MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

(A Govt. Aided UGC Autonomous Institute Affiliated to RGPV, Bhopal)
NAAC Accredited with A++ Grade

Department of Engineering Mathematics & Computing

(B. Tech. IV Semester)
Transform and Vector Calculus
(MAC – 2250401)

Objective of Course

- To perceive the transform techniques in engineering problems
- To expose the concept of Fourier series and Fourier Transform
- To understand Wavelet transform & Z-Transform
- To explore the Vector Calculus

L	T	P	C
2	1	0	3

Unit 1: Fourier series and Fourier Transform

Introduction, Periodic functions: Even & Odd functions: Properties, Euler's Formulae for Fourier Series, Fourier Series for arbitrary and periodic functions, Dirichlet's conditions, Half Range Fourier Series, Harmonic analysis. Fourier integral, Complex Fourier transform, Inverse Transforms, Convolution Theorems, Fourier sine and cosine transform, Applications of Fourier transform.

Unit 2: Laplace Transform & Its Applications

Definition of Laplace Transform, conditions for existence of Laplace Transform. Properties of Laplace transform,
Unit step functions, Dirac delta-function. Inverse Laplace transform, convolution theorem, Solution of ordinary differential equations with the initial and boundary conditions.

Unit 3: Z- Transform & Difference Equations

Introduction to Z- transform, Properties of the Z-Transform, Inverse Z-Transform, Convolution, Partial Fraction Method, Residual Method and Solving Linear Difference Equation Using Z-Transform.

Unit 4: Wavelet Transform

Introduction to Wavelet transform, Discrete and Continuous Wavelet Transform, Orthogonal Wavelet Decomposition, MRA, Ortho Normal Wavelets and their Relationship to Filter Banks, Examples of Wavelets, Alternative Wavelet Representations, Non-Separable Multidimensional Wavelets, Embedded Tree Image Coding, Construction of Simple Wavelets.

Unit 5: Vector calculus

Introduction of Vector calculus, Vector differentiation: Gradient, Divergence, and Curl, directional derivative, Solenoidal and Irrotational vectors, Vector Integration: Line integral, Gauss divergence theorem and Stoke's theorem.

Course Outcomes

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

CO's	Description of CO's
CO1	Identify the concepts of Fourier series and Fourier transform
CO2	Describe Laplace Transform.
CO3	Illustrate the problems of Z- transform & Difference Equations
CO4	Analyze the Wavelet Transform
CO5	Evaluate vector calculus

Recommended Books:

1. B. S. Grewal: Higher Engineering Mathematics, Khanna Publisher, 43rd Edition, 2015.
2. G. ShankerRao: Mathematical Methods, I. K. International Publications, 1st Edition, 2009.
3. J.C. Goswami and A.K. Chan: Fundamentals of Wavelets: Theory, Algorithms, and Applications, 2nd ed., Wiley,2011.
4. Michel Misiti, Yves Misiti, Georges Oppenheim, JeanMichel Poggi: Wavelets and their Applications, John Wiley &Sons, 2010.
5. Ian N. Sneddon: Fourier Transforms, Dover Publications, 2010.
6. Loknath Debnath: Integral Transforms and their applications, Chapman and Hall/CRC, 2nd edition, 2006.
7. Narayan Shanti and P. K. Mittal: A Text Book of Vector Analysis, S. Chand, Company, 2010 Edition.

Department of Engineering Mathematics and Computing

(B. Tech. Fourth Semester)

Database Management Systems and SQL

(MAC - 2250402)

L	T	P	C
2	1	2	4

Course Objectives

- To explain basic database concepts, applications, data models, schemas and instances.
- To demonstrate the use of constraints and relational algebra operations.
- Describe the basics of SQL and construct queries using SQL.
- To emphasize the importance of normalization in databases, design and concurrency.

Unit-1-Introduction: Advantage of DBMS approach, various view of data, data independence, schema and sub-schema, primary concepts of data models, Database languages, transaction management, Database administrator and users, data dictionary, overall system architecture.
ER model: basic concepts, design issues, mapping constraint, keys, ER diagram, weak and strong entity sets, specialization and generalization, aggregation, inheritance, design of ER schema, reduction of ER schema to tables.
Unit-2 -Domains, Relations and Keys: domains, relations, kind of relations, relational database, various types of keys, candidate, primary, alternate and foreign keys.
Relational Algebra & SQL: The structure, relational algebra with extended with extended operations, modifications of Database, idea of relational calculus, basic structure of SQL, set operations, aggregate functions, null values, nested sub queries, derived relations, views, modification of Database, join relations, DDL in SQL.
Database Integrity: general idea. Integrity rules, domain rules, attribute rules, relation rules, Database rules, assertions, triggers, integrity and SQL.
Unit-3- Functional Dependencies and Normalization: basic definitions, trivial and non-trivial dependencies, closure set of dependencies and of attributes, irreducible set of dependencies, introduction to normalization, non-loss decomposition, FD diagram, first, second, third Normal forms, dependency preservation, BCNF, multivalued dependencies and fourth normal form, Join dependency and fifth normal form.
Unit-4-Transaction, concurrency and Recovery: basic concepts, ACID properties, Transaction states, implementation of atomicity and durability, concurrent executions, basic idea of serializability, basic idea of concurrency control, basic idea of deadlock, failure classification, storage structure types, stable storage implementation, data access, recovery and atomicity- log based recovery, deferred Database modification, immediate Database modification, checkpoints.
Unit-5-Distributed Database: basic idea, distributed data storage, data replication, data fragmentation- horizontal vertical and mixed fragmentation.
Emerging Fields in DBMS: Object Oriented Databases-basic idea and the model, object structure, object class, inheritance, Data Warehousing- terminology, definitions, characteristics, data mining and it's overview, Multimedia Databases-difference with conventional DBMS, issues, similarity based retrieval.
Storage structure and file organizations: overview of physical storage media, magnetic disks-performance and optimizations, basic idea of RAID, file organizations, organization of records in files, basic concepts of indexing, ordered indices.

Course Outcomes

After completion of this course, the students would be able to:

CO's	Description of CO's
CO1	Demonstrate the concepts of different type of database system.
CO2	Apply Relational algebra concepts to design database system.
CO3	Make use of queries to design and access database system.
CO4	Analyze the evaluation of transaction processing and concurrency control.
CO5	Determine the optimize database for real world applications.

Recommended Books:

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan: Database System Concepts, McGraw-Hill 6th Edition.
2. Ramakrishnan Raghu and Gehrke Johannes: Database Management System, McGraw Hill, 3rd Edition.
3. Elmasri & Navathe: Fundamentals of Database System, Addison-Wesley Publishing, 5th Edition.
4. C.J. Date: An Introduction to Database Systems, Addison-Wesley Publishing, 8th Edition.
5. Bipin Desai: An introduction to Database System –Galgotia Publications, Revised Edition, 2010

Department of Engineering Mathematics and Computing

(B. Tech. Fourth Semester)

Theory of Computation (MAC - 2250403)

L	T	P	C
2	1	0	3

COURSE OBJECTIVES:

- To understand computability, decidability, and complexity through problem solving.
- To analyse and design abstract model of computation & formal languages
- To understand and conduct mathematical proofs for computation and algorithms

Unit-1:
Introduction to Theory of Computation: Automata, Computability and Complexity, Alphabet, Symbol, String, and Formal Languages, Examples of automata machines, Finite Automata as a language acceptor and translator, Moore machines and Mealy machines, Composite Machine, Conversion from Mealy to Moore and vice versa.

Unit-2
Types of Finite Automata: Non Deterministic Finite Automata (NDFA), Deterministic finite automata machines, conversion of NDFA to DFA, minimization of automata machines, regular expression, Arden's theorem. Pumping lemma, applications, Closure properties of regular languages, 2 way DFA.

Unit-3
Grammars: Types of grammar, context sensitive grammar, and context free grammar, regular grammar. Derivation trees, Rightmost and Leftmost derivations of Strings, ambiguity in grammar, simplification of context free grammar, killing null and unit productions, conversion of grammar to automata machine and vice versa, Chomsky hierarchy of grammar,. Chomsky Normal Form (CNF) and Greibach Normal Form (GNF).

Unit-4
Push down Automata: Definition, Model, Acceptance of CFL, Acceptance by Final State and Acceptance by Empty stack, Example of PDA, deterministic and non-deterministic PDA, conversion of PDA into context free grammar and vice versa, CFG equivalent to PDA.

Unit-5
Turing Machine: Techniques for construction. Universal Turing machine Multitape, multihead and multidimensional Turing machine, N-P complete problems. Decidability and Recursively Enumerable Languages, decidability, decidable languages, undecidable languages, Halting problem of Turing machine & the post correspondence problem (PCB).

Course Outcomes

After completion of this course, the students would be able to:

CO's	Description of CO's
CO1	Explain the basic concepts of switching and finite automata theory & languages.
CO2	Relate practical problems to languages, automata, computability and complexity.
CO3	Construct abstract models of computing and check their power to recognize the languages.
CO4	Analyse the grammar, its types, simplification and normal form.
CO5	Interpret formal mathematical methods to prove properties of languages, grammars and automata.

Recommended Books:

1. Hopcroft& Ullman: Introduction to Automata Theory Language & Computation, Narosa Publication, 2009.
2. Lewis &Christors: Element of the Theory Computation, Pearson, 2011.
3. Chandrasekhar & Mishra: Theory of Computation, PHI, 2011
4. Daniel I-A Cohen: Introduction to Computing Theory, John Wiley, 2010.

Department of Engineering Mathematics and Computing

(B. Tech. Fourth Semester)

Design and Analysis of Algorithms

(MAC - 2250404)

L	T	P	C
2	1	0	3

Course Objectives

- To analyze performance of algorithms.
- To choose the appropriate data structure and algorithm design method for a specified application.
- To understand how the choice of data structures and algorithm design methods impacts the performance of programs.

Unit-1: Review of elementary Data Structures: Stacks, Queues, Lists, Trees, Hash, Graph, Internal representation of Data Structures, Code tuning techniques: Loop Optimization, Data Transfer Optimization, Logic Optimization, etc.

Unit-2: Definitions of complexity, Time and Space Complexity; Time space tradeoff, various bounds on complexity, Asymptotic notation: O-notation, Ω-notation, Ɵnotation, Recurrences and Recurrences solving techniques: Recursion-tree method and Master method, Average time analysis methods: Probabilistic methods. Amortized analysis.

Unit 3: Design and analysis of algorithms using the brute-force, greedy, dynamic programming, divide-and-conquer and backtracking techniques.

Unit-4: Algorithm for sorting and searching, string matching algorithm, Numbertheoretic algorithms, linear programming, Matrix Manipulation algorithms, tree and Graph Algorithms.

Unit-5: NP-hard and NP-complete problems, Approximations Algorithms, Data Stream Algorithms, Introduction to design and complexity of Parallel Algorithms.

Course Outcomes

After completion of this course, the students would be able to:

CO's	Description of CO's
CO1	Define the basic properties of algorithm.
CO2	Analyze the complexity of an algorithm.
CO3	Apply mathematical preliminaries to analyze and design stages of different types of algorithms.
CO4	Examine algorithms for a number of important computational problems.
CO5	Compare different design techniques to develop algorithms for various computational problems.

Recommended Books

1. Leiserson Cormen, Stein Rivest: Introduction to Algorithms, 3rd Edition, PHI, 2010.
2. A.V.Aho, J. E. Hopcroft, J. Ullman: Design and Analysis of Computer Algorithms, Addison Wesley, 1998.
3. Horowitz E. and Sahani: Fundamentals of Computer Algorithms‖, 2nd Edition, Galgotia Publications, 2008.
4. D. Knuth: Fundamental algorithms: The Art of Computer programming, Volume – I, Third Edition, Pearson Education 1998.
5. D. Knuth: Sorting and Searching: The Art of Computer programming, Volume – III, Second Edition Pearson Education1998.
6. John Kleinberg, Trades E: Algorithm Design, Pearson Education 2002.
7. Papoulis, S.U. Pillai: Probability, Random Variables and Stochastic Processes‖, McGraw Hill, Fourth Edition 2006.

Department of Engineering Mathematics and Computing

B. Tech. (Fourth Semester)

Number Theory and Cryptography (MAC - 2250405)

L	T	P	C
3	1	NIL	4

Objective of Course

- To Understand the Crypto graphical techniques to converting some secret information to not readable texts
- Explore the Crypto graphical techniques in various applications such as include military information transmission,computer passwords, electronic commerce, and others.
- Introduce the idea of encryption and public key cryptosystem in the context of algebra and elementary number theory.

Unit 1:
Number theory, Divisibility theory, Modular Arithmetic, primes and their distribution, theory of congruence and its application in security, Congruence: basic definitions and properties, complete and reduced residue systems.

Unit 2:
Integer representations (binary and base expansions, base conversion algorithm), Fermat's Little Theorem and Euler's Theorem, primitive roots, quadratic reciprocity, and Divisibility: basic definition, properties, prime numbers, some results on distribution of primes.

Unit 3:
Arithmetical functions: examples, with some properties and their rate of growth; Continued fractions, and their connections with Diophantine approximations, applications to linear and Pell's equations; Binary quadratic forms; Partition: basic properties and results; Diophatine equations: linear and quadratic, some general equations.

Unit 4:
Overview of cryptography, Encryption, Symmetric Encryption, Plain text, cipher text, Historical Ciphers, Shift Cipher, Substitution Cipher, Vigen'ere Cipher, Permutation Cipher, Symmetric Ciphers, Stream Cipher, Block Ciphers. Symmetric Key Distribution, key management, secret key distribution, public and private key cryptography.

Unit 5:
RSA cryptosystem, Primality Testing and Factoring, Key Exchange and Signature Schemes Diffie–Hellman Key Exchange, Digital Signature Schemes, Cryptographic hash functions, Authentication, Digital Signatures, Identification, certification, Discrete logarithm problem in general and on finite fields. Polynomials on finite fields, irreducibility and their applications to coding theory.

Course Outcomes

After completing this course, student will be able to:

CO's	Description of CO's
CO1	Acquire the knowledge of number theory and transcendental numbers
CO2	Describe the divisibility and related algorithms, factorization and quadratic sieve, efficiency of other factoring algorithms.
CO3	Evaluate arithmetical functions, Distribution of primes and Diophantine equations
CO4	Apply cryptography tools in various applications
CO5	Examine the Public key cryptosystems

Recommended Books:

1. Nigel Smart : Cryptography : An Introduction, CRC Press,3rd edition, 2013
2. Neal Koblitz : A course in number theory and cryptography, Springer-Varlag, 2nd edition, 1994.
3. W. Stein: Elementary Number Theory: Primes, Congruences and Secrets, OPAQUE, 2017
4. Burton, David M. Elementary Number Theory, 7th ed., 2011, McGraw-Hill, Inc.
5. Koshy, Thomas. Elementary Number Theory With Applications, 2nd ed., 2007. Elsevier, Inc
6. Robbins, Neville. Beginning Number Theory, 1993. Iowa: Wm. C. Brown
7. P. S. Gill, Cryptography and Network Security, 2011, Oxford Publication
8. Stein, William, Elementary Number Theory: Primes, Congruences, and Secrets: A Computational Approach, 2017,