Teaching Scheme of B.Tech.-II (CSE) (Semester III)

Sr. No.	Course	Code	Credit	Teaching Scheme			Examination Scheme			Total
				L	T	P	L	T	P	
1	Discrete Mathematics (Mathematics – III)	MA221	4	3	1	0	100	25	0	125
2	Data Structures (Core-1)	CS210	5	3	1	2	100	25	50	175
3	Computer Organization (Core-2)	CS201	5	3	1	2	100	25	50	175
4	Digital Electronics & Logic Design (Core-3/Interdisciplinary Subject)	EC207	5	3	1	2	100	25	50	175
5	Digital Communication (Core-4/Interdisciplinary Subject)	EC209	4	3	0	2	100	0	50	150
	Total		**23**	**15**	**4**	**8**	**500**	**100**	**200**	**800**
	Total Contact Hours per week			**27**						

Practical Examination Scheme (Internal 50% and External 50%)

Teaching Scheme of B.Tech.-II (CSE) (Semester IV)

Sr. No.	Course	Code	Credit	Teaching Scheme			Examination Scheme			Total
				L	T	P	L	T	P	
1	Linear Algebra and Statistical Analysis (Mathematic – IV)	MA212	4	3	1	0	100	25	0	125
2	Microprocessor and Interfacing Techniques (Core-5)	CS202	5	3	1	2	100	25	50	175
3	Database Management System (Core-6)	CS204	5	3	1	2	100	25	50	175
4	Design and Analysis of Algorithms (Core-7)	CS206	5	3	1	2	100	25	50	175
5	Automata and Formal Languages (Core-8)	CS208	4	3	1	0	100	25	0	125
	Total		**23**	**15**	**5**	**6**	**500**	**125**	**150**	**775**
	Total Contact Hours per week			**26**						

Practical Examination Scheme (Internal 50% and External 50%)

B.Tech. II (CSE) Semester – III
DISCRETE MATHEMATICS
MA221
(MATHEMATICS - III)

	L	T	P	Credit
Scheme	3	1	0	04

1. Course Outcomes (COs):

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

CO1	acquire knowledge of sets, group and functions, graphs.
CO2	apply group theory, relations and lattice.
CO3	analyse functions, counting and based on mathematical logic.
CO4	evaluate formal verification of computer programmes.
CO5	design solutions for various types of problems in different disciplines like information security, optimization, mathematical analysis.

2. Syllabus

- **INTRODUCTION** **(04 Hours)**

  Set Definition, Finite and Infinite Sets, Equality of Sets, Disjoint Sets, Family of Sets, Types of Sets, Operations on Sets, Algebra of Sets, Cardinality of a Set, Venn Diagrams, Multisets, Cartesian Product, Principle Inclusion and Exclusion, Functions as a Set, Domain and Co-domain, Image, Range, Types of Functions, Equal and Identity Functions, Invertible Functions, Composition of Functions, Application of Functions in Computer Science Areas.

- **GROUP THEORY** **(08 Hours)**

  Basic Properties of Group, Groupoid, Semigroup & Monoid, Abelian Group, Subgroup, Cosets, Normal Subgroup, Lagrange's Theorem, Cyclic Group, Permutation Group, Homomorphism & Isomorphism of Groups, Basic Properties, Error Correction & Detection Code.

- **RELATION & LATTICES** **(05 Hours)**

  Definition & Basic Properties, Graphs Of Relation, Matrices Of Relation, Equivalence Relation, Equivalence Classes, Partition, Partial Ordered Relation, Posets, Hasse Diagram, Upper Bounds, Lower Bound, GLB & LUB Of Sets, Definition & Properties Of Lattice, Sub Lattice, Distributive & Modular Lattices, Complemented & Bounded Lattices, Complete Lattices & Boolean Algebra.

- **MATHEMATICAL LOGIC AND PROGRAM VERIFICATION** **(05 Hours)**

  Induction, Propositions, Combination Of Propositions, Logical Operators & Propositional Algebra, Equivalence, Predicates & Quantifiers, Interaction of Quantifiers with Logical Operators, Logical Interference & Proof Techniques, Formal Verification of Computer Programs (Elements of Hoare Logic).

- **COUNTING AND RECURRENCE RELATION (05 Hours)**

  First Counting Principle, Second Counting Principle, Permutation, Circular Permutations, Combination, Pigeonhole Principle, Recurrence Relations, Linear Recurrence Relations, Inclusion And Exclusion, Generating Functions.

- **BASICS OF GRAPHS (05 Hours)**

  Graph Definition, Graph Representation, Basic Concepts Of Finite & Infinite Graph, Incidence & Degree, Isomorphism, Subgraph, Walk, Path & Circuits, Cliques, Cycles and Loops, Operations On Graphs, Connected Graph, Disconnected Graph & Components, Complete Graph, Regular Graph, Bipartite Graph, Planar Graphs, Weighted Graphs, Directed & Undirected Graphs, Connectivity Of Graphs.

- **GRAPHS ALGORITHMS (10 Hours)**

  Flows, Combinatorics, Euler's Graph, Hamiltonian Paths & Circuits, Activity Planning and Critical Path, Planar Graphs: Properties, Graph Coloring, Vertex Coloring, Chromatic Polynomials, Edge Coloring, Planar Graph Coloring, Matching and Factorizations: Maximum Matching In Bipartite Graphs, Maximum Matching In General Graphs, Hall's Marriage Theorem, Factorization; Networks: Max-Flow Min-Cut Theorem, Menger's Theorem, Graph and Matrices.

  Tutorials will be based on the coverage of the above topics separately (14 Hours)

  (Total Contact Time: 42 Hours + 14 Hours = 56 Hours)

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3. Tutorials:

1 Examples using different set operations

2 Examples of defining groups and studying properties

3 Examples on formal verification and applying different functions

4 Examples of mathematical logics and relations

5 Examples of recurrence and counting

4. Books Recommended:

1. Rosen K.H., "Discrete Mathematics and Its Applications", 6/E, MGH, 2006.
2. Liu C.L., "Elements of Discrete Mathematics", MGH, 2000.
3. Deo Narsingh., "Graph theory with applications to Engineering & Computer Science", PHI, 2000.
4. J A Bondy and USR Murty, "Graph Theory", Springer, 2008.
5. V. K. Balakrishnan, "Theory and Problems of Graph Theory", Tata McGraw-Hill, 2007.

ADDITIONAL REFERENCE BOOKS

1. Kolman B., Busby R.C. & Ross S., "Discrete Mathematical Structure", 5/E, PHI, 2003.
2. Tremblay J. P. & Manohar R., "Discrete Mathematical structure with applications to computer science", MGH, 1999.
3. Liu C.L., "Elements of Discrete Mathematics", MGH, 2000.
4. D B West, “Introduction to Graph Theory”, 2nd Edition, PHI 2002.
5. G Chatrand and O.R. Ollermann, “Applied and Algorithmic Graph Theory” ,McGraw Hill, 1993.

B.Tech. II (CSE) Semester – III
DATA STRUCTURES (CORE-1)
CS210

Scheme

L	T	P	Credit
3	1	2	05

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1. Course Outcomes (COs):
At the end of the course, students will be able to

CO1	recognize the need of different data structures and understand its characteristics.
CO2	apply different data structures for given problems.
CO3	design and analyse different data structures, sorting and searching techniques.
CO4	evaluate data structure operations theoretically and experimentally.
CO5	give solution for complex engineering problems.

2. Syllabus

- **INTRODUCTION TO DATA STRUCTURES (02 Hours)**

  Review of Concepts: Information and Meaning, Abstract Data Types, Internal Representation of Primitive Data Structures, Arrays, Strings, Structures, Pointers.

- **LINEAR LISTS (06 Hours)**

  Sequential and Linked Representations of Linear Lists, Comparison of Insertion, Deletion and Search Operations for Sequential and Linked Lists, Doubly Linked Lists, Circular Lists, Lists in Standard Template Library (STL), Applications Of Lists.

- **STACKS (06Hours)**

  Sequential and Linked Implementations, Representative Applications such as Recursion, Expression Evaluation Viz., Infix, Prefix and Postfix, Parenthesis Matching, Towers of Hanoi, Wire Routing in a Circuit, Finding Path in a Maze.

- **QUEUES (06 Hours)**

  Operations of Queues, Circular Queue, Priority Queue, Dequeue, Applications of Queues, Simulation of Time Sharing Operating Systems, Continuous Network Monitoring System Etc.

- **SORTING AND SEARCHING (04 Hours)**

  Sorting Methods, Bubble Sort, Selection Sort, Quick Sort, Radix Sort, Bucket Sort, Dictionaries, Hashing, Analysis of Collision Resolution Techniques, Searching Methods, Linear Search, Binary Search, Character Strings and Different String Operations.

- **TREES (08 Hours)**

Binary Trees and Their Properties, Terminology, Sequential and Linked Implementations, Tree Traversal Methods and Algorithms, Complete Binary Trees, General Trees, AVL Trees, Threaded Trees, Arithmetic Expression Evaluation, Infix-Prefix-Postfix Notation Conversion, Heaps as Priority Queues, Heap Implementation, Insertion and Deletion Operations, Heapsort, Heaps in Huffman Coding, Tournament Trees, Bin Packing.

- **MULTIWAY TREES** **(04 Hours)**

Issues in Large Dictionaries, M-Way Search Trees, B Trees, Search, Insert and Delete Operations, Height of B-Tree, 2-3 Trees, Sets and Multisets in STL.

- **GRAPHS** **(06 Hours)**

Definition, Terminology, Directed and Undirected Graphs, Properties, Connectivity in Graphs, Applications, Adjacency Matrix and Linked Adjacency Chains, Graph Traversal, Breadth First and Depth First Traversal, Spanning Trees, Shortest Path and Transitive Closure, Activity Networks, Topological Sort and Critical Paths.

Tutorials will be based on the coverage of the above topics separately **(14 Hours)**

Practicals will be based on the coverage of the above topics separately **(28 Hours)**

(Total Contact Time: 42 Hours + 14 Hours + 28 Hours = 84 Hours)

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3. Tutorials:

1 Problems on Array
2 Problems on Stack and Queue
3 Problems on Linked List
4 Problems on Trees
5 Problems on Graph

4. Practicals:

1 Implementation of Array and its applications
2 Implementation of Stack and its applications
3 Implementation of Queue and its applications
4 Implementation of Link List and its applications
5 Implementation of Trees and its applications
6 Implementation of Graph and its applications
7 Implementation of Hashing functions and collision resolution techniques
8 Mini Project (Implementation using above Data Structure)

5. Books Recommended:

1. Trembley & Sorenson: "An Introduction to Data Structures with Applications", 2/E, TMH, 1991.
2. Tanenbaum & Augenstein: "Data Structures using C and C++", 2/E, Pearson, 2007.
3. Horowitz and Sahani: "Fundamentals of Data Structures in C", 2/E, Silicon Press, 2007.
4. T. H. Cormen, C. E. Leiserson, R. L. Rivest: "Introduction to Algorithms",3/E, MIT Press, 2009.
5. Robert L.Kruse, C.L.Tondo and Brence Leung: "Data Structures and Program Design in C", 2/E, Pearson Education, 2001.

B.Tech. II (CSE) Semester – III
COMPUTER ORGANIZATION (CORE-2)
CS201

	L	T	P	Credit
Scheme	**3**	**1**	**2**	**05**

1. Course Outcomes (COs):

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

CO1	acquire knowledge of basics of computer architecture, its components with peripheral devices, instruction set architecture, instruction execution using data path and control unit interface.
CO2	apply knowledge of combinational and sequential logic circuits to mimic simple computer architecture to solve the given problem.
CO3	analyze performance of various instruction set architecture, control unit, memories, various processor architectures.
CO4	evaluate programming solutions to implement fast methods of ALU, FP unit implementations, processor architectures and instruction set architectures.
CO5	implement fast methods of ALU, FP unit implementations and to design and develop hardware solution for given instruction coding scheme of an Instruction Set Architecture or vice versa using available technology tools.

2. Syllabus

- **PROCESSOR BASICS** **(05 Hours)**

  Basics CPU Organization - Functional Units, Data Paths, Registers, Stored Program Concept, Data Representation - Basic Formats, Fixed and Floating Point Representation, Instruction Sets, Instruction Types, Instruction Formats, Addressing Modes, Designing of an Instruction Set, Data path Design, Concepts of Machine Level Programming, Assembly Level Programming and High Level Programming.

- **ARITHMETIC AND LOGIC UNIT** **(08 Hours)**

  Arithmetic and Logical Operation and Hardware Implementation, Implementation of some Complex Operation: Fixed-Point Arithmetic Multiplication Algorithms-Hardware Algorithm, Booth Multiplication Algorithm, Division Algorithm, Divide Overflow Algorithm, Combinational ALU and Sequential ALU, Floating Point Arithmetic Operations.

- **CONTROL UNIT** **(07 Hours)**

  Basic Concepts, Instruction Interpretation and Execution, Hardwired Control, Microprogrammed Control, CPU Control Unit Design, Performance.

- **SUBROUTINE MANAGEMENT** **(03 Hours)**

  Concepts of Subroutine, Subroutine Call and Return.

- **MEMORY ORGANIZATION** **(06 Hours)**

  Concepts of Semiconductor Memory, Cpu-Memory Interaction, Organization of Memory Modules, Cache Memory and Related Mapping and Replacement Policies, Virtual Memory.

- **SYSTEM ORGANIZATION** **(05 Hours)**

  Introduction to Input And Output Processing, Working with Video Display Unit and Keyboard and Routine to Control them, Programmed Controlled I/O Transfer, Interrupt Controlled I/O Transfer, DMA Controller, Secondary Storage and Type Of Storage Devices, Introduction to Buses and Connecting I/O Devices to CPU and Memory.

- **PIPELINE CONTROL AND PARALLEL PROCESSING** **(08 Hours)**

  Instruction Pipelines, Pipeline Hazards, Pipeline Performance, Superscalar Processing, Introduction to Parallel Processing, Processor-Level Parallelism, Multiprocessor.

  Tutorials will be based on the coverage of the above topics separately. **(14 Hours)**

  Practicals will be based on the coverage of the above topics separately. **(28 Hours)**

  (Total Contact Time: 42 Hours + 14 Hours + 28 Hours = 84 Hours)

3. Tutorials:

1 Problems on data conversion in various formats and floating-point representation

2 Solving computations involving complex arithmetic operations and hardware implementation of the same

3 Interpretation of basic instruction execution and various addressing modes possible

4 Learning instruction set architecture level instructions for the high level language programming

5 Problems on memory management, mapping and replacement policies

4. Practicals:

1 Implementation of arithmetic operations on various number systems

2 Implementation of basic combinatorial logic circuits in Logisim

3 Implementation of complex combinatorial logic circuits in Logisim

4 Design storage components as per the given specifications

5 Design of arithmetic logic unit and its associated control unit

6 Design of control unit of set of instructions

7 Implementation of control unit and memory modules

8 Implementation of basic components of computers and integration of them in Logisim

5. Books Recommended:

1. John L. Hannessy, David A. Patterson, "Computer organization and Design", 3/E, Morgan Kaufmaan, reprint -2003.
2. Andrew S. Tanenbaum, "Structured Computer Organization", 6/E, PHI EEE, reprint 1995.
3. William Stallings, "Computer Organization & Architecture: Designing For Performance", 6/E, PHI, 2002.
4. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, "Computer Organization", 5/E, McGraw-Hill, 2002.
5. Morris Mano, "Computer Systems Architecture", 3/E, PHI, reprint 1997.

B.Tech. II (CSE) Semester – III
DIGITAL ELECTRONICS & LOGIC DESIGN (CORE-3)
(Interdisciplinary Subject)
EC207

	L	T	P	Credit
Scheme	**3**	**1**	**2**	**05**

1. Course Outcomes(COs):

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

CO1	acquire knowledge about different types of diodes and circuits.
CO2	apply the knowledge of gates, Boolean algebra and operational amplifier in designing logical and integrated circuits.
CO3	analyse the logical, integrated, and operational amplifier based circuits.
CO4	evaluate the different circuits and compare their performance.
CO5	design ALU and control unit.

2. Syllabus

- **PN DIODE AND TRANSITOR (04 Hours)**

  PN Diode Theory, PN Characteristic and Breakdown Region, PN Diode Application as Rectifier, Zener Diode Theory, Zener Voltage Regulator, Diode as Clamper and Clipper, Photodiode Theory, LED Theory, 7 Segment LED Circuit Diagram and Multi Colour LED, LASER Diode Theory and Applications, Bipolar Junction Transistor Theory, Transistor Symbols And Terminals, Common Collector, Emitter and Base Configurations, Different Biasing Techniques, Concept of Transistor Amplifier, Introduction to FET Transistor And Its Feature.

- **WAVESHAPING CIRCUITS AND OPERATIONAL AMPLIFIER (06 Hours)**

  Linear Wave Shaping Circuits, RC High Pass and Low Pass Circuits, RC Integrator and Differentiator Circuits, Nonlinear Wave Shaping Circuits, Two Level Diode Clipper Circuits, Clamping Circuits, Operational Amplifier OP-AMP with Block Diagram, Schematic Symbol of OP-AMP, The 741 Package Style and Pinouts, Specifications of Op-Amp, Inverting and Non-Inverting Amplifier, Voltage Follower Circuit, Multistage OP-AMP Circuit, OP-AMP Averaging Amplifier, OP-AMP Subtractor.

- **BOOLEAN ALGEBRA AND SWITCHING FUNCTIONS (04 Hours)**

  Basic Logic Operation and Logic Gates, Truth Table, Basic Postulates and Fundamental Theorems of Boolean Algebra, Standard Representations of Logic Functions- SOP and POS Forms, Simplification of Switching Functions-K-Map and Quine-Mccluskey Tabular Methods, Synthesis of Combinational Logic Circuits.

- **COMBINATIONAL LOGIC CIRCUIT USING MSI INTEGRATED CIRCUITS (07 Hours)**

Binary Parallel Adder; BCD Adder; Encoder, Priority Encoder, Decoder; Multiplexer and Demultiplexer Circuits; Implementation of Boolean Functions Using Decoder and Multiplexer; Arithmetic and Logic Unit; BCD to 7-Segment Decoder; Common Anode and Common Cathode 7-Segment Displays; Random Access Memory, Read Only Memory And Erasable Programmable ROMS; Programmable Logic Array (PLA) and Programmable Array Logic (PAL).

- **INTRODUCTION TO SEQUENTIAL LOGIC CIRCUITS** **(04 Hours)**

  Basic Concepts of Sequential Circuits; Cross Coupled SR Flip-Flop Using NAND or NOR Gates; JK Flip-Flop Rise Condition; Clocked Flip-Flop; D-Type and Toggle Flip-Flops; Truth Tables and Excitation Tables for Flip-Flops; Master Slave Configuration; Edge Triggered and Level Triggered Flip-Flops; Elimination of Switch Bounce using Flip-Flops; Flip-Flops with Preset and Clear.

- **SEQUENTIAL LOGIC CIRCUIT DESIGN** **(06 Hours)**

  Basic Concepts of Counters and Registers; Binary Counters; BCD Counters; Up Down Counter; Johnson Counter, Module-N Counter; Design of Counter Using State Diagrams and Table; Sequence Generators; Shift Left and Right Register; Registers With Parallel Load; Serial-In-Parallel-Out (SIPO) And Parallel-In-Serial-Out(PISO); Register using Different Type of Flip-Flop.

- **REGISTER TRANSFER LOGIC** **(04 Hours)**

  Arithmetic, Logic and Shift Micro-Operation; Conditional Control Statements; Fixed-Point and Floating-Point Data; Arithmetic Shifts; Instruction Code and Design Of Simple Computer.

- **PROCESSOR LOGIC DESIGN** **(03 Hours)**

  Processor Organization; Design of Arithmetic Logic Unit; Design of Accumulator.

- **CONTROL LOGIC DESIGN** **(04 Hours)**

  Control Organization; Hard-Wired Control; Micro Program Control; Control Of Processor Unit; PLA Control.

(Total Contact Time: 42 Hours + 14 Hours + 28 Hours = 84 Hours)

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3. Tutorials:

1 Problems on different diode based circuits and wave shaping circuit design

2 Problems on logic gates and application of operational amplifiers

3 Problems on boolean algebra and logical circuit design

4 Problems on designing sequential circuits using digital logic gates and integrated circuits

5 Problems on designing ALU and CPU

4. Practicals:

1. Study of BJT Characteristics
2. Study of CE Amplifier

3. Study of RC Coupled / Tuned Amplifier
4. Study of FET Characteristics
5. Study of Diode Clipper Circuits
6. Study of Diode Clamper Circuits
7. Study and Implement RC Low Pass and High Pass Filter Circuits
8. Study and Implement RC Integrator Circuits
9. Study and Implement RC Differentiator Circuits
10. Full and Half-Adder/ Half-subtarctor Circuits using a serial Input
11. 4-Bit Gray to Binary/ Binary to Gray Code convertor using Select input
12. Logic expression with the Help of MUX IC 74153
13. Flip-flops using NAND/ NOR Gate
14. Modulo-7 Ripple Counter
15. 4-Bit Shift Left/Right Register
16. Sequence Generator

5. Books Recommended:

1. Schilling Donald L. and Belove E., "Electronics Circuits- Discrete and Integrated", 3rd Ed., McGraw-Hill, 1989, Reprint 2008.
2. Millman Jacob, Halkias Christos C. and Parikh C., "Integrated Electronics", 2nd Ed., McGraw-Hill, 2009.
3. Taub H. and Mothibi Suryaprakash, Millman J., "Pulse, Digital and Switching Waveforms", 2nd Ed., McGraw-Hill, 2007.
4. Mano Morris, “Digital Logic and Computer Design”, 5th Ed., Pearson Education, 2005.
5. Lee Samual, “Digital Circuits and Logic Design”, 1st Ed., PHI, 1998.

ADDITIONAL REFERENCE BOOKS

1. Malvin Albert & David J. Bates, "Electronic Principles", 7th edition, Tata McGraw Hill, 2007.
2. De Debashis, "Basic of Electronics", 1st Ed., Pearson Education, 2008.
3. Floyd and Jain, “Digital Fundamentals”, Pearson Education, 2006.

B.Tech. II (CSE) Semester – III
DIGITAL COMMUNICATION (CORE-4)
(Interdisciplinary Subject)
EC209

	L	T	P	Credit
Scheme	**3**	**0**	**2**	**04**

1. Course Outcomes (COs):

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

CO1	acquire knowledge about the basics of communication theory.
CO2	apply different modulations schemes for designing the communication network.
CO3	analyse different modulations schemes to design better schemes for different types of channels.
CO4	evaluate and compare different communication topology, modulations schemes and their performance over various types of channels.
CO5	design robust communication network based of advanced modulations scheme.

2. Syllabus

- **INTRODUCTION (05 Hours)**

  History, Concept of Transmitter, Receiver, Channel, Noise, Modulation, Types of Modulation, Different communication systems based on Input and Output. Classification Of Signals, Unit Impulse Signals, Correlation Of Signals, Orthogonal Signal Set, Exponential Fourier Series, Types of Noises, Internal: Shot, Thermal, Agitation, Transit Time Noise and External: Atmospheric, Extra-Terrestrial, Industrial Noise, White Noise and Filtered Noise, AWGN Properties, Signal To Noise Ratio.

- **AMPLITUDE MODULATION (AM) (06 Hours)**

  AM, AM Index, Frequency spectrum, Average Power for Sinusoidal AM, Effective Voltage and Current, Non sinusoidal Modulation, DSBFC & DSBSC Modulation, Amplitude modulator and Demodulator Circuits, AM Transmitters.

- **SINGLE-SIDEBAND (SSB) MODULATION (06 Hours)**

  SSB Principles, Balanced Modulators, SSB Generation and Reception.

- **ANGLE MODULATION (06 Hours)**

  Frequency Modulation (FM), Frequency spectra, Average power, Deviation Ratio, Measurement of Modulation Index, Phase Modulations (PM), Sinusoidal PM, Digital PM, Angle Modulator Circuits, FM Transmitters, Angle Modulations Detectors.

- **PULSE MODULATION** **(07 Hours)**

  Pulse Amplitude Modulation, Pulse Code Modulation, Delta Modulation, Pulse Frequency Modulation, Pulse Time Modulation, Pulse Position modulation and Pulse Width Modulation.

- **DIGITAL CARRIER SYSTEM** **(06 Hours)**

  Introduction and representation of Digital Modulated Signal, ASK, PSK, FSK, QAM with Mathematics and Constellation Diagram, Spectral Characteristics of Digitally Modulated Signals. M-Ary Digital Carrier Modulation.

- **FIBER-OPTIC COMMUNICATIONS** **(06 Hours)**

  Principles of Light Transmission in Fiber Losses in Fibers, Dispersion, Light Sources and Detectors for Fiber Optics.

(Total Contact Time: 42 Hours + 28 Hours = 70 Hours)

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3. Practicals:

1. Study of The Spectrum Analyzer.
2. Study of Various Signals and its Spectrum Using MATLAB.
3. DSB-SC and DSB-C AM Transmitter and Receiver with Tone and Voice Input.
4. FM Transmission and Reception Techniques.
5. Frequency Division Multiplexing Techniques.
6. AM and FM Simulation On MATLAB with AWGN Channel and Concept of SNR.
7. Study of Sampling Theorem Pulse Code Modulation and Demodulation.
8. Study of PAM/PWM/PPM Modulation.
9. Study of Delta Modulation and Demodulation.
10. ASK, FSK, PSK, QAM With Performance Analysis Under Channel Effects And BER

4. Books Recommended:

1. Dennis Roddy & John Coolen, “Electronic Communications”, PHI, 4/E, 1995.
2. George Kennedy, “Electronic Communication Systems”, 3/E, McGraw Hill Book Co., 1993.
3. Simon Haykin, “Communication Systems”, 2/E, Wiley Eastern Ltd, 1994.
4. Taub and Schilling, “Principles of communication Systems”, 3/E, Mc Graw Hill Publication, 1992.
5. B.P.Lathi, ”Modern digital and analog communication systems”, 4th Ed., Holt, Sounders Pub. 1998.

ADDITIONAL REFERENCE BOOKS

1. Lathi B. P. and Ding Zhi, "Modern Digital and Analog Communication Systems", Oxford University Press, 4th Ed., 2010.
2. Proakis J. and Salehi M., "Fundamental Of Communication Systems", PHI/Pearson Education-LPE, 2nd Ed., 2006.

B.Tech. II (CSE) Semester – IV
LINEAR ALGEBRA AND STATISTICAL ANALYSIS
MA212
(MATHEMATIC – IV)

	L	T	P	Credit
Scheme	**3**	**1**	**0**	**04**

1. Course Outcomes (COs):

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

CO1	acquire knowledge about different terminology of graphs and statistics.
CO2	apply graph-theoretic models to solve problems of connectivity and constraint satisfaction for different problems.
CO3	analyze the problems for developing the solution, its correctness and performance using graphs and statistics methods learned.
CO4	evaluate the solution built using different graph based modelling.
CO5	design an efficient solution using statistical methods and variety of graphs for real problems.

2. Syllabus

- **LINEAR ALGEBRA** **(08 Hours)**

  Vectors, Matrices, Determinants, Linear equations, Vector spaces, Subspace, Field, Ring, Norm and distance, Linear Mapping, Orthogonality, Eigenvectors and Eigenvalues, Least square, Least square data fitting, Constrained least square applications.

- **NUMBER THEORY** **(08 Hours)**

  Divisibility, Prime numbers, Greatest common divisor, Fermat and Mersenne primes, Congruences, Chinese remainder theorem, Fermat's Little theorem, Probabilistic primality test, Elliptic Curves.

- **PROBABILITY THEORY AND RANDM PROCESS** **(08 Hours)**

  Fundamentals of Probability Theory: - views of probability, Random variables and Joint distributions, Marginal distribution, Conditional probability, Conditional independence, Expectation and variance, Probability distributions Central limit theorem, Functions of random variable, Sum of independent random variable, Correlation and regression, Random process, Stationary random process, Autocorrelation and cross correlation, Ergodic process, Markov process, Birth and death process, Poisson process, Markov chain, Chapman Kolmogorov theory, Spectral analysis of random processes, power spectral density.

- **ESTIMATION AND STATISTICS** **(08 Hours)**

  Sampling theory, Population and sample, Statistical interference, Sampling distribution,

Sample mean, Bias estimation, Unbiased estimator, Confidence interval, Point estimation and interval estimates, Statistical decision, Hypothesis testing, Statistical hypotheses, Null hypotheses, Significance test, Type I and types II errors, Level of significance, One tail and two tailed test, Chi square test, Maximum likelihood estimate, Least square estimate, MAP estimate, Minimum mean square estimate.

- **PROBABILISTIC GRAPHICAL MODELS** **(06 Hours)**

Graphical models, Directed models: Bayesian network, Undirected model: Markov Random Fields, Dynamic model: Hidden Markov Model, Learning in Graphical models: Parameter estimation, Expectation Maximization, Factor Graph, Bayes Ball theorem and D-separation, Hammersley-Clifford theorem, Inference in graphical models, Belief propagation, Viterbi algorithm.

- **SCIENTIFIC ASPECTS OF PROGRAMME DEVELOPMENT** **(04 Hours)**

Development of Programmes, Developing Invariants, Ballon Theory, Bound Functions, Iterations and Recursion, Efficiency considerations in a program, Restricting nondeterminism, Case studies of developing efficient programs.

Tutorials will be based on the coverage of the above topics separately. **(14 Hours)**

(Total Contact Time: 42 Hours + 14 Hours = 56 Hours)

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3. Tutorials:

1 Preliminary exercises based on different terminology learned of various Graphs and statistics

2 Use different types of graph and its algorithm for solving basic problems

3 Use probability and estimation methods for solving different problems in core subjects

4 Use different graphical models to build different network models for high end applications

4. Books Recommended:

1. Gilbert Strang, “Introduction to Linear Algebra”, Wellesley Cambridge Press, 4th Ed., 2009.
2. Kenneth Hoffman and Ray Kunze, “Linear Algebra”, 2nd Ed., Prentice Hall India, 2013.
3. David C. Lay, “Linear Algebra and its applications”, 3rd Ed., Pearson, 2006.
4. A. Papoulis and S. U. Pillai, “Probability, Random Variables and Stochastic Processes”, 4th Ed., Mc-Graw Hill, 2002.
5. Murray R. Spiegel, John J. Schiller, R. Alu Srinivasan, “Theory and Problems of Probability and Statistics”, 2nd Ed, Tata McGraw-Hill, 2007.

ADDITIONAL REFERENCE BOOKS

1. Gilbert Strang, “Linear Algebra and its Applications”, Cengage Learning, 4th Ed., 2006.
2. Cheney and Kincaid, “Linear Algebra”, 2nd Ed., Jones and Bartlett learning, 2014.

3. Koller, D. and Friedman, N.,"Probabilistic Graphical Models: Principles and Techniques", MIT Press, 2009.
4. Jensen, F. V. and Nielsen, T. D.,"Bayesian Networks and Decision Graphs. Information Science and Statistics", Springer, 2nd edition, 2002.

B.Tech. II (CSE) Semester – IV
MICROPROCESSOR AND INTERFACING TECHNIQUES (CORE-5)
CS202

Scheme

L	T	P	Credit
3	1	2	05

1. Course Outcomes (COs):

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

CO1	acquire knowledge of different architectures, addressing modes and instructions of 8085/86.
CO2	interface memory, I/O devices and interrupt controller with 8085/86 microprocessors.
CO3	analyse and compare the features of microprocessors and microcontrollers.
CO4	describe the internal architecture and different modes of operations of a typical peripheral device.
CO5	design and develop assembly language programs using 8085/86 instructions, software interrupts, subroutines, macros.

2. Syllabus

- **INTRODUCTION TO MICROPROCESSORS EVOLUTION (02 Hours)**

  Introduction to Microprocessor and Development and its Operation.

- **ARCHITECTURE FEATURES OF 8085 (03 Hours)**

  8085 Architecture and Pin out diagram, 8085 Operations.

- **INSTRUCTION SET AND PROGRAMMING OF 8085 (06Hours)**

  Data Transfer instructions, Arithmetic instructions and its examples, Logical Instructions and its examples, Branch, Stack, and I/O related instructions, How to write, assemble and execute assembly language programmes, Assembly language programming Practice Based on above instructions for 8085, Design Counters in 8085, Design Time delays in 8085, Stack & Subroutines: Restart, Conditional and Unconditional Call and Return Instructions, Advanced Subroutine Concepts, Code Conversion, 16-bit Data Operation.

- **PERIPHERAL & MEMORY INTERFACING WITH 8085 (08 Hours)**

  Basic I/O Interfacing Concepts: Interfacing Display devices, Interfacing Input devices, Memory Interfacing: Absolute decoding, Partial Decoding, Shadow Memory, Interfacing Peripherals: 8255A Programmable Peripheral Interface, Examples of Interfacing Keyboard and seven-segment Display, Examples of Bidirectional Data transfer Between Two Microcomputer, The 8254 (8253) Programmable Interval Timer, The 8259A Programmable Interrupt Controller, Direct Memory Access and 8237 DMA Controller, The 8279 Programmable Keyboard/Display Interface, Interfacing Scanned Multiplexed Displays and Liquid Crystal Displays, Interfacing a

Matrix Keyboard, Serial I/O and Data Communication: Basic concepts in Serial I/O, Software-Controlled Asynchronous Serial I/O, The 8085-Serial I/O lines: SOD and SID, Hardware Controlled Serial I/O Using Programmable Chips.

- **8085 INTERRUPT MANAGEMENT** **(04 Hours)**

  Interrupts and its Types in 8085, Interrupt Vector Table, Priority of Interrupts, Programming using Interrupts.

- **8086 ARCHITECTURE** **(03 Hours)**

  8086 Architecture, Pin Out Diagram and its Features, Registers of 8086.

- **INSTRUCTION SET OF 8086** **(06 Hours)**

  Data Transfer Instructions and Examples based on it, Arithmetic Instructions and Examples based on it, Logical Instructions, Comparison Instructions, Jump Instructions, Examples based on Logical, Comparison, Jump Instructions, Various 8086 Assembler Directives, Examples based on Various Assembler Directives, What are Procedures in 8086?, Procedure based Examples in 8086, What are Macros in 8086?, Macros based Examples in 8086.

- **PERIPHERAL & MEMORY INTERFACING WITH 8086** **(04 Hours)**

  Interfacing Peripherals:- 8255A: Examples of Interfacing Keyboard and Seven-segment Display, Interfacing with Alphanumeric Displays, Examples of Bidirectional Data Transfer Between Two Microcomputer, 8254, 8259A, and 8279 Interfacing with 8086.

- **8086 INTERRUPTS MANAGEMENT AND APPLICATIONS** **(03 Hours)**

  8086 Interrupts and Interrupts Responses, Interrupt Pointer Table, Hardware Interrupt, Software Interrupts, Interrupt Applications.

- **RECENT TRENDS IN MICROPROCESSORS** **(03 Hours)**

Tutorials will be based on the coverage of the above topics separately **(14 Hours)**

Practicals will be based on the coverage of the above topics separately **(28 Hours)**

(Total Contact Time: 42 Hours + 14 Hours + 28 Hours= 84 Hours)

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3. Practicals:

1 Introduction of 8085 kit and Installation 0f 8085 simulator

2 Assembly Language Programming based on Data transfer and Arithmetic and Logic instructions

3 Assembly Language Programming based on Branch operations

4 Assembly Language Programming based on stack and subroutines

5 Assembly Language Programming based on Code conversions

6. Assembly Language Programming based on counter and time delays

7. Introduction of 8086 Microprocessor and Installation of TASM,TLINK, TD, and DEBUG
8. Assembly Language Programming based on 8086 instruction and assembler directives
9. Practical based on 8085 interfacing

4. Books Recommended:

1. Sentilkumar N, Saravanan M and Jeevananthan S, “Microprocessors and Microcontrollers” 2/E, Oxford University Press, 2018.
2. Ramesh S. Gaonkar, "Microprocessor Architecture, Programming and Applications with 8085", 6/E, Penram International Publishing (India) Pvt. Ltd., 2013.
3. Douglas V Hall, "Microprocessors and Interfacing: Programming & Hardware", 3/E, TMH, 2013.
4. Brey, The Intel Microprocessors", 8/E, Pearson Education, 2009.
5. A K Ray and K M Bhurchandi, "Advanced Microprocessors & Peripherals: Architecture Programming & Interfacing", 2/E, TMH, 2006.

ADDITIONAL REFERENCE BOOKS

1. Abel Peter and Nizamuddin, "IBM PC Assembly Language and Programming", 5/E, Pearson Education, 2001.

B.Tech. II (CSE) Semester – IV
DATABASE MANAGEMENT SYSTEMS (CORE-6)
CS204

	L	T	P	Credit
Scheme	**3**	**1**	**2**	**05**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	understand different database models and query languages to manage the data for given real life application scenario.
CO2	apply the concept of lock management to handle transactions and concurrent user access.
CO3	analyse and evaluate the database design to produce efficient and optimum solution.
CO4	analyse and evaluate the query performance and design the optimum query solution.
CO5	design, populate, and document a normalized database that meets business requirements using industry standards for the given problem.

2. Syllabus

- **INTRODUCTORY CONCEPTS OF DBMS (02 Hours)**

  Introduction, Applications of DBMS, Purpose of Database, Data Independence, Database System Architecture, Data Abstraction, Database users and DBA.

- **ENTITY RELATIONSHIP MODEL (06 Hours)**

  Basic Concepts, Design Process, Constraints, Keys, Design Issues, E-R Diagrams, Attribute Types, Mapping Cardinality, Types of Relationship, Weak/Strong Entity Sets, Extended E-R Features – Generalization, Specialization, Aggregation.

- **RELATIONAL MODELS (04 Hours)**

  Structure of Relational Databases, Domains, Relations, Mapping of ER Model to Relational Model, Relational Algebra – Fundamentals, Operators and Syntax, Relational Algebra Queries, Tuple Relational Calculus.

- **RELATIONAL DATABASE DESIGN (08 Hours)**

  Functional Dependency – Definition, Trivial and Non-trivial FD, Closure of FD Set, Closure of Attributes, Irreducible Set of FD, Normalization – 1Nf, 2NF, 3NF, Decomposition using FD-Dependency Preservation, BCNF, Multi- Valued Dependency, 4NF, Join Dependency and 5NF.

- **QUERY PROCESSING AND OPTIMIZATION (04 Hours)**

  Overview of Query Processing, Measures of Query Cost, Select Operation, Sorting, Join Operation, Other Operations, Evaluation of Expressions, Overview of Query Optimization, Transformation of Relational, Expressions, Estimating Statistics of Expression Results, Choice

of Evaluation Plans, Materialized Views, Advanced Topics in Query Optimization.

- **TRANSACTION MANAGEMENT** **(06 Hours)**

  Transaction Concepts, Properties of Transactions, Serializability of Transactions, Testing for Serializability, System Recovery, Two- Phase Commit Protocol, Recovery and Atomicity, Log-based Recovery, Concurrent Executions of Transactions and Related Problems, Locking Mechanism, Solution to Concurrency Related Problems, Deadlock, Two-phase Locking Protocol, Isolation, Intent Locking.

- **SQL CONCEPT** **(04 Hours)**

  Basics of SQL, DDL,DML,DCL, Structure – Creation/Alteration, Defining Constraints – Primary Key, Foreign Key, Unique, Not Null, Check, IN Operator.

- **PL-SQL CONCEPT** **(04 Hours)**

  Cursors, Stored Procedures, Stored Function, Database Triggers.

- **ADVANCED TOPICS** **(04 Hours)**

  Data security : Introduction, Discretionary Access Control, Mandatory Access Control, Data Encryption, Semi Structured Data and XML, Object Oriented and Object Relational DBMS, Distributed DBMS, NOSQL DBMS.

  Tutorials will be based on the coverage of the above topics separately **(14 Hours)**

  Practicals will be based on the coverage of the above topics separately **(28 Hours)**

  (Total Contact Time: 42 Hours + 14 Hours + 28 Hours = 84 Hours)

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3. Tutorials:

1 Introduction and application of DBMS

2 Designing Relational Models, ER Models and Relational databases

3 Query solving using SQL and PL/SQL

4 Optimum query designing

5 Managing Locks for the management of Transactions and concurrent access of the database

4. Practicals:

1 Implementation for Physical data storage (Sequential, Index Sequential..)

2 Practicing DDL and DML Queries for database creation and managing the data

3 Develop a Database system for the real life application scenario by managing the storage constrains

4 Practicing PL/SQL with the designed databases

5 Design considering Transaction management and concurrency control

6 Design of ER model based example

7 Design of Relational model based example

8 Design of Normalized form of database

5. Books Recommended:

1. A Silberschatz, H. F. Korth, and S Sudarshan, "Database System Concepts", 6/E,TMH, 2010.
2. McFadden, F.Hoffer, Prescott : M. B "Modern database management", 8/E, Benjamin/Cummings Inc, 2006.
3. C.J Date, "An Introduction to Database Systems", Publisher: Addison, Wesley, 8/E, 2003.
4. Raghu Ramakrishnan and Gehrke: "Database Management System", 3/E, WCB/McGraw-Hill, 2003.
5. Margaret H. Dunham, "Data Mining: Introductory and advanced topics", Pearson Education, 2003.

B.Tech. II (CSE) Semester – IV
DESIGN AND ANALYSIS OF ALGORITHMS (CORE-7)
CS206

	L	T	P	Credit
Scheme	**3**	**1**	**2**	**05**

1. Course Outcomes (COs):

At the end of course, students will be able to

CO1	acquire knowledge about the application of mathematical formula and technique to solve the problem and computational complexity analysis.
CO2	apply the different algorithm design techniques for designing a solution of different applications.
CO3	analyse the performance of algorithms using different algorithmic design techniques based on asymptotic or amortized or probabilistic methods.
CO4	evaluate the correctness and implementation of algorithms using different methods of performance evaluation.
CO5	design and innovate efficient algorithms in the field of computer science & engineering and industry related applications using the different algorithm design techniques.

2. Syllabus

- **INTRODUCTION** **(04 Hours)**

  Introduction to Algorithms, Analysis and Design Techniques, Analysis Techniques: Mathematical, Empirical and Asymptotic Analysis. Recurrence Relations and Solving Recurrences, Mathematical Proof Techniques, Amortized Analysis, Probabilistic Analysis.

- **DIVIDE AND CONQUER APPROACH** **(06 Hours)**

  Sorting & Order Statistics, Divide and Conquer Technique, Various Comparison based Sorts, Analysis of the Worst-Case and the Best-Cases, Randomized Sorting Algorithms, Lower Bound on Sorting, Non-comparison based Sorts, Medians and Order Statistics, Min-Max Problem, Polynomial Multiplication, Fast Fourier Transform.

- **GREEDY DESIGN TECHNIQUES** **(08 Hours)**

  Basic Greedy Control Abstraction, Motivation, Thirsty Baby Problem, Formalization, Activity Selection and its Variants, Huffman Coding, Horn Formulas, Tape Storage Problem, Container Loading Problem, Knapsack Problem, Graph Algorithms, Graph algorithms: All-pairs Shortest Paths, Topological Ordering of DAG, DFS in Directed Graphs, Strongly Connected Components, Minimum Spanning Trees, Single Source Shortest Paths, Maximum Bipartite Cover Problem, Network Flows: Ford Fulkerson Algorithm, Max-flow Min-cut Theorem, Polynomial Time Algorithms for Max-flow.

- **DYNAMIC PROGRAMMING** **(08 Hours)**

  Motivation, Matrix Multiplication Problem, Assembly Line Problem, Coin Changing Problem, Longest Common Subsequence, 0/1 Knapsack problem, All-pairs Shortest Path Problems, Dynamic Programming Control Abstraction, Optimal Binary Search Tree.

- **SEARCHING ALGORITHMS** **(04 Hours)**

  Backtracking, N-Queens Problem, Sum of Subset Problem, Complexity Analysis, Branch & Bound, Least Cost Branch & Bound (LCBB), LCBB Complexity Analysis, 15-Puzzle Problem, Traveling Sales Person Problem.

- **NUMBER THEORETIC ALGORITHMS** **(06 Hours)**

  Number Theoretic Notions, GCD, Modular Arithmetic, Chinese Remainder Theorem, Generators, Cyclic Groups, Galois Fields, Applications in Cryptography, Primality Testing.

- **NP-COMPLETE PROBLEMS** **(06 Hours)**

  Polynomial Time, Verification, NP-completeness, Search Problems, Reductions, Dealing with NP-Completeness, Approximation Algorithms, Local Search Heuristics.

  Tutorials will be based on the coverage of the above topics. **(14 Hours)**

  Practicals will be based on the coverage of the above topics. **(28 Hours)**

  (Total Contact Time: 42 Hours + 14 Hours + 28 Hours = 84 Hours)

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3. Practicals:

1 Practical based on time analysis of sorting algorithms.

2 Practical based on divide and conquer technique.

3 Practical based on greedy design technique.

4 Practical based on dynamic programming.

5 Practical based on searching algorithms.

6 Practical based on back tracking technique.

7 Practical based on Graph based algorithms.

8 Practical based on branch and bound technique.

4. Books Recommended:

1. Cormen, Leiserson, Rivest, Stein," Introduction to Algorithms", 3/E, MIT Press, 2009.
2. J. Kleinberg, E. Tardos, "Algorithm Design", 1/E, Pearson Education, Reprint 2006.
3. SartajSahni, "Data Structures, Algorithms and Applications in C++", 2/E, Universities Press/Orient Longman, 2005
4. Sara Baase, Allen van Gelder," Computer Algorithms: Introduction to Design & Analysis, 3/E,

Pearson Education, 2000.

5. Knuth, Donald E., “The Art of Computer Programming, Vol I &III”, 3/E, Pearson Education, 1997.

B.Tech. II (CSE) Semester – IV
AUTOMATA AND FORMAL LANGUAGES (CORE-8)
CS208

	L	T	P	Credit
Scheme	**3**	**1**	**0**	**04**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge of the basis of theory of computation, different computational problems and the importance of automata as a modelling tool of computational problems.
CO2	to apply rigorously formal mathematical methods to prove properties of languages, grammars and automata.
CO3	analyse the solutions for different problems and argue formally about correctness on different restricted machine models of computation.
CO4	evaluate and Identify limitations of computational models and possible methods of proving them.
CO5	design the solution in the forms of different types of machine with correctness proof and able to develop different system software.

2. Syllabus

- **INTRODUCTION (05 Hours)**

  Basic Mathematical Objects: Sets, Logic, Functions, Relations, Strings, Alphabets, Languages; Mathematical Induction: Inductive Proofs, Principles, Recursive Definitions, Set Notation.

- **FINITE AUTOMATA AND REGULAR EXPRESSIONS (12 Hours)**

  Finite State Systems, Deterministic Finite Automata; Nondeterministic Finite Automata, Nondeterministic Finite Automata with Epsilon, Applications, Kleene' Theorem; Two-way Finite Automata, Finite Automata with Output, Regular Languages & Regular Expressions, Properties of Regular Sets: The Pumping Lemma for Regular Sets, Closure Properties, Decision Properties of Regular Languages, Equivalence and Minimization of Automata, Moore and Mealy Machines.

- **CONTEXT FREE GRAMMARS (14 Hours)**

  Definition, Derivation Trees & Ambiguity, Inherent Ambiguity, Parse Tree, Application of CFG, Simplification of CFG, Normal Form of CFG, Chomsky Normal Form and Chomsky Hierarchy, Unrestricted Grammars, Context-Sensitive Languages, Relations between Classes of Languages, Properties of Context Free Languages: The Pumping Lemma, Closure Properties, Decision Properties of CFL.

- **PUSHDOWN AUTOMATA (05 Hours)**

  Definitions, Languages of PDA, Equivalence of PDA and CFG , Deterministic PDA.

- **TURING MACHINES (06 Hours)**

Turing Machine Model, Language of a Turing Machine (TM), Programming Techniques of the TM, Variations of TM, Multiple TM, One-Tape and Multi-Tape TM, Deterministic and Non deterministic TM, Universal TM, Churche Thesis, Recursively Enumerable Languages, Decidability, Reducibility, Intractable Problem Classes of Problems NP Hard, NP Complete.

Tutorials will be based on the coverage of the above topics. (14 Hours)

(Total Contact Time: 42 Hours + 14 Hours = 56 Hours)

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3. Tutorials:

1 Problem statements based on Regular Language and Finite Automata.

2 Questions based on Context Free Grammar.

3 Problems regarding Push Down Automata.

4 Solving Problems for Turing Machine.

5 Decidable and Undecidable Problems.

4. Books Recommended:

1. Michael Sipser, "Introduction to the Theory of Computation",Cengage Learning, 3/E, 2013.
2. John C Martin, "Introduction to Languages & the Theory of Computation", 3/E, Tata McGraw-Hill, 2011.
3. John E. Hopcroft, Rajeev Motwani, Jeffrey Ullman, "Introduction to Automata theory, languages computation, 3/E, Pearson India, 2008.
4. Daniel I A Cohen, "Introduction to Computer Theory", John Wiley & Sons, 2/E, Reprint 2008.
5. Andrew Ilachinski, "Cellular Automata", 1st Ed., World Scientific, 2001.

ADDITIONAL REFERENCE BOOKS

1. Sushil Kumar Azad, "Theory of Computation, An introduction to /automata, Formal Languages And Computability", Dhanpat Ray & Co., New Delhi, 2005.
2. A.M. Natarajan, A.Tamilarasi, "Theory of computation", New Age Publication, 1/E, 2003.