

**SCHOOL OF ENGINEERING**  
**SRI SATYA SAI UNIVERSITY OF TECHNOLOGY AND MEDICAL SCIENCES**  
**Outcome based Curriculum for**  
**Undergraduate Degree Courses in Engineering & Technology**  
**Department of Computer Science & Engineering**

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Subject Code	Subject	L	T	P	Credit	Hours/week
CSA-601	Compiler Design	2	1	0	3	3

**Objective:**

The main objective of this course is to introduce the major concept areas of language translation and compiler design and to develop an awareness of the function and complexity of modern compilers. This course is a study of the theory and practice required for the design and implementation of interpreters and compilers for programming languages.

**Outcome** :

By the end of the course, the successful student will be able to do:

- To realize basics of compiler design and apply for real time applications.
- To introduce different translation languages – To understand the importance of code optimization.
- To know about compiler generation tools and techniques.
- To learn working of compiler and non-compiler applications.
- Design a compiler for a simple programming language

**UNIT-I (9 Hr.)**

Introduction: Alphabets, Strings and Languages, Automata and Grammars, Deterministic finite Automata (DFA)-Formal Definition, Simplified notation: State transition graph, Transition table, Language of DFA, Nondeterministic finite Automata (NFA), Equivalence of NFA and DFA, Minimization of Finite Automata, Regular Expressions, Arden's theorem.

**UNIT-II (10 Hr.)**

Compiler Structure: Compilers and Translators, Various Phases of Compiler, Pass Structure of Compiler, Bootstrapping of Compiler. Lexical Analysis: The role of Lexical Analyzer, A simple approach to the design of Lexical Analyzer, Implementation of Lexical Analyzer. The Syntactic Specification of Programming Languages: CFG, Derivation and Parse tree, Ambiguity, Capabilities of CFG. Basic Parsing Techniques: Top-Down parsers with backtracking, Recursive Descent Parsers, Predictive Parsers.

**UNIT-III (8 Hr.)**

Bottom-Up Parsers, Shift-Reduce Parsing, Operator Precedence Parsers, LR parsers (SLR, Canonical LR, LALR) Syntax Analyzer Generator: YACC, Intermediate Code Generation: Different Intermediate forms: three address code, Quadruples & Triples. Syntax Directed translation mechanism and attributed definition. Translation of Declaration, Assignment,

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Control flow, Boolean expression, Array References in arithmetic expressions, procedure calls, case statements, postfix translation.

**UNIT-IV (8 Hr.)**

Run Time Memory Management: Static and Dynamic storage allocation, stack based memory allocation schemes, Symbol Table management Error Detection and Recovery: Lexical phase errors, Syntactic phase errors, Semantic errors.

**UNIT-V(5 Hr.)**

Code Optimization and Code Generation: Local optimization, Loop optimization, Peephole optimization, Basic blocks and flow graphs, DAG, Data flow analyzer, Machine Model, Order of evaluation, Register allocation and code selection

**REFERENCES:**

- 1.Principles of compiler design -A.V. Aho . J.D.Ullman; Pearson Education.
- 2.Modern Compiler Implementation in C- Andrew N. Appel, Cambridge University Press.
- 3.A. C. Holub. Compiler Design in C , Prentice-Hall Inc., 1993.
- 4.Raghavan, Compiler Design, TMH Pub.

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<b>Subject Code</b>	<b>Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>	Hours/week
<b>CSA-601</b>	<b>Compiler Design</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>	2

**List of Experiments:**

1. Develop a lexical analyzer to recognize a few patterns.
2. Write a program to parse using Brute force technique of Topdown parsing.
3. Develop LL (1) parser (Construct parse table also).
4. Develop an operator precedence parser (Construct parse table also)
5. Develop a recursive descent parser
6. Write a program for generating for various intermediate code forms i) Three address code ii) Polish notation
7. Write a program to simulate Heap storage allocation strategy
8. Generate Lexical analyzer using LEX
9. Generate YACC specification for a few syntactic categories.
10. Given any intermediate code form implement code optimization techniques

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<b>Subject Code</b>	<b>Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credit</b>	<b>Hours/week</b>
<b>CSA-602</b>	<b>Computer Network</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>	<b>3</b>

**Objective:**

This course is to provide students with an overview of the concepts and fundamentals of data communication and computer networks. Topics to be covered include: data communication concepts and techniques in a layered network architecture, communications switching and routing, types of communication, network congestion, network topologies, network configuration and management, network model components, layered network models (OSI reference model, TCP/IP networking architecture) and their protocols, various types of networks (LAN, MAN, WAN and Wireless networks) and their protocols.

**Outcomes:**

The students will be able to:

- Build an understanding of the fundamental concepts of computer networking.
- Familiarize the student with the basic taxonomy and terminology of the computer networking area.
- Introduce the student to advanced networking concepts, preparing the student for entry Advanced courses in computer networking.
- Allow the student to gain expertise in some specific areas of networking such as the design and maintenance of individual networks.

**UNIT-I (9 Hr.)**

Introduction to computer networks and Internet, overview Advantages - network, Types-server based, peer, hybrid, Server types, Network Topology: Bus, Star, Ring, Star bus, Star ring, Mesh, Network Protocols Hardware Protocols, Software Protocols, Selecting and design the network for an organization.

**UNIT-II (8 Hr.)**

Signal Transmission: Digital signaling, Analog Signaling, Bit synchronization, Baseband and Broadband transmission, Network Media types- properties & specialties, Network adapters-working principals, configuration and selection.

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**UNIT-III (8Hr.)**

Network Layer: Network Layer Design issues, Store and Forward Packet Switching, connection less and connection oriented networks, routing algorithm's, optimality principle, shortest path, flooding, Distance Vector Routing, Control to Infinity Problem, Hierarchical Routing, Congestion control algorithms, admission control.

**UNIT-IV (8 Hr.)**

Internetworking: Tunneling, Internetwork Routing, Packet fragmentation, IPv4, IPv6 Protocol, IP addresses, CIDR, ICMP, ARP, RARP, DHCP. Transport Layer: Services provided to the upper layers elements of transport protocol-addressing connection establishment, connection release, Crash Recovery.

**UNIT-V (7 Hr.)**

UDP, RPC, Real Time Transport Protocols, The Internet Transport Protocols- Introduction to TCP, The TCP Service Model, The TCP Segment Header, The Connection Establishment, The TCP Connection Release, The TCP Connection Management Modeling, The TCP Sliding Window, The TCP Congestion Control, The future of TCP. Application Layer: Introduction, providing services, Applications layer paradigms, Client server model, Standard client-server application-HTTP, FTP, electronic mail, TELNET, DNS, SSH.

**REFERENCES:**

1. Andrew & Tanenbaum, "Computer Network".
2. Prakash C Gupta, "Data Communication.
3. William Stallings, "Data and Computer Communication".
4. Computer Networking and the Internet (5th edition), Fred Halsall, Addison Wesley.
5. TCP/IP Protocol Suite (3rd edition), Behrouz Forouzan, McGraw Hill.

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Subject Code	Subject	L	T	P	Credit	Hours/week
CSA-602	Computer Network	0	0	2	1	2

**LIST OF EXPERIMENTS:**

1. Establishment and configuration of LAN.
2. Study of WAN.
3. Case study of ARP AND RARP Protocols.
4. Study of basic networking commands like ping, ipconfig, etc.
5. Case study of various Routing Strategies.
6. Case studies of various Network Topologies.
7. Study of sliding window protocol.
8. Configuring routers, bridges and switches and gateways.
9. Case study of client-server application.
10. Study of IPv4, IPv6 Protocol.

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Subject Code	Subject	L	T	P	Credit	Hours/week
CSA-603(A)	Advance Computer Architecture	3	1	0	4	4

**Objective:**

The objective of this course is to make students know about the Parallelism concepts in Programming, to give the students an elaborate idea about the different memory systems and buses, to introduce the advanced processor architectures to the students, to make the students know about the importance of multiprocessor and multicomputers, to study about data flow computer architectures.

**Outcome:**

Students will be able to:

- Demonstrate concepts of parallelism in hardware/software.
- Discuss memory organization and mapping techniques.
- Describe architectural features of advanced processors.
- Interpret performance of different pipelined processors.
- Explain data flow in arithmetic algorithms
- Development of software to solve computationally intensive problems

**UNIT-I (9 Hr.)**

Flynn's Classification, System Attributes to Performance, Parallel computer models - Multiprocessors and Multicomputers, Multivector and SIMD Computers. Data and resource dependences, Hardware and Software Parallelism, Program partitioning and scheduling, Grain size and latency, Control flow, Data flow and Demand driven mechanisms. Static interconnection networks, Dynamic interconnection Networks, Bus Systems, Crossbar Switch, Multiport Memory, Multistage and Combining Networks.

**UNIT- II (9 Hr.)**

Instruction set Architecture, CISC Scalar Processors , RISC Scalar Processors, VLIW architecture, Memory Hierarchy, Inclusion, Coherence and Locality, Memory capacity planning. Interleaved memory organization, Memory interleaving, Pipelined memory access, Bandwidth and Fault Tolerance. Backplane Bus System, Backplane bus specification, Addressing and timing protocols, Arbitration transaction and interrupt.

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**UNIT-III (8 Hr.)**

Linear Pipeline Processor, Nonlinear Pipeline Processor, Instruction Pipeline design, Mechanisms for instruction Pipelining, Pipeline Hazards, Dynamic instruction scheduling - score boarding and Tomosulo's algorithm, Branch handling techniques, Arithmetic Pipeline Design, Static arithmetic Pipeline, Multifunctional Arithmetic Pipelines. Superscaler Pipeline design, Super Pipeline Processor Design.

**UNIT-IV (7 Hr.)**

Cache Coherence, Snoopy protocols, Directory based protocols. Message routing schemes in multicomputer network, Deadlock and virtual channel. Vector Processing Principles, Vector instruction types, Vector-access memory schemes. Vector supercomputer architecture, SIMD organization, Distributed memory model and shared memory model. Principles of Multithreading, Multithreading Issues and Solutions, Multiple-Context Processors.

**UNIT-V (7 Hr.)**

Parallel Programming Models, Shared-Variable Model, Message-Passing Model, Data-Parallel Model, Object-Oriented Model, Functional and Logic Models, Parallel Languages and Compilers, Language Features for Parallelism, Parallel Programming Environment, Software Tools and Environments.

**REFERENCES:**

1. Kai Hwang, "Advanced computer architecture", TMH.
2. J.P. Hayes, "computer Architecture and organization"; MGH.
3. V.Rajaraman & C.S.R. Murthy, "Parallel computer"; PHI Learning.
4. Kain, "Advance Computer Architecture: - A System Design Approach", PHI Learning



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Subject Code	Subject	L	T	P	Credit	Hours/week
CSA-603(B)	Advanced Data Structure	3	1	0	4	4

**Objective:**

The objective of this course is to impart the basic concepts of data structures and algorithms, to understand concepts about searching and sorting techniques, to Understand basic concepts about stacks, queues, lists, trees and graphs, to understanding about writing algorithms and step by step approach in solving problems with the help of fundamental data structures.

**Outcome:**

Students will be able to :

- Ability to analyze algorithms and algorithm correctness.
- Ability to summarize searching and sorting techniques
- Ability to describe stack, queue and linked list operation.
- Ability to have knowledge of tree and graphs concepts

**UNIT-I (9 Hr.)**

**Introduction:** Basic Terminology, Data types and its classification, Algorithm complexity notations like big Oh, Array Definition, Representation and Analysis of Arrays, Single and Multidimensional Arrays, Address calculation, Array as Parameters, Ordered List and operations, Sparse Matrices, Storage Pools, Garbage collection.

**UNIT-II (9 Hr.)**

**Recursion:** - Recursion- definition and processes, simulating recursion, Backtracking, Recursive algorithms, Tail recursion, Removal of recursion. Tower of Hanoi Problem. Linear Data Structure:- Stack, Array Implementation of stack, Linked Representation of Stack, Application of stack, Queue, Array and linked implementation of queues, Circular queues, D -queues and Priority Queues.

**UNIT-III (8Hr.)**

Introduction of Linked list, Implementation of Singly Linked List, Two-way Header List, Doubly linked List, Linked List in Array. Generalized linked list, Non Linear Data Structure :-Trees: Basic terminology, Binary Trees, , algebraic Expressions, Complete Binary Tree, Extended Binary Trees, Array and Linked Representation of Binary trees, Traversing Binary trees, Threaded Binary trees, Binary Search Tree(BST ), Height-balanced and weight-balanced trees, B-trees, B+ -trees.

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**UNIT-IV (7 Hr.)**

**Searching, Sorting and Design Techniques:-** Searching Techniques, Sorting-Internal Sorting, Bubble Sort, Insertion Sort, Quick Sort, Heap Sort, Bin Sort, Radix Sort, External Sorting, Merge Sort, Multi-way Merge Sort ,Design Techniques -Divide and Conquer, Dynamic Programming, Greedy Algorithm, Backtracking, Local Search Algorithms.

**UNIT-V (7 Hr.)**

**Memory Management:** -Issues -Managing Equal Sized Blocks, Garbage Collection Algorithms for Equal Sized Blocks, Storage Allocation for Objects with Mixed Sizes, Buddy Systems, Garbage collection and compaction.

**Reference Books:**

1. Aho, Hopcroft, Ullman, "Data Structures and Algorithms", Pearson Education P
2. Lipschutz; Data structure (Schaum); TMH
3. R. Kruse et al, "Data Structures and Program Design in C", Pearson Education Asia, Delhi-2002

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Subject Code	Subject	L	T	P	Credit	Hours/week
CSA-604(A)	Data Mining and Data Warehousing	3	0	0	3	3

**Objectives:**

The objective of this course is to familiar with mathematical foundations of data mining tools, Understand and implement classical models and algorithms in data warehouses and data mining, Characterize the kinds of patterns that can be discovered by association rule mining, classification and clustering.

**Outcomes:**

Students will be able to:

- Understand Data Warehouse fundamentals, Data Mining Principles
- Design data warehouse with dimensional modeling and apply OLAP operations.
- Identify appropriate data mining algorithms to solve real world problems
- Compare and evaluate different data mining techniques like classification, prediction, clustering and association rule mining
- Describe complex data types with respect to spatial and web mining

**UNIT- I (9 Hr.)**

Data Mining: Basic concept ,technology and rules, application of data mining, KDD v/s Data Mining, DBMS v/s Data Mining , DM techniques, Mining problems, Issues and Challenges in DM, DM Application areas.

**UNIT-II (9 Hr.)**

Rules & Clustering Techniques: Introduction, Various association algorithms like A Priori, Partition, Pincer search etc., Generalized association rules. Clustering paradigms; Partitioning algorithms like K- Method, CLARA, CLARANS; Hierarchical clustering, DBSCAN, BIRCH, CURE; categorical clustering algorithms, STIRR, ROCK, CACTUS.

**UNIT-III (7 Hr.)**

Data mining techniques: Exploration of data mining methodologies, decision tables, decision trees, classification rules, association rules, clustering, statistical models & linear models.

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Web mining: Introduction to web mining techniques, web basics and HTTP, data sources on the web, personalization, working with logs, forms and cookies, user identification and path analysis. E-Metrics.

**UNIT-IV (8 Hr.)**

Data Mining of Image and Video : A case study. Image and Video representation techniques, feature extraction, motion analysis, content based image and video retrieval, clustering and association paradigm, knowledge discovery.

**UNIT-V (7 Hr.)**

Data warehousing : Data warehouse, OLAP and Data mining. OLTP vs OLAP. Data Warehouse Design Identifying facts & dimensions, designing fact tables, dimension tables, star flake schema query redirection. OLAP operations Data ware house High Performance Computing architecture, Multidimensional schemes:1 partitioning strategy, aggregation, data marting, metadata. Capacity planning, tuning the data warehouse testing the data warehouse: developing test plan, testing operational environment Distributed and virtual data warehouses.

**Reference Books :**

1. Data Mining Techniques ; Arun K.Pujari ; University Press.
2. Data Mining; Adriaans & Zantinge; Pearson education.
3. Mastering Data Mining; Berry Linoff; Wiley.
4. Data Mining; Dunham; Pearson education.

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Subject Code	Subject	L	T	P	Credit	Hours/week
CSA-604(B)	Soft Computing	3	0	0	3	3

**Objective:**

The objective of this course is to develop the skills to gain a basic understanding of neural network theory and fuzzy logic theory, introduce students to artificial neural networks and fuzzy theory from an engineering perspective.

**Scope:**

The students are expected to:

- Comprehend the fuzzy logic and the concept of fuzziness involved in various systems and fuzzy set theory.
- Understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic
- To understand the fundamental theory and concepts of neural networks, Identify different neural network architectures, algorithms, applications and their limitations
- Understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications
- Reveal different applications of these models to solve engineering and other problems

**UNIT-I (9 Hr.)**

Soft Computing:- Introduction of soft computing, soft computing vs hard computing, various types of soft computing techniques, applications of soft computing. Introduction to Neural Network:- Concept, biological neural network, evolution of artificial neural network, McCulloch-Pitts neuron models, Learning (Supervised & Unsupervised) and activation function, Models of ANN-Feed forward network and feedback network, Learning Rules Hebbian, Delta, Perceptron Learning and Windrow-Hoff, winner take all.

**UNIT - II (9 Hr.)**

Supervised Learning: Perceptron learning,- Single layer/multilayer, linear Separability,

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Adaline, Madaline, Back propagation network, RBFN. Application of Neural network in forecasting, data compression and image compression.

**UNIT - III (7 Hr.)**

Unsupervised learning: Kohonen SOM (Theory, Architecture, Flow Chart, Training Algorithm) Counter Propagation (Theory, Full Counter Propagation NET and Forward only counter propagation net), ART (Theory, ART1, ART2), Application of Neural networks in pattern and face recognition, intrusion detection, robotic vision.

**UNIT - IV (7 Hr.)**

Fuzzy Set: Basic Definition and Terminology, Set-theoretic Operations, Member Function, Formulation and Parameterization, Fuzzy rules and fuzzy Reasoning, Extension Principal and Fuzzy Relations, Fuzzy if-then Rules, Fuzzy Inference Systems. Hybrid system including neuro fuzzy hybrid, neuro genetic hybrid and fuzzy genetic hybrid, fuzzy logic controlled GA. Application of Fuzzy logic in solving engineering problems.

**UNIT - V (7 Hr.)**

Genetic Algorithm: Introduction to GA, Simple Genetic Algorithm, terminology and operators of GA (individual, gene, fitness, population, data structure, encoding, selection, crossover, mutation, convergence criteria). Reasons for working of GA and Schema theorem, GA optimization problems including JSP (Job shop scheduling problem), TSP (Travelling salesman problem), Network design routing, timetabling problem. GA implementation using MATLAB.

**REFERENCES:**

1. S.N. Shivnandam, "Principle of soft computing", Wiley
2. Rich E and Knight K, Artificial Intelligence, TMH, New Delhi.
3. Klir & Yuan, Fuzzy sets & Fuzzy Logic: Theory & Appli., PHI Pub.
4. S, Rajasekaran & G.A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic & Genetic Algorithms, Synthesis & applications, PHI Publication.

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Subject Code	Subject	L	T	P	Credit	Hours/week
CSA-605(A)	Information Theory & Coding	3	0	0	3	3

**Objective:**

The objectives of this course are to understand the fundamentals of Cryptography, to acquire knowledge on standard algorithms used to provide confidentiality, integrity and authenticity, to understand the various key distribution and management schemes, to understand how to deploy encryption techniques to secure data in transit across data networks, to design security applications in the field of Information technology.

**Outcome:**

The students at the end of the course will be able to:

- Understand and explain the basic concepts of information theory, source coding, channel and channel capacity, channel coding and relation among them.
- Describe the real life applications based on the fundamental theory.
- Calculate entropy, channel capacity, bit error rate, code rate, steady-state probability and so on.
- Implement the encoder and decoder of one block code or convolutional code using any program language

**UNIT-I (9 Hr.)**

Uncertainty, Information and Entropy Information Measures, Characteristics on information measure, Shannon's concept of information, Shannon's measure of information, Model for source coding theorem, Communication system, Source coding and line/channel coding, channel mutual information capacity (Bandwidth).

**UNIT-II (8Hr.)**

Channel coding, Theorem for discrete memory less channel, Information capacity theorem: Error detecting and error correcting codes, Types of codes, Block codes, Tree codes, Hamming Codes, Description of linear block codes by matrices, Description of linear tree code by matrices, Parity check codes, Parity check polynomials.

**UNIT-III (9 Hr.)**

Compression: Lossless and lossy, Huffman codes, Binary Image compression schemes, Run

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length Encoding, CCITT group-3 1D compression, CCITT group-3 2D compression, CCITT group-4 2D compression.

**UNIT-IV (7 Hr.)**

Video Image Compression: Requirement of full motion video compression, CCITT H 261 video coding algorithm, MPEG compression methodology, MPEG-2 compression, Audio (Speech)compression.

**UNIT-V (7Hr.)**

Cryptography: Encryption, Decryption, Cryptogram (cipher text), Concept of cipher, Cryptanalysis, Keys: Single key (Secret key), Cryptography, two-key (Public key) cryptography, Single key cryptography, Ciphers, Block Cipher code, Stream ciphers, Requirements for secrecy, The data Encryption Standard, Public Key Cryptography, Diffie-Hellmann public key distribution, The Rivest- Shamir Adelman(R-S-A) system for public key cryptography, Digital Signature.

**REFERENCES:**

1. Rajan Bose "Information Theory, Coding and Cryptography", TMH, 2002.
2. G A Jones J M Jones, "Information and Coding Theory", Springer Verlag, 2004.
3. Cole, "Network Security", Bible, Wiley INDIA, Second Addition.
4. K Sayood, "Introduction to Data Compression" 3/e, Elsevier 2006.



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Subject Code	Subject	L	T	P	Credit	Hours/week
CSA-605(B)	Cyber Law & Ethics	3	0	0	3	3

**Objective:**

The Objectives Of This Course Is To Enable Learner To Understand, Explore, And Acquire A Critical Understanding Cyber Law. Develop Competencies For Dealing With Frauds And Deceptions (Confidence Tricks, Scams) And Other Cyber Crimes For Example, Child Pornography Etc. That Are Taking Place Via The Internet.

**Outcomes:**

Student will be able to:

1. Make Learner Conversant With The Social And Intellectual Property Issues Emerging From 'Cyberspace.
2. Explore The Legal And Policy Developments In Various Countries To Regulate Cyberspace;
3. Develop The Understanding Of Relationship Between Commerce And Cyberspace; And
4. Give Learners In Depth Knowledge Of Information Technology Act And Legal Frame Work Of Right To Privacy, Data Security And Data Protection.
5. Make Study On Various Case Studies On Real Time Crimes.

**UNIT-I (9 Hr.)**

Cyber world: an overview, internet and online resources, security of information, digital signature, intellectual property (IP), historical background of IP, IPR governance, National patent offices, the world intellectual property organization (WIPO).

**UNIT-II (9 Hr.)**

Introduction about the cyber space, cyber law, regulation of cyber space, scope of cyber laws:

ecommerce; online contracts; IPRs (copyright, trademarks and software patenting), e-taxation; e-governance and cyber-crimes, cyber law in India with special reference to Information Technology Act, 2000.

**UNIT-III (8 Hr.)**

Introduction to computer and cyber-crimes, Cyber-crimes and related concepts, distinction between cyber-crimes and conventional crimes, Cyber criminals and their objectives. Kinds of cyber-crimes cyber stalking; cyber pornography, forgery and fraud, crime related to IPRs, cyber terrorism; computer vandalism etc. Cyber forensics, computer forensics and the law, forensic evidence, computer forensic tools.

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**UNIT-IV (7 Hr.)**

Regulation of cyber-crimes, Issues relating to investigation, issues relating to jurisdiction, issues relating to evidence, relevant provisions under Information Technology Act 2000, Indian penal code, pornography Act and evidence Act etc.

**UNIT-V (7 Hr.)**

Copyright issues in cyberspace: linking, framing, protection of content on web site, international treaties, trademark issues in cyberspace: domain name dispute, cyber-squatting, uniform dispute resolution policy, computer software and related IPR issues.

**REFERENCES:**

1. Nelson, Phillips, "Computer Forensics and Investigations", Cengage Learning India.
2. Vinod V. Sople, "Managing Intellectual Property" PHI Learning Private Limited.
3. Dr.R.K.Tiwari P.K.Sastri,K.V. Ravikumar, "Computer crime and Computer Forensics", First Edition 2002, Select publishers.
4. NIIT, Understanding Forensics in IT, PHI Learning