S. INSTITUTE OF TECHNOLOGY AND SCIENCE, INDORE
(GOVERNMENT AIDED AUTONOMOUS INSTITUTE)

DEPARTMENT OF
APPLIED MATHEMATICS AND COMPUTATIONAL SCIENCE

Syllabi of PG Subjects

(Approved by B.O.S. held on 17-07-2020 and Academic Council held on11- 11 - 2020)

INDEX

DEPARTMENT OF APPLIED MATHEMATICS AND COMPUTATIONAL SCIENCE

M.Sc. I Semester

MA 94105: COMPUTER AIDED NUMERICAL ANALYSIS

HOURS PER WEEK			CREDITS			MAXIMUM MARKS				
T	P	TU	T	P	TU	THEORY		PRACTICAL		TOTAL MARKS
						CW	END SEM	SW	END SEM	
4	--	--	4	--	--	30	70	--	--	100

COURSE OBECTIVES

To differentiate between numerical methods and numerical analysis and to apply numerical analysis concepts for solving various analytical and real life problems.

COURSE OUTCOMES

After completion of the course, students are able to

- acquire knowledge of numerical analysis and fundamentals of programming
- solve the algebraic, transcendental and system of linear equation using numerical methods
- understand the concept of interpolation and apply it in finding the differentiation and integration
- understand the concept and applications of difference equations
- apply the numerical methods to solve ordinary and partial differential equations

COURSE CONTENTS

THEORY

Unit 1 Errors and approximations, Number representation, Numerical Analysis and numerical Methods, Numerical stability, ill condition and convergence, numerical algorithm and Numerical Flow Charts, an Introduction of MATLAB, overview of C features its use in Numerical Methods.

Unit 2 Solution of Algebraic and Transcendental Equations: Bisection (or Bolzano) method, method of false position, Newton Raphson method. Solution of Simultaneous algebraic equations: Direct method- Gauss Elimination method Gauss Jordan method, Iterative method-Jacobi’s method, Gauss Seidal method.

Unit 3 Interpolation: Introduction, Interpolating polynomial, Missing term techniques, Newton’s forward and backward interpolation formula, central difference formula, Lagrange’s interpolation formula for unequal distances. Numerical differentiation: derivatives from forward and backward interpolations, Numerical Integration: General quadrature formula, formulae derived from it.

Unit 4 Difference equations: Definition, formation of difference equations, linear difference equations with constant coefficients. Difference equations reducible to linear form. Simultaneous difference equations with constant coefficient.

Unit 5 Numerical solution of Ordinary Differential Equations: Initial value problem, Euler's method, Picard's method, Taylor's method, modified Euler's method, Runge method, Runge-Kutta method, Adams-Bashforth method, Milne's method. Numerical solution of Partial Differential Equations: Classification of second order equations, finite difference approximations to partial derivatives. Elliptic, Parabolic and Hyperbolic equations.

ASSESSMENT

1. Internal Assessment for continuous evaluation, mid-term tests, , tutorials, class performance, etc. (30%).
2. End semester Theory Exam (70%)

TEXT BOOKS RECOMMENDED

1. K Sankara Rao, Numerical methods for Scientist and Engineers, Prentice Hall of India.
2. Balaguruswamy E., Numerical methods, Tata McGraw-Hill Publishing Company Ltd., New Delhi.

REFERENCE BOOKS

1. Pradeep Niyogi, Numerical Analysis and Algorithm, Tata Mcgraw-Hill Publishing Com. Ltd, New Delhi.
2. Jain N.K., Iyengar, S.R.K. and Jain R.K., Numerical methods for scientific and Engineering Computations, Wile Eastern Ltd.,1984.
3. Steven C. Chapra and Raymond P. Candle, Numerical methods for Engineers, 5th edition, Tata McGraw hill publishing company Ltd., New Delhi2006.

DEPARTMENT OF APPLIED MATHEMATICS AND COMPUTATIONAL SCIENCE
M.Sc. I Semester
MA 94106: COMPUTER ARCHITECTURE

<table>
<tr><td colspan="3">HOURS PER WEEK</td><td colspan="3">CREDITS</td><td colspan="5">MAXIMUM MARKS</td></tr>
<tr><td rowspan="2">T</td><td rowspan="2">P</td><td rowspan="2">TU</td><td rowspan="2">T</td><td rowspan="2">P</td><td rowspan="2">TU</td><td colspan="2">THEORY</td><td colspan="2">PRACTICAL</td><td>TOTAL MARKS</td></tr>
<tr><td>CW</td><td>END SEM</td><td>SW</td><td>END SEM</td><td></td></tr>
<tr><td>4</td><td>--</td><td>--</td><td>4</td><td>--</td><td>--</td><td>30</td><td>70</td><td>--</td><td>--</td><td>100</td></tr>
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COURSE OBJECTIVE

To introduce the general concepts of digital logic design and its applications, architecture of memory and I/O organization in a computer system and fundamentals concepts of parallel computing, pipeline processing, vector processing and array processing.

COURSE OUTCOMES

After completion of the course, students will be able to

- acquire the knowledge ofnumber systems, general concepts of digital devices and their use in combinational and sequential logic circuit design and solve Boolean expression using Karnaugh map method.
- understand the working process, structure and **organization of various parts of a system memory hierarchy and CPU.**
- understand the internal organization of DMA, Input/Outputs processor and relations between their main components.
- acquire the knowledge of advanced concepts of parallel processing, different types of Inter processor arbitration techniques, inter processor communication and synchronization.
- Understand **the fundamentals concepts of pipeline processing, vector processing**, array processing and RISC/CISC architectures.

COURSE CONTENTS

THEORY

Unit 1 Introduction to CA : Number system , Von Neumann Model , Digital devices: Logic gates , flip flops , Logic Design : Boolean Algebra , K-map , Method of simplification of Logic expression , Combinational & Sequential circuits.

Unit 2 CPU Organization: ALU, Control unit, Registers, Memory organization, memory properties, Associative memory, Cache memory, machine language level, instruction types, Input Output Organization: I/O interface. Modes of transfer.

Unit 3 Memory: Memory mapped I/O and I/O mapped I/O, programmed I/O, concepts of interrupts and DMA, I/O processors, concept of hardwired and micro programmed control instruction.

Unit 4 Introduction to advanced architecture: Parallel processing, Interconnection structure, Interprocessor Arbitration: Serial, Parallel and Dynamic arbitration Procedure, Interprocessor Communication and Synchronization, Cache Coherence.

Unit 5 Pipeline processing: Concepts , Arithmetic and Instruction Pipeline , Vector, and Array processing: vector operation, matrix multiplication, memory interleaving, Attachedarray Processor, SIMD Array Processor. Comparison of RISC and CISC.

ASSESSMENT

1. Internal Assessment for continuous evaluation, mid-term tests, tutorials, class performance, etc. (30%).
2. End semester Theory Exam (70%)

TEXT BOOKS RECOMMENDED

1. Moris Mano, Computer System Architecture, Prentice Hall of India.
2. William Stallings, Computer Organization and Architecture, 7th Edition, Pearson Education Prentice Hall of India,2009.

REFERENCE BOOKS

1. Andrew S.Tanenbaum, Structured Computer organizations, 5th Edition, Pearson Education Prentice Hall of India,2006.
2. A.P.Godse and D.A. Godse, Computer Architecture, 4thEdition, Technical Publications Pune,2009.

DEPARTMENT OF APPLIED MATHEMATICS AND COMPUTATIONAL SCIENCE
M.Sc. I Semester
MA 94108: ADVANCE DISCRETE MATHEMATICS AND ALGEBRA

HOURS PER WEEK			CREDITS			MAXIMUM MARKS				
T	P	TU	T	P	TU	THEORY		PRACTICAL		TOTAL MARKS
						CW	END SEM	SW	END SEM	
4	--	--	4	--	--	30	70	--	--	100

COURSE OBJECTIVE

To introduce the concept of set theory, Boolean algebra, Graph theory, Automatatheory, theory of formal languages, grammars, ring and field theory.

COURSE OUTCOMES

After completion of the course, students are able to

- understand the basic concepts of set theory, Boolean algebraand mathematical logic for analyzing prepositions.
- understand various graphs, solving minimal weight problems and shortest path problems using suitable algorithm in graph theory.
- understand basic properties of formal languages, grammars and finite automata.
- understand ring theory and modules theory with their properties.
- Apply basic theory of vector space in field extensions.

COURSE CONTENTS

THEORY

Unit 1 Formal Logic: Basic preliminaries Sets, functions, relations (equivalence relations and poset) for logic and subsequent development; statements, symbolic representation and tautologies, Quantifiers, Predicates, Propositional and Predicate calculus, Proofs & method of proofs, Algebra and Lattices: Boolean expression, Logic gates and circuits, Karnaugh maps, Lattices, Distributive lattice.

Unit 2 Graph Theory: Definition of (Undirected) Graphs, Paths, Circuits, Cycles and Subgraphs, Degree of Vertex ,Connectivity, Complete regular and bipartite graphs and Complete Bipartite Graphs, Kuratowskis Theorem (Statement only) and its uses, planer graphs and their properties, Euler's formula for connected Planer Graphs, Graph colourings, directed graphs, Trees and Binary Trees, Spanning Trees, Cut-sets, Minimal Spanning Trees, Euler's Theorem on the existence of Eulerian paths and circuits, Directed Graphs, In degree and Out degree of a vertex, weighted undirected graphs, Matrix representation of Graph.

Unit 3 Introduction to Languages, Operation on Languages, Regular Expression, Regular Languages, Grammars, Language generated by a grammar, Types of Grammars, Finite State Automata, Pumping Lemma , Finite State Machine, Turing Machine.

Unit 4 Algebra: Review of basic concepts of group theory.Rings: Some basic concepts, Algebra over fields, ideals, Minimal, Maximal & prime ideals, PID and UFD, Euclidean domain, Polynomial rings. Modules : Definition of modules, properties of modules, sub modules, linear sum of two sub modules, direct sum of sub modules , homomorphism of modules, kernel of a homomorphism, cyclic modules.

Unit 5 Vector space: Review of Basic Concepts. Field: Extension field, Algebraic and Transcendental Extension field, roots of Polynomial, finite field.

ASSESSMENT

1. Internal Assessment for continuous evaluation, mid-term tests, tutorials, class performance, etc. (30%).
2. End semester Theory Exam (70%)

TEXT BOOKS RECOMMENDED

1. Herstein, I.N, Topics in Algebra, Vikas Publications, Delhi-6, 1969.
2. SwapanK.Sarkar, AText Book of Discrete Mathematics, S. Chand &Company Ltd., N Delhi,2003.
3. S. Lipschutz M. Lipson, Schaum's Outline of Theory and Problems of Discrete Mathematics,2nd edition Tata McGraw Hill Publishing Company Ltd., NewDelhi,1997

REFERENCE BOOKS

1. Artin Michael, Algebra, Pearson Education Inc., 2007.
2. S.A.Wiitala, Discrete Mathematics, A Unified Approach, McGraw Hill Company, Singapore, 1987.

DEPARTMENT OF APPLIED MATHEMATICS AND COMPUTATIONAL SCIENCE
M.Sc. I Semester
MA 94109: ORDINARY AND PARTIAL DIFFRENTIAL EQUATIONS

HOURS PER WEEK			CREDITS			MAXIMUM MARKS				
T	P	TU	T	P	TU	THEORY		PRACTICAL		TOTAL MARKS
						CW	END SEM	SW	END SEM	
4	--	--	4	--	--	30	70	--	--	100

COURSE OBJECTIVE

To introduce the concept of Ordinary Differential Equations, Partial Differential Equationsand their applications.

COURSE OUTCOMES

After completion of the course, students are able to

- solve the problems based on existence and uniqueness of solutions of an initial value problem of first order using the concept of Lipschitz condition.
- understand detailed concepts of existence and uniqueness of solutions of an initial value problem of n-th order linear differential equations. Also they will be able to apply Wronskian and its properties to analyze linear dependence of solutions.
- classify PDE and solve their canonical form.
- apply and solve PDE in various coordinate systems using the method ofseparation of variables.
- understand the concept of Green's function and its applications in solving Laplace, Wave equation and Helmholtz theorem.

COURSE CONTENTS

THEORY

Unit 1 Theory of Ordinary Differential Equation: Initial and Boundary Value Problems, Picard's Iterations, Lipschitz conditions, Sufficient conditions for being Lipschitzian in terms of partial derivatives, Examples of Lipschitzian and Non-Lipschitzian functions, Picard's Theorem for local existence and uniqueness of solutions of an initial value problem of first order which is solved for the derivative, examples of problems without solutions and of equations where Picard's iterations do not converge .

Unit 2 Theory of Ordinary Differential Equation: Existence & Uniqueness for Ordinary Differential Equation, Wronskian and Linear independence, Initial value problem for nth order differential equation, Linear equations with variable coefficients, Lipschitz condition.

Unit 3 Fundamental concepts of partial differential equation, Elliptic differential Equations, Parabolic Differential equations, Hyperbolic Differential Equations.

Unit 4 Method of separation of variables: Laplace, Diffusion and Wave equations in Cartesian, cylindrical and spherical polar coordinates, Boundary value problems for transverse vibrations of strings and heat diffusion in a finite rod, Classification of linear integral equations, Relation between differential and integral equation.

Unit 5 Green's Functions: Introduction, Green's Function for Laplace Equation, Green's Function for the Wave Equation-Helmholtz Theorem.

ASSESSMENT

1. Internal Assessment for continuous evaluation, mid-term tests, tutorials, class performance, etc. (30%).
2. End semester Theory Exam (70%)

TEXT BOOKS RECOMMENDED

1. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall of India, New Delhi, 1968.

2. ZafarAhsan, Differential Equations and their Application, Prentice-Hall of India Pvt. Ltd., New Delhi, 2004.

REFERENCE BOOKS

1. Sankara Rao, K., Introduction to Partial Differential Equations, Prentice Hall of India Pvt. Ltd., New Delhi ,1997.
2. Friedrich Sauvigny, Partial Differential Equations, Springer London Heidelberg 2006.
3. I.N. Sneddon: Elements of Partial Differential Equations, McGraw-Hill Pub.,1957.
4. T. Amaranath: An Elementary Course in Partial Differential Equations, Narosa Pub. 2005.

DEPARTMENT OF APPLIED MATHEMATICS AND COMPUTATIONAL SCIENCE
M.Sc. II Semester
MA 94205: MATHEMATICAL THEORY OF COMPUTATION

HOURS PER WEEK			CREDITS			MAXIMUM MARKS				
T	P	TU	T	P	TU	THEORY		PRACTICAL		TOTAL MARKS
						CW	END SEM	SW	END SEM	
4	--	--	4	--	--	30	70	--	--	100

COURSE OBJECTIVE

To introduce the concepts of mathematical foundations of computation using automata theory, formal languages and grammar, turing machine with their complexity and computability.

COURSE OUTCOMES

After completion of the course, students are able to

- acquire the knowledge of basic concepts of set theory, graphs, preposition and predicate calculus.
- understand the concept of finite automata and its different types together with formal languages and grammars, regular grammar and regular languages.
- understand the fundamental concepts and properties of context-free languages , context-free grammar and solve various problems by applying normal form techniques for context free-grammars.
- analyze and design Pushdown Automata machine for given CF language.
- acquire the knowledge of basic concepts of Turing machines and solve computational problems regarding their computability and complexity.

COURSE CONTENTS

THEORY

Unit 1 Introduction: Review of sets, Relations and Functions, Graphs, Trees, Principal of Induction, Languages and Grammers-Fundamental Concepts, Preposition and Predicate Calculus.

Unit 2 Theory of Automata: Definition of Automata; Description of finite Automata-Deterministic finite Accepters (DFAs), Non-deterministic finite Accepters (NFAs),Regular expression, Regular Grammars and Languages, Properties of Regular Languages, Pumping Lemma for Regular Languages.

Unit 3 Context Free Languages: Context free-grammars and Derivation Trees, Parsing and ambiguity, Normal form for Context free-grammars -Chomsky and Greibach normal form, Pumping Lemma for Context Free languages,Properties of Context Free languages.

Unit 4 Pushdown Automata:Basic Definition of Pushdown Automata, Non Deterministic Pushdown Automata and Deterministic PushdownAutomata, Pushdown Automata and Context Free languages.

Unit 5 Turing Machines:Definition of a Turing Machine, Turing Machine as Language, Accepters, Turing's Thesis, Universal Turing Machine, Linear Bounded Automata, Computational complexity theory- P and NP Problems.

ASSESSMENT

1. Internal Assessment for continuous evaluation, mid-term tests, tutorials, class performance, etc. (30%).
2. End semester Theory Exam (70%)

TEXT BOOKS RECOMMENDED

1. Peter Linz, An Introduction to Formal Languages and Automata, 2nd Edition, Narosa Publishing House,1997.
2. K.L.P.Mishra, N.Chandrasekaran, Theory of Computer Science Automata, Language and Computation, 3rd Edition, Prentice Hall of India,2007.

REFERENCE BOOKS

1.H. R. Lewis and C.H.Papadimitriu , Elements of the theory of Computations, Prentice Hall of India Pvt. Ltd., New Delhi;1999.
2.Robert N. Moll , Michael A. Arbib , A.J.Kfoury , An introduction to formal language theory , Springer Verlag, New York,1988.
3.Michael Sipser, Introduction to the Theory of Computations, PWS Publishing Company Boston,1997.

DEPARTMENT OF APPLIED MATHEMATICS AND COMPUTATIONAL SCIENCE
M.Sc. II Semester
MA 94206: DATA PROCESSING AND COMPUTATION

HOURS PER WEEK			CREDITS			MAXIMUM MARKS				
T	P	TU	T	P	TU	THEORY		PRACTICAL		TOTAL MARKS
						CW	END SEM	SW	END SEM	
4	--	--	4	--	--	30	70	--	--	100

COURSE OBJECTIVE

To introduce the concept of data models, Structured Query Language (SQL), network and hierarchical data model and data base methodologies

COURSE OUTCOMES

After completion of the course, students are able to

- acquire the knowledge of basic concepts of various data model used in database design .
- understand ER modeling, relational modeling and apply relational database theory to describe relational algebra expression.
- write SQL queries to retrieve information from databases and understand the concepts and importance of indexing, view and sequences.
- acquire the knowledge of basic concepts of normalization theory, network and hierarchical data models.
- understand the concept of query processing ,optimization techniques, transaction, concurrency control and recovery in database.

COURSECONTENTS

THEORY

Unit 1 Basics concepts, Data Models: Categories Schema, Instances and database state, Database architecture and data independence, database languages.

Unit 2 Data Models: Entity relationships models, Relational Data Models, Relational algebra: Basic Relational algebra operations.

Unit 3 Structured Query languages (SQL): Data Types, Basic Quires in SQL, insert, delete & update statements in SQL, indexing, sequences and VIEW in SQL (LAB).

Unit 4 Network and Hierarchical data models, Normalization theory.

Unit 5 Database methodologies and DBA, Transaction Management: Basic concepts of Transactions, Concurrency Control and Recovery system, Query Processing.

ASSESSMENT

1. Internal Assessment for continuous evaluation, mid-term tests, tutorials, class performance, etc. (30%).
2. End semester Theory Exam (70%)

TEXT BOOKS RECOMMENDED

1. RamezElmasri and ShamkantB.Navathe, Fundamentals of Database Systems, 7th Edition, Pearson,2016.
2. H.F Korth, A. Silberchatz and S.Sudarshan, Database Systems Concepts,6th Edition McGraw Hill,2010.

REFERENCE BOOKS

1. J.D WaldmenGalgolia, Principles of Database Systems,1984.
2. Fundamentals of Database Management System, RenuWig and EktaWalia, Indian Society for Technical Education, New Mehrauli Road, NewDelhi-110016.

DEPARTMENT OF APPLIED MATHEMATICS AND COMPUTATIONAL SCIENCE
M.Sc. II Semester
MA 94207: OPERATIONS RESEARCH

HOURS PER WEEK			CREDITS			MAXIMUM MARKS				
T	P	TU	T	P	TU	THEORY		PRACTICAL		TOTAL MARKS
						CW	END SEM	SW	END SEM	
4	--	--	4	--	--	30	70	--	--	100

COURSE OBJECTIVE

To introduce operation research for solving assignment, transportation, sequencing, Dynamic and Non-Linear Programming problems.

COURSE OUTCOMES

After completion of the course, students are able to

- formulate and solve linear programming problems using graphical, Simplex, dual Simplex and Big M methods.
- solve Assignment, Transportation and Game Theory problems.
- apply sequencing and scheduling problems
- understand basic concepts related to information theory and its applications
- understand and apply dynamic programming problems and non-linear programming problems

COURSE CONTENTS

THEORY

Unit 1 Introduction to Operations research, Mathematical formation of Linear Programming problems, Graphical solution as two phase method, Linear Programming problems, Simplex method, Big M method, Duality in linear programming, Dual simplex method, degeneracy.

Unit 2 Assignment and Transportation problems, Game theory: Simple and mixed strategy game, two persons zero sum games, Dominance property.

Unit 3 Sequencing and scheduling: Sequencing problem with n jobs and m machines, optimal sequence algorithm, Critical path determination by CPM and PERT methods.

Unit 4 Information Theory: Basics ideas, Communication system, Noisy and noiseless channel, Channel matrix, Mathematical Definition of information, Measure of uncertainty and properties of entropy function, Channel capacity, efficiency and redundancy encoding, Shannon Fano method.

Unit 5 Dynamic and Non-linear programming: Concept of dynamic programming,decision tree and Bellman's principle of optimality, Solution of problem with finite number of stages, minimum path problem. Lagrangian method, Kuhn- Tucker conditions, Quadratic programming.

ASSESSMENT

1. Internal Assessment for continuous evaluation, mid-term tests, tutorials, class performance, etc. (30%).
2. End semester Theory Exam (70%)

TEXT BOOKS RECOMMENDED

1. TahaH. A, Operations Research: An Introduction, McMillian Co., NewYork.
2. Gupta, Kanti Swaroop, Gupta P.K. and Manmohan, Operations Research, Sultan Chand and Sons, NewDelhi.

REFERENCE BOOKS

1. R. Pannerselvam, Operations Research, Prentice Hall of India Pvt. Ltd., New Delhi, 2004.
2. S.D. Sharma, Operations Research, KedarNath&Co.Meerut.

DEPARTMENT OF APPLIED MATHEMATICS AND COMPUTATIONAL SCIENCE
M.Sc. II Semester
MA 94208: REAL AND COMPLEX ANAYSILS

<table>
<tr><td colspan="3">HOURS PER WEEK</td><td colspan="3">CREDITS</td><td colspan="5">MAXIMUM MARKS</td></tr>
<tr><td rowspan="2">T</td><td rowspan="2">P</td><td rowspan="2">TU</td><td rowspan="2">T</td><td rowspan="2">P</td><td rowspan="2">TU</td><td colspan="2">THEORY</td><td colspan="2">PRACTICAL</td><td>TOTAL MARKS</td></tr>
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<tr><td>4</td><td>--</td><td>--</td><td>4</td><td>--</td><td>--</td><td>30</td><td>70</td><td>--</td><td>--</td><td>100</td></tr>
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COURSE OBJECTIVE

To introduce the concept of Lebesgue measure theory, Fourier Series, Real and Complex Analysis.

COURSE OUTCOMES

After completion of the course, students are able to

- understand the concept of measurable sets, measurable functions and Lebesgue integration.
- understand Fourier series with its convergent criteria and consequences of Riemann-Lebesgue theorem.
- understand the concept of analytic functions, conformal mappings and their properties, application of mean value property, Poisson and Schwartz's theorem.
- solve the integration of function of complex variable using Cauchy's theorem and integral formula.
- understand the concept of Cauchy residue theorem and its application.

COURSE CONTENTS

THEORY

Unit 1 Measure theory, function of bounded variation, measurable non-measurable sets, Borel sets, measurable functions, Lebesgue integral for bounded function over a set of finite measure, Lebesgue integral for unbounded function, theorems on convergence in measure, Lebsegue class L^P.

Unit 2 Fourier series: Convergent criteria of Fourier series, Convergent problem, Dirichlet's Conditions, Riemann-Lebesgue Theorem and its Consequences and Fourier analysis.

Unit 3 Concept of analytic function, C-R equations, Conjugate function, harmonic functions, the mean value property, Poisson's formula, Schwarz's theorem and the reflection principle. Conformality, areas and closed curves analytic function in regions, Conformal mapping, length and area, linear transformation, the linear groups, cross-ratio symmetry and oriented circles, use of level surface.

Unit 4 Complex Integration: Line integrals, Rectifiable arcs, Cauchy's theorem for a rectangle, Cauchy's theorem for a circular disk. The index of a point with respect to a closed curve, Cauchy's integral formula.

Unit 5 The general form of Cauchy's theorem and calculus of residues: chains and cycles, simple connectivity, Exact differentials in simply connected regions, Residue theorem, the argument principle, Branch points.

ASSESSMENT

1. Internal Assessment for continuous evaluation, mid-term tests, tutorials, class performance, etc. (30%).
2. End semester Theory Exam (70%)

TEXT BOOKS RECOMMENDED

1. AlhforsL.V., Complex Analysis (3rd Edition), McGraw Hill, Inc. Singapore, 1979.
2.Royden H.L., Real Analysis (3rd Edition), Collier Macmillan International, New York, 1987.

REFERENCE BOOKS

1.SE.C.Titchmarsh, The Theory of Functions, 2nd edition, Oxford University Press,London,1939.
2.Singh Bijendra ,KaranjgaokarVarsha, Chandel R.S. , Complex Analysis , Gaura Pustak Sadan ,Agra.

DEPARTMENT OF APPLIED MATHEMATICS AND COMPUTATIONAL SCIENCE
M.Sc. III Semester
MA 94303: FUNCTIONAL ANALYSIS AND INTEGRAL EQUATIONS

HOURS PER WEEK			CREDITS			MAXIMUM MARKS				
T	P	TU	T	P	TU	THEORY		PRACTICAL		TOTAL MARKS
						CW	END SEM	SW	END SEM	
4	--	--	4	--	--	30	70	--	--	100

COURSE OBJECTIVE

To introduce the concepts of Topological space, Normed linear space, Hilbert space, Finite dimensional spectral theory and Integral Equations.

COURSE OUTCOMES

After completion of the course, students are able to

- Acquire the knowledge of continuous functions, homeomorphisms, compact spaces, connected spaces and separation axioms over various topological spaces.
- understand the proof and application of some famous theorems as; Hahn-Banach theorem, closed graph theorem and Uniform bounded principle in functional analysis.
- understand the concept of Hilbert space and its properties, application of Bessel's inequality, Riesz representation theorem.
- understand the concept of various operators with their properties, application of spectral theorems and fixed point theory.
- solve the problems on integral equation and use ofgreen's function in boundary value problems.

COURSE CONTENTS

THEORY

Unit 1 Topological Space: Definition, Open Set, Closed Set, Neighborhood, filter, Countable Space, Separation axioms, Continuous mapping, Homomorphism, Connectedness and Compactness.

Unit 2 Normed Linear Spaces**:** Branch space, Quotient space, continuous linear transformation, Hahn Banach theorem and its consequences, Conjugate space and separability. The Natural imbedding of the normed linear closed graph theorem, The uniform boundedness principle.

Unit 3 Hilbert Spaces: Definition and some of its properties, orthonormal complements, the projection theorem, orthonormal sets. The Bessel'sinequality, Fourier expansion and parseval's equation (without proof) Riesz representation theorem.

Unit 4 Finite Dimensional Spectral Theory: Basic preliminary definitions of adjoint of an operator, self adjoint operators, normal and unitary operators, And their properties. Projections, the spectral theorem, fixed-point theory and its applications.

Unit 5 Integral Equations: Preliminary concepts, formulation of integral equations and Classification of linear integral equations. Integral differential equations, conversions of ordinary differential equations to integral equations. Solutions of integral equations with separable kernels. Characteristics number and eigen functions, fredholm determinant method. Construction of Green's functions and its use in solving the boundary value problems, reductions of B.V. problems to integral equations. Resolvantkernal of the integral equations, method of successive approximation, convolution type kernels integral transform methods.

ASSESSMENT

1. Internal Assessment for continuous evaluation, mid-term tests, tutorials, class performance, etc. (30%).
2. End semester Theory Exam (70%)

TEXT BOOKS RECOMMENDED

1. B.k. Lahiri , Elements of functional analysis, The world press Pvt. Ltd. , Calcutta,1982.
2.Karsnov M., Kiselv A., MakAernkog, Problems and Exercise in Integral Equations.

REFERENCE BOOKS

1. A.H. Siddhiqui, Functional Analysis. With Applications, Tata McGraw HillPublishing Company Ltd., New Delhi, 1986.
2. G. F. Simmons, "Introduction to Topology and Modern Analysis," McGraw Hill Book Company, Inc., New York,1963.

DEPARTMENT OF APPLIED MATHEMATICS AND COMPUTATIONAL SCIENCE
M.Sc. III Semester
MA 94304: OBJECT ORIENTED PROGRAMMING SYSTEMS

HOURS PER WEEK			CREDITS			MAXIMUM MARKS				
T	P	TU	T	P	TU	THEORY		PRACTICAL		TOTAL MARKS
						CW	END SEM	SW	END SEM	
4	--	--	4	--	--	30	70	--	--	100

COURSE OBJECTIVE

To develop programming skills, learn the basic concepts of OOPS, object-oriented program analysis, design and testing.

COURSE OUTCOMES

After completion of the course, students are able to

- understand the basic concepts and importance of object oriented programming system, difference between structured oriented and object oriented programming features.
- apply the concepts of objects, classes, function overloading, operator overloading for developing programs.
- understand the concepts of inheritance, polymorphism and its different types.
- investigate principles and different methods of object-oriented analysis and design.
- acquire the knowledge of basic aspects of object-oriented program testing with its different methods, techniques of Rapid Prototyping and UML.

COURSE CONTENTS

THEORY

Unit 1 Introduction to Object Oriented Programming fundamentals, Comparison with procedural programming, Basic concepts of object oriented programming, Merits and demerits of OO methodology, Elements of the object model.

Unit 2 Object oriented concepts: Concepts of objects and classes, attributes and methods, Access modifiers, static member of a class, Instances, Message passing, Constructors and destructor, data abstraction, encapsulation and data hiding.

Unit 3 Inheritance: purpose and its types, Polymorphism: Introduction, Method of overriding and overloading, compile time and run time polymorphism.

Unit 4 Introduction to object oriented analysis and design: Design concepts, use cases, class diagrams, State Transition diagrams, object diagrams.

Unit 5 Rapid prototyping: Overview, method process and techniques, object oriented testing: Concepts, methods, UML pattern.

ASSESSMENT

1. Internal Assessment for continuous evaluation, mid-term tests, tutorials, class performance, etc. (30%).
2. End semester Theory Exam (70%)

TEXT BOOKS RECOMMENDED

1. Grady Booch, Objected Oriented Analysis and Design with Applications, Addison Wesley, 2nd Edition California 1994.
2. Balaguruswamy, Object Oriented Programming using C++, TataMc-Graw publication, 1995.

REFERENCE BOOKS

1. James Martin, Principles of Object Oriented Analysis and Design, Prentice Hall.
2. Timothy A. Budd, An Introduction to Object Oriented Programming, 3rdEdition,Pearson Education,2008.

DEPARTMENT OF APPLIED MATHEMATICS AND COMPUTATIONAL SCIENCE
M.Sc. III Semester
MA 94352: STATISTICAL QUALITY CONTROL, STOCHASTIC PROCESS AND RELIABILITY

HOURS PER WEEK			CREDITS			MAXIMUM MARKS				
T	P	TU	T	P	TU	THEORY		PRACTICAL		TOTAL MARKS
						CW	END SEM	SW	END SEM	
4	--	--	4	--	--	30	70	--	--	100

COURSE OBJECTIVE

To introduce the concept of reliability, sampling theory, statistical quality control and stochastic process.

COURSE OUTCOMES

After completion of the course, students are able to

- understand the concept of random variables, various distributions and also use reliability concept to analyze the system failures.
- acquire the knowledge of sampling distribution and use sampling techniques to test the hypothesis.
- understand the concept of statistical quality control and apply them in real life problems
- differentiate between various sampling plans using Acceptance Sampling
- classify random processes and also understand Markov Process

COURSE CONTENTS

THEORY

Unit 1 Reliability: Introduction, A Brief idea of random variable, sample space probability distributions, evaluation of system reliability.

Unit 2 Sampling Theory: Sampling distribution, law of large number and central limit theorem, theory of estimation, Test of Hypothesis.

Unit 3 Statistical Quality Control: Aims, objectives and advantages of SQC, Techniques of SQC , Control charts for variables and attributes, Process capabilities.

Unit 4 Acceptance Sampling: Definition, Acceptance, Sampling Plans: Single, Double and sequential sampling plans, Operating Characteristics Curves (O.C.), producer’s and consumer’s risk. A brief idea of Taguchi method.

Unit 5 Stochastic Process: Classification of stochastic process, Autocorrelation function. Poissonian process-Queuing and birth and death process; Markovian process. Renewal theory.

ASSESSMENT

1. Internal Assessment for continuous evaluation, mid-term tests, tutorials, class performance, etc. (30%).
2. End semester Theory Exam (70%)

TEXT BOOKS RECOMMENDED

1. A. Baisnab and M. Jana, Elements of Probability and Statistics, Tata MacGraw Hill Publishing Company Ltd., New Delhi,1993.
2. Ramesh Sircar, Statistical Techniques and Applications, New Control Book Agency, 8/1, Chintaman Das Lane,Calcutta.

REFERENCE BOOKS

1. Balaguruswamy, A Text Book of Reliability, TataMc-Graw Hill education Pvt.Ltd.2002
2. Papoulis, Athanasios, Probability, Random Variables and Stochastic Process, Mc-Graw Hill BookCo.,2014.

DEPARTMENT OF APPLIED MATHEMATICS AND COMPUTATIONAL SCIENCE
M.Sc. III Semester
MA 94371: MATHEMATICAL AND STATISTICAL MODELLING

HOURS PER WEEK			CREDITS			MAXIMUM MARKS				
T	P	TU	T	P	TU	THEORY		PRACTICAL		TOTAL MARKS
						CW	END SEM	SW	END SEM	
4	--	--	4	--	--	30	70	--	--	100

COURSE OBJECTIVE

To introduce the concept of simulation techniques to implement the Markov process, neural network and fuzzy system.

COURSE OUTCOMES

After completion of the course, students are able to

- understand and apply the modeling and simulation techniques to a variety of engineering problems.
- acquire the knowledge of Markov chain and reliability for quality improvement of manufactured products and components.
- understand the fundamentals of artificial neural networks and apply training algorithms to solve the formalized problem using neural network models.
- use neural networks for practical applications such as character recognition and acquire concept of neuro dynamical models.
- understand basic knowledge of fuzzy sets and fuzzy logic and apply it for practical application.

COURSE CONTENTS

THEORY

Unit 1 Simulation Method: Definition of simulation, application of simulation methods, Monte Carlo Methods and its applications, Evolutionary Techniques.

Unit 2 Markov Process: Application to Reliability and other problems.

Unit 3 Neural Network: Basic Idea, Artificial neural network and its building blocks, Terminologies learning rules, back propagation network and its rule, feedback network, Adaline and madaline network, Neurons as function of single monotocity, single and multiplayer neural network, neural dynamical systems and state spaces, neural dynamic, activation models, additive neuronal dynamics.

Unit 4 Neural Network (contd.): Passive membrane decay, Perceptrons LMS Algorithms, linear stochastic approximation, The back propagation, Functional link network.

Unit 5 Fuzzy System: Definition of Fuzzy sets and set operations, Brief idea of theory of possibility, Fuzzy functions, Fuzzy Algebra, Brief idea of fuzzy statistics, Brief idea of modeling of system under uncertain environments.

ASSESSMENT

1. Internal Assessment for continuous evaluation, mid-term tests, tutorials, class performance, etc. (30%).
2. End semester Theory Exam (70%)

TEXT BOOKS RECOMMENDED

1. S.N. Sivananda, S. Sumathi, S.N. Deepa, Introduction to Neural Network using matlab6.0, Tata McGraw Hill Publishing Company Ltd., New Delhi,2006.
2. Ganesh, Introduction to Fuzzy Sets and Fuzzy Logic, Prentice Hall of India Ltd., New Delhi,2006.

REFERENCE BOOKS

1. H. Simon, Neural Networks and Learning Machines 3rd Edition, Prentice Hall, Canada 2008.
2. K.K.Vinoth,Neural Network and Fuzzy Logic,1st Edition, KATSONBook,2009.

DEPARTMENT OF APPLIED MATHEMATICS AND COMPUTATIONAL SCIENCE

M.C.A. I Year (I Semester)

MA 10210: STATISTICAL COMPUTING TECHNIQUES

HOURS PER WEEK			CREDITS			MAXIMUM MARKS				
T	P	TU	T	P	TU	THEORY		PRACTICAL		TOTAL MARKS
						CW	END SEM	SW	END SEM	
4	2	--	3	1	-	30	70	--	--	100

COURSE OBJECTIVE

To introduce the concept of statistics, probability, forecasting methods and simulation.

COURSE OUTCOMES

After completion of the course, students are able to

- use the probability concepts in problem solving
- understand the basic statistical concepts and sampling theory
- acquire the knowledge of correlation and regression
- apply various forecasting methods in real life problems
- understand and apply simulation techniques to a variety of engineering problems.

COURSE CONTENTS

THEORY

Unit 1 Probability Theory: Mathematical and classical definition of probability. Addition theorem of probability, Multiplication theorem of probability, Conditional probability, Bayes theorem. Introduction to random variables and types of random variable.

Unit 2 Statistics: Meaning and definitions. Uses and limitations of statistics, Measures of Central Tendency (Mean, Median, Mode), Measures of Dispersion (Mean Absoluter Deviation, Mean Squared Deviation, Standard Deviation). Sampling theory and test of hypothesis.

Unit 3 Correlation and Regression Analysis: Importance and types of correlation. Karl-Parson and Spearman's Rank correlation coefficient. Lines of regression, Regression coefficient and their properties. Curve fitting methods of least squares.

Unit 4 Forecasting Methods and Models: Qualitative and Quantitative. Time Series and Its Components, Analysis, Models of Time Series, Measurement of Trend, Seasonal Variations and Cyclic Variations.Time Series Forecasting (Averaging methods, Moving Average, Exponential Smoothing method).

Unit 5 Statistical Simulation: Definition of random numbers, Properties of random numbers, Generation of pseudo-random numbers, Techniques for generating random numbers. Advantages and disadvantages of Simulation, Areas of application. Monte Carlo Simulation.

ASSESSMENT

1. Internal Assessment for continuous evaluation, mid-term tests, tutorials, class performance, etc.(30%)
2. End semester Theory Exam (70%).

TEXT BOOKS RECOMMENDED

1. S. C. Gupta, Fundamental of Statistics, Himalaya Publishing House Pvt. Ltd. New Delhi.
2. Ramesh Sircar, Statistical Techniques and Applications, New Control Book Agency, Kolkata.

REFERENCE BOOKS

1. S. Makridakis, S.C. Wheelwright and R.J. Hyndman, Forecasting Methods and Applications, John Wiley & Sons, NJ.
2. Irvin R. Miller, John E. Freund and R. Johnson, Probability and Statistics for Engineers, PHI Ltd. New Delhi.

DEPARTMENT OF APPLIED MATHEMATICS AND COMPUTATIONAL SCIENCE
M.B.A. I Semester
MAA 1104: MATHEMATICS AND STATISTICS FOR MANAGERS

HOURS PER WEEK			CREDITS			MAXIMUM MARKS				
T	P	TU	T	P	TU	THEORY		PRACTICAL		TOTAL MARKS
						CW	END SEM	SW	END SEM	
3	--		3	--	--	30	70	--	--	100

COURSE OBJECTIVE

To introduce mathematical and statistical techniques and their application to business problems. The emphasis will be on the concepts and application rather than derivations.

COURSE OUTCOMES

After completion of the course, students are able to
- understand the basic concepts of set theory and probability theory
- solve the linear equations using the concept of matrices
- understand the fundamentals of statistic
- understand the various theoretical distributions
- use the concept of time series in prediction and decision making

COURSE CONTENTS

THEORY

Unit 1 Sets theory and probability: Sets, Subsets, Types of Sets, and Operations on Sets, Cartesian Product of Sets, and Applications. Probability Theory: Concepts, Additive, Multiplicative, Conditional Probability Rules, Baye's Theorem.

Unit 2 Determinants and Matrices with Business Application: Types of Matrices, Operations on Matrices, Adjoint Matrix, Inverse Matrix, Elementary Row Operations. Solution of Simultaneous Linear Equations using Matrices, Input/ Output Analysis.

Unit 3 Introduction to Statistics: Meaning and Definition of Statistics, Scope and Limitations of Statistics, Role of Statistics in Management Decisions, Measures of Central Tendency and Dispersion. Correlation and Regression.

Unit 4 Probability Distributions: Theoretical distributions - Binomial, Poisson and Normal Distributions. Their characteristics and applications.

Unit 5 Time Series and Statistical Decision Theory: Time Series and Its Components, Analysis, Models of Time Series, Measurement of Trend, Seasonal Variations and Cyclic Variations. Introduction to Statistical Decision Theory, Decision Making Process, Decisions under Uncertainty and Risk, Decision tree.

ASSESSMENT

1. Internal Assessment for continuous evaluation, mid-term tests, assignments, seminars, class performance, etc.(30%)
2. End semester Theory Exam(70%).

TEXT BOOKS RECOMMENDED

1. J.K. Sharma, Mathematics for Management and Computer Applications, Galgotia Publication
2. D.N. Elhance, Veena Elhance , Fundamentals of Statistics, KitabMahal,1964
3. R. K. Ghosh and S. Saha, Business Mathematics and Statistics, Calcutta, New Central Book Agency,2012

REFERENCE BOOKS

1. J. N. Kapur and H. C. Saxena, Mathematical Statistics, S Chand and Company Ltd.,2013
2. Jayprakash Reddy and M. Reddy, A Text Book of Business Mathematics, Ashish Publishing House,2004

DEPARTMENT OF APPLIED MATHEMATICS AND COMPUTATIONAL SCIENCE
M.B.A. II Semester
MAA 2102: QUANTITATIVE DECISION MAKING

HOURS PER WEEK			CREDITS			MAXIMUM MARKS				
T	P	TU	T	P	TU	THEORY		PRACTICAL		TOTAL MARKS
						CW	END SEM	SW	END SEM	
4	--	--	3	--	--	30	70	--	--	100

COURSE OBJECTIVE

The objectives of this course are to help the students acquire quantitative tools, and use these tools for the analysis and solution of business problems. The emphasis will be on the concepts and application rather than derivations.

COURSE OUTCOMES

After completion of the course, students are able to

- understand the basic concept of quantitative techniques.
- understand different methods for solving linear programming problems.
- find basic feasible solution of transportation problem by various methods.
- use the concept of waiting line model to solve real life problems
- apply simulation techniques in various physical models

COURSE CONTENTS

THEORY

Unit 1 Quantitative Techniques and Operations Research: Meaning, Scope of Quantitative Techniques and Operations Research in Management, Advantages and Limitations of Quantitative Techniques/Operation Research, Operation Research Process.

Unit 2 Linear Programming: Meaning of Linear programming, General Mathematical Formulation of LPP, Graphical Analysis, Solution of LPP: Simplex Method, Big- M Method, Advantage and limitations of LPP.

Unit 3 Transportation Model: Transportation Problem as a particular case of LPP Mathematical Formulation, Initial Basic Feasible Solution, Vogel’s Approximation Method, Optimization (Minimization and Maximization) using Modified Distribution Method and Stepping Stone Method.

Unit 4 Waiting Line Models and Game Theory: Introduction, Scope in Management Decisions, Queuing Models – Single Server, Multi server with infinite capacity. Introduction to Games, Maximin and Minimax Principles, Pure and Mixed Strategies, Rule of dominance, Solutions of Games using –Algebric and Graphical Methods, Game Theory and Linear Programming.

Unit 5 Markov Chain Analysis and Simulation: Computation of sequential probability of states for different periods, Steady State Probability of states and application of Markov Chain. Introduction to simulation, Monte Carlo Technique and its applications, single stage and multi stage simulation.

ASSESSMENT

1. Internal Assessment for continuous evaluation, mid-term tests, assignments, seminars, class performance, etc.(30%)
2. End semester Theory Exam (70%).

TEXT BOOKS RECOMMENDED

1. Gupta, Kanti Swaroop, Gupta P.K. and Manmohan, Operations Research, Sultan Chand and Sons, New Delhi.
2. N.D Vohra, Quantitative Techniques, Tata McGraw Hill, New Delhi,India.
3. P. K. Gupta and D. S. Hira, Operations Research, Sultan Chand Publications, New Delhi.

REFERENCE BOOKS

1. S. D. Sharma, "Operations Research", KedarNath Ram Nath and Co. Meerut, India
2. Rathindra P Sen Operation Research, PHI publications, India
3. Winston, Wayne L., Operation Research applications and algorithms, Wadsworth Publishing Company, Australia.

DEPARTMENT OF APPLIED MATHEMATICS AND COMPUTATIONAL SCIENCE
M.E. ELECTRICAL ENGINEERING (Semester I)
(Specialization: Power Electronics and DTI)
MA 60015: ADVANCED ENGINEERING MATHEMATICS

HOURS PER WEEK			CREDITS			MAXIMUM MARKS				
T	P	TU	T	P	TU	THEORY		PRACTICAL		TOTAL MARKS
						CW	END SEM	SW	END SEM	
4	--	-	4	--	-	30	70	--	--	100

COURSE OBJECTIVE

To introduce the concept of linear system of equations, stochastic process, neural network, non-linear and combinatorial optimization.

COURSE OUTCOMES

After completion of the course, students are able to

- solve the system of linear equations and linear transformations.
- use the correct techniques to solve the non-linear and combinatorial optimization problems.
- acquire the knowledge of graph theory and its applications in solving optimization problems.
- understand the concepts of stochastic theory and its applications.
- implement the concept of neural network to train and analyze the data.

COURSE CONTENTS

THEORY

Unit 1 Linear system of equations: Basic concepts, rank of matrix, linear independence, solution of linear systems of equations: existence, uniqueness and general form, homogeneous and non-homogeneous equations, Eigen values, Eigen vectors, Matrix Eigen-value problems, Applications of Eigen value problem.

Unit 2 Non-Linear Optimization: Formulation of non-linear programming, general non-linear programming problem, Lagrangean method, Kuhn-Tucker condition, Fibonacci Search, Quadratic Interpolation.

Unit 3 Combinatorial Optimization: Introduction and basic terminology of graphs, path, circuit, Eulerian circuits, Hamiltonian cycles, shortest path problem, Dijkstra's algorithm. Tree, spanning tree, minimum spanning tree algorithms: Kruskal's and Prim's algorithm. Flow augmented paths, Ford-Fulkerson algorithm, Max. Flow min. cut Method theorem.

Unit 4 Elements of Stochastic Process: Random variable, sample space, statespace, random process (Stochastic process), Classification of stochastic process, Autocorrelation and auto covariance. Markov Process: probability vector, stochastic matrix, regular stochastic matrix and their applications, transition matrix, Poisson Process.

Unit 5 Neural Network: Basic Idea, Artificial neural network and its building blocks, Terminologies learning rules, back propagation network and its rule, feedback network, Adaline and madaline network, Neurons as function of single monotocity, Perceptrons , Functional link network and fuzzy logic.

ASSESSMENT

1. Internal Assessment for continuous evaluation, mid-term tests, tutorials, class performance, etc.(30%)
2. End semester Theory Exam (70%)

TEXT BOOKS RECOMMENDED

1. Erwin Kreyszig: Advance Engineering Mathematics, John Wiling & Sons, 8thEdition.
2. S. S. Sastry: Engineering Mathematics, VolII, 2nd Edition, PHI, New Delhi.

REFERENCE BOOKS

1. K.K.Vinoth, Neural Network and Fuzzy Logic,1st Edition, KATSONBook,2009.
2. Pannerselvam R. , Operations Research , Prentice Hall of India Pvt. Ltd. , New Delhi , 2004.

DEPARTMENT OF APPLIED MATHEMATICS AND COMPUTATIONAL SCIENCE

M.E. (Electronics and Communications Engineering) Semester I

MA 65004: LINEAR ALGEBRA, PROBABILITY THEORY AND OPTIMIZATION

HOURS PER WEEK			CREDITS			MAXIMUM MARKS				
						THEORY		PRACTICAL		TOTAL MARKS
T	P	Tu	T	P	Tu	CW	END SEM	SW	END SEM	
3	-	1	4	-	-	30	70	-	-	100

COURSE OBJECTIVE

To introduce the concepts of Linear algebra, Probability, Calculus and Optimization for wireless communication

COURSE OUTCOMES

After completion of course, students will be able to

- use matrix analysis concept to solve communication problem.
- understand the concept of vector space.
- use the probability and random process concept in network.
- implement the calculus concept in wireless communication.
- apply the optimization technique in network.

COURSE CONTENTS

THEORY

Unit 1 Matrix Analysis: Basic Concepts, type of matrices, scalar multiplication, matrix multiplication, properties, hadamard product, inverse, rank, system of linear equations, linear transformation, Eigen values and Eigen vectors, positive definite matrix, Principle component analysis, Singular value decomposition.

Unit 2 Vector Space: Definition, scalars, addition, scalar multiplication, inner product(dot product), vector projection, cosine similarity, orthogonal vectors, normal and orthonormal vectors, vector norm, vector space, subspace, linear combination, linear span, linear independence, basis and dimension.

Unit 3 Probability: Events, sample space, dependent and independent events, conditional probability, Random variables- continuous and discrete, expectation, variance, binomial, Bernoulli, Poisson, exponential, Gaussian distributions, random process, Markov Chain- definition, transition matrix, stationary.

Unit 4 Calculus: Differentiation, chain rule, partial derivatives, total differentiation, implicit differentiation, Jacobian, gradient, directional derivative, Expansion of functions by Taylor’s and Maclaurin’s series of one and two variables.

Unit 5 Optimization: Maxima and minima, saddle point, Lagrange's method of undetermined multipliers and their applications, non-linear optimization, Kuhn-Tucker condition, Fibonacci search, quadratic interpolation optimization, evolutionary algorithms.

ASSESSMENT

1. Internal Assessment for continuous evaluation, mid-term tests, assignments, seminars, class performance, etc.(30%)
2. End semester Theory Exam (70%).

TEXT BOOKS RECOMMENDED

1. S. Lipschutz & M. Lipson, Schaum's outlines on Linear Algebra, McGraw Hill Education, 2005.
2. James Stewart, Calculus, Brooks/Cole; International ed edition, 2003.

REFERENCES

1. Scott Miller & Donald childers, Probability and Random Processes with Applications to Signal Processing and Communications, Elsevier Science, 2004.
2. Kalyanmoy Deb, Multi-objective optimization using evolutionary algorithms, Wiley, 2001.

DEPARTMENT OF APPLIED MATHEMATICS AND COMPUTATIONAL SCIENCE
M.TECH. I SEMESTER (INFORMATION TECHNOLOGY)
MA78001/MA78005: MATHEMATICAL FOUNDATION OF COMPUTER SCIENCE

HOURS PER WEEK			CREDITS			MAXIMUM MARKS				
						THEORY		PRACTICAL		TOTAL MARKS
T	P	Tu	T	P	Tu	CW	END SEM	SW	END SEM	
3	-	-	3	-	-	30	70	-	-	100

COURSE OBJECTIVE

To introduce the concepts of set theory, statistical inference, graph theory**,** combinatorial enumeration problems and recurrence relations.

COURSE OUTCOMES

After completion of course, students will be able to

- use logical notation to define and reason about fundamental mathematical concepts such as sets, relation and function.
- understand problem of Statistical inference, problem of testing of hypothesis and multivariate statistical models like regression and its classification.
- concept of discrete and continuous random variables and their probability distribution including expectation and its application.
- apply the basic concept of graph theory and use permutation and combinations to solve counting problems with sets and multisets and apply them to combinatorial problems.
- solve the problem involving recurrence relation and generating function.

COURSE CONTENTS

THEORY

Unit 1 UNIT 1: Set Theory: introduction, operations on binary sets, principle of Inclusion and Exclusion. Relations: properties of binary relations, relation matrix and digraphs. Operations on relations. Partitions and covering. Transitive closure, Equivalence. Compatibility and partial ordering relations. Functions: Bi-jective functions, comparison of functions, inverse functions, permutation functions, recursive function.

Unit 2 UNIT 2: Statistical inference, Introduction to multivariate statistical models: regression and classification problems, principal components analysis, the problem of over-fitting model assessment. Random samples, sampling distributions.

Unit 3 UNIT 3: Probability mass, density, and cumulative distribution functions, parametric families of distributions, Expected value, variance, conditional expectation, Applications of the univariate and multivariate Central Limit Theorem, Probabilistic inequalities, Markov chains.

Unit 4	UNIT 4: Graph Theory: Isomorphism, Planar graphs, graph coloring, Hamilton circuits and Euler cycles. Permutations and Combinations with and without repetition. Specialized techniques to solve combinatorial enumeration problems
Unit 5	Recurrence Relations: Generating Functions, Function of Sequences, Partial Fractions, Calculating Coefficient of Generating Functions, Recurrence Relations, Formulation as Recurrence Relations, Solving Recurrence Relations by Substitution and Generating Functions, Method of Characteristic Roots, Solving Inhomogeneous Recurrence Relations

ASSESMENT

1. Internal Assessment for continuous evaluation, mid-term tests, assignments, seminars, class performance, etc.(30%)
2. End semester Theory Exam (70%).

TEXT BOOKS RECOMMENDED

1. K.H. Rosen, Discrete Mathematics and its Applications with Combinatorics and Graph Theory, 7th Edition, Tat McGraw Hill.
2. John Vince, "Foundation Mathematics for Computer Science", Springer.
3. K. Trivedi., "Probability and Statistics with Reliability, Queuing, and Computer Science Applications", Wiley.

REFERENCE BOOKS

1. M. Mitzenmacher and E. Upfal, "Probability and Computing: Randomized Algorithms and Probabilistic Analysis",
2. Alan Tucker, "Applied Combinatorics", Wiley

DEPARTMENT OF APPLIED MATHEMATICS AND COMPUTATIONAL SCIENCE
M.TECH. I SEMESTER (Mechanical Engineering and Thermal Engineering)
MA 85201/ MA 84201: ADVANCE MATHEMATICAL METHODS IN ENGINEERING

HOURS PER WEEK			CREDITS			MAXIMUM MARKS				
T	P	Tu	T	P	Tu	THEORY		PRACTICAL		TOTAL MARKS
						CW	END SEM	SW	END SEM	
3	-	-	3	-	-	30	70	-	-	100

COURSE OBJECTIVE

To introduce the concepts and applications of ordinary, partial differential equations, random variables, distributions, their significances and techniques to solve ANOVA.

COURSE OUTCOMES

After completion of course, students will be able to

- classify differential equations according to certain features and solve first order differential equations.
- solve homogeneous partial differential equations of n th order and their classification.
- use techniques to solve second order partial differential equations.
- understand random variables as well as distribution and their significance.
- understand concept of Test of Hypothesis and different techniques of ANOVA.

COURSE CONTENTS

THEORY

Unit 1 Ordinary Differential Equation: First-order equation (Linear, Equi-dimensional, Separable, Exact, Homogeneous); Second-order linear differential equation with constant coefficients (homogeneous and non homogeneous); Solution methods such as undetermined coefficients and variation of parameters.

Unit 2 Partial Differential Equation : First order Partial Differential Equation- Lagrange's and Charpit's Method; Second order linear homogeneous Partial Differential Equation with constant coefficients; Classification of PDE, Canonical form.

Unit 3 3Variable separable method – derivations and problems, Second order Parabolic, Elliptic and hyperbolic equations in rectangular coordinate system (Steady state method); Solution of PDE by Fourier transform method.

Unit 4 Random Variables, Distribution Function and Density Function, Standard Discrete distribution(Binomial distribution, Poisson distribution, Geometric distribution)and Continuous distribution (Uniform distribution, Exponential distribution, Gamma distribution, Weibull distribution, Normal distribution), Central Limit Theorem and its significance.

Unit 5 Relevant topics required for ANOVA (Sample Estimates and Test hypothesis)ANOVA: One- way, Two-way with/without interactions, latin squares ANOVA techniques.

ASSESSMENT

1. Internal Assessment for continuous evaluation, mid-term tests, assignments, seminars, class performance, etc.(30%)
2. End semester Theory Exam (70%).

TEXT BOOKS RECOMMENDED

1.ZafarAhsan, Differential Equation and their Applications, Prentice Hall of India Pvt. Ltd., New Delhi, 2004

2. T. Veerarajan, Probability, Statistics and Random Processes, Third edition, McGraw Hill Education Pvt. Ltd., New Delhi 2008.

REFERENCES

1. K. Sankara Rao, "Introduction to Partial Differential Equations," Third edition, PHI Learning Private Ltd, 2019.

2. Sanjeev Kumar, V.S. Verma, Computer Based Numerical & Statistics Technique, Ram Prashad Publication, Revised Addition, 2019.

DEPARTMENT OF APPLIED MATHEMATICS AND COMPUTATIONAL SCIENCE
M.TECH. Biomedical Engineering (Signal Processing and Instrumentation)
MA 75503: Applied and Computational Linear Algebra

HOURS PER WEEK			CREDITS			MAXIMUM MARKS				
						THEORY		PRACTICAL		TOTAL MARKS
T	P	Tu	T	P	Tu	CW	END SEM	SW	END SEM	
3	-	-	3	-	-	30	70	-	-	100

COURSE OBJECTIVES

To understand the various concepts of linear algebra for solving system of linear equations, inner product spaces, orthogonality, Eigen values and eigenvectors.

COURSE OUTCOMES

After completion of this course, students are able to

- solve the system of equations using various techniques.
- understand the concept of vector space and linear mapping
- use the concept of inner product space and orthogonal in their core domain.
- analyze the linear transformation and identify the eigenvectors using many techniques.
- solve Eigen value problem using various numerical techniques.

COURSE CONTENTS

THEORY

Unit 1 Matrices and System of Linear Equations: Basic definitions, Elementary operations, Rank of a matrix, Solution of linear system of equations, Direct method: Gauss elimination method, Gauss- Jordan method, LU decomposition method, Cholesky decomposition method, Iterative methods: Gauss-Jacobi and Gauss-Seidel – SOR Method.

Unit 2 Vector Spaces and Linear Mapping: Vector spaces, Subspaces, Linear combinations, Linear dependence and independence, Basis and Dimension, , The four fundamental subspaces, Linear transformation, Matrix Representation of linear transformation, Null space, Range dimension theorem, Change of basis.

Unit 3 Inner Product Spaces and Orthogonality:Inner product spaces, Cauchy-Schwarz inequality, Orthogonality, Orthogonal sets and bases, Gram-Schmidt orthogonalization process, Least square approximations.

Unit 4 Diagonalization: Eigen values, Eigen vectors: Eigen values and Eigen vectors, Diagonalization, Difference equations and the powers A^k, Differential equations and e^{At},Similarity transformations,Test for positive, negative and semidefinite and indefinite matrices.

Unit 5 Numerical Solution of Eigen value problems and Generalized Inverses: Eigen value Problems: Power method, Inverse Power method, Jacobi's rotation method, conjugate gradient method, QR algorithm, Singular Value Decomposition method (SVD), Principal-Component Analysis and the SVD, Using the SVD in PCA, Singular values of Sparse Matrices.

ASSESSMENT

1. Internal Assessment for continuous evaluation, mid-term tests, assignments, seminars, class performance, etc.(30%)
2. End semester Theory Exam (70%).

TEXT BOOKS RECOMMENDED

1. Strang,G.,LinearAlgebraanditsapplications‖,Thomson(Brooks/Cole),NewDelhi,2005.
2. Lipschutz, S. & Lipson, M.L., Schaum'soutine of Theory and Problems of Linear Algebra, Third edition, McGraw Hill Edu. Pvt. Ltd, 2005.

REFERENCES

1. Kumaresan,S.,LinearAlgebra,Ageometricapproach‖,PrenticeHallofIndia, New Delhi, Reprint,2010.
2. Bernard Kolman, David R. Hill, Introductory Linear Algebra‖, Pearson Education, New Delhi, First Reprint2009.