

AY 2019-20 ONWARDS

## Course Structure and Curriculum

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*Master of Technology in Computer Science and Engineering*

*(Specialization: Computer Science and Engineering)*



**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING  
VEER SURENDRA SAI UNIVERSITY OF TECHNOLOGY, ODISHA,  
BURLA – 768018**

## **VISION**

To be a recognized leader by imparting quality technical education and thereby facilitating the extensive research environment, equipping students with latest skills in the field of technology supplemented with practical orientation to face challenges in the fast morphing modern computing industry and academia for the betterment of the society.

## **MISSION**

1. To produce best quality computer science professionals and researchers by providing state-of-the-art training, hands on experience and healthy research environment.
2. To collaborate with industry and academia around the globe for achieving quality technical education and excellence in research through active participation of all the stakeholders.
3. To promote academic growth by establishing Center of Excellences and offering inter-disciplinary postgraduate and doctoral programs.
4. To establish and maintain an effective operational environment and deliver quality, prompt cost effective and reliable technology services to the society as well as compliment the local and global economic goals.

## **PROGRAM EDUCATIONAL OBJECTIVES**

The program educational objectives of M.Tech. in Computer Science and Engineering (Computer Science and Engineering) program of VSSUT Burla are to prepare its graduates:

1. The graduates will be able to build up an ability to analyze the requirements, understand the technical specification, design and provide novel engineering solutions to resolve various industrial and technological problems.
2. The graduates will be able to reveal professionalism, ethical attitude and maintain good teamwork spirit in their profession as engineering professionals and leaders to set up technical ambience in the society.
3. The graduates will be able to employ their skill with a strong base to prepare them for higher learning and research activities so as to emerge as leaders in engineering, management, applied research, and education.

	<b>M1</b>	<b>M2</b>	<b>M3</b>	<b>M4</b>
<b>PEO1</b>	<b>3</b>	<b>3</b>	<b>1</b>	<b>2</b>
<b>PEO2</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>3</b>
<b>PEO3</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>1</b>

### **PROGRAM OUTCOMES for M.Tech. (CSE)**

PO1	An ability to independently carry out research/investigation and development work to solve practical problems.
PO2	An ability to write and present a substantial technical report/document.
PO3	An ability to demonstrate a degree of mastery over Computer Science & Engineering which is at a level higher than the requirements in the undergraduate program in Computer Science & Engineering and Information Technology.
PO4	An ability to create, select, learn and apply appropriate techniques, resources, and modern hardware and software tools, including prediction and modeling, to complex engineering activities with an understanding of the limitations.
PO5	An ability to understand the group dynamics, recognize opportunities and contribute positively to collaborative-multidisciplinary scientific research in order to achieve common goals.
PO6	Demonstrate a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity and rational analysis to further the learning of themselves as well as others.

### **Program Specific Outcomes for M.Tech. (CSE)**

PSO1	Ability to design, model and analyze various advanced computing tools to investigate various socio-economic problems in the domain of Computer Science and Engineering
PSO2	Ability to apply knowledge to provide innovative cutting-edge engineering hardware and software solutions to existing problems and identify the research gaps.

**VSS UNIVERSITY OF TECHNOLOGY BURLA ODISHA****Model Course Structure  
for  
M.Tech., Specialization in Computer Science & Engineering to be introduced from  
July 2019****Semester I**

<b>Sl. No.</b>	<b>Core/ Elective</b>	<b>Subject Code</b>	<b>Subject Name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
1	Core-1		Advances in Data Structures and Algorithms	3	0	0	3
2	Core-2		Advances Computer Architecture	3	0	0	3
3	PE-1		Professional Elective-1	3	0	0	3
4	PE-2		Professional Elective-2	3	0	0	3
5	Common		Research Methodology & IPR	3	0	0	3
6	Lab-1		Simulation Using MATLAB	0	0	3	1.5
7	Lab-2		Advanced Computing Laboratory	0	0	3	1.5
8	Audit -1		Audit Course - 1				
<b>Total Credits</b>							<b>18</b>

**Semester II**

<b>Sl. No.</b>	<b>Core/ Elective</b>	<b>Subject Code</b>	<b>Subject Name</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
1	Core-3		Distributed Operating Systems	3	0	0	3
2	Core-4		Advanced Database Systems	3	0	0	3
3	PE-3		Professional Elective -3	3	0	0	3
4	PE-4		Professional Elective -4	3	0	0	3
5	Common		Minor project & Seminar	0	0	4	2
6	Lab-3		Computational Intelligence Laboratory	0	0	3	2
7	Lab-4		Cloud Computing Laboratory	0	0	3	2
8	Audit -2		Audit Course -2				
<b>Total Credits</b>							<b>18</b>

### Semester III

Sl. No.	Core/ Elective	Subject Code	Subject Name	L	T	P	Credits
1	PE-5		Professional Elective -5	3	0	0	3
2	OE-1		Open Elective -1	3	0	0	3
3	Minor Project		Dissertation (Phase-I)	0	0	20	12
<b>Total Credits</b>							18

### Semester IV

Sl. No.	Core/ Elective	Subject Code	Subject Name	L	T	P	Credits
1	Major Project		Dissertation (Phase-II)	0	0	32	16
<b>Total Credits</b>							16

**GRAND TOTAL CREDITS: 18+18+18+16= 70**

1 <sup>st</sup> Semester				2 <sup>nd</sup> Semester			
Core: Theory (Compulsory)				Core: Theory (Compulsory)			
Subject Code	Subject	Contact Hours (L-T-P)	Credit	Code	Subject	Contact Hours (L-T-P)	Credit
	Advanced Data Structures and Algorithms	3-0-0	3		Distributed Operating Systems	3-0-0	03
	Advanced Computer Architecture	3-0-0	3		Advances in Database Systems	3-0-0	03
<b>Professional Elective-I (any One)</b>				<b>Professional Elective-III (any One)</b>			
	Optimization Techniques	3-0-0	03		Advanced Networking	3-0-0	03
	Cryptography and Data Security	3-0-0	03		Selected Topics on Theory of Computation	3-0-0	03
	Real Time Systems	3-0-0	03		Machine Learning	3-0-0	03
	Artificial Intelligence and expert Systems	3-0-0	03		Randomized Algorithm	3-0-0	03
<b>Professional Elective-II (any One)</b>				<b>Professional Elective-IV (any One)</b>			
	Embedded Systems	3-0-0	03		Computer Vision	3-0-0	03
	Intrusion Detection Systems	3-0-0	03		Data Mining and Data Warehousing	3-0-0	03
	Pattern Recognition	3-0-0	03		Privacy and Security in Social Networks	3-0-0	03
	Bio-Informatics	3-0-0	03		Knowledge Representation and Learning	3-0-0	03
<b>Common</b>							
	Research Methodology and IPR	3-0-0	3		Minor Project and Seminar	0-0-4	02
<b>Practical/Sessionals</b>				<b>Practical/Sessionals</b>			
	Simulation using MATLAB	0-0-3	1.5		Computational Intelligence Laboratory	0-0-3	02
	Advanced Computing Laboratory	0-0-3	1.5		Cloud Computing Laboratory	0-0-3	02
<b>Credits (Practicals/Sessionals)</b>			<b>03</b>	<b>Credits (Practicals/Sessionals)</b>			<b>04</b>
<b>Audit Course-1 (any One)</b>				<b>Audit Course-2 (any One)</b>			
	Constitution of India				English for Research Paper Writing		
	Stress Management by Yoga				Value Education		
	Pedagogy Studies				Personality Development through Life Enlightenment Skills		
<b>Credits (Theory)</b>			<b>18</b>	<b>Credits (Theory)</b>			<b>18</b>

<b>Total Semester Credits</b>				<b>18</b>	<b>Total Semester Credits</b>				<b>18</b>
<b>Total Cumulative Credits</b>				<b>18</b>	<b>Total Cumulative Credits</b>				<b>36</b>
<b>3<sup>rd</sup> Semester</b>					<b>4<sup>th</sup> Semester</b>				
<b>Professional Elective-V (any One)</b>									
<b>PE-5</b>	Compiler Design	3-0-0	03						
	Information and Coding Theory	3-0-0	03						
	Digital Forensic	3-0-0	03						
	Internet of Things	3-0-0	03						
<b>Open Elective-1</b>									
<b>OE-1</b>	Machine Learning	3-0-0	03						
	Cryptography and Data Security	3-0-0	03						
	Data Mining and Data Warehousing	3-0-0	03						
Credits (Theory)				<b>06</b>	Credits (Theory)				<b>00</b>
<b>Major Project</b>					<b>Major Project</b>				
	Major Project Dissertation(Ph-I)	0-0-20	10		Major Project & Dissertation (Ph-II)	0-0-32	16		
Total Semester Credits				<b>16</b>	Total Semester Credits				<b>16</b>
					<b>Total Cumulative Credits (18+18+16+16)</b>				<b>68</b>

## Audit course 1 & 2

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills.

**Core 1 : ADVANCED DATA STRUCTURES AND ALGORITHMS**

L-T-P 3-0-0

Cr. -3

**Module I**

Elementary Data Structures & Complexity Analysis: Arrays, linked lists, trees, Asymptotic notations -big oh, omega and theta notations, Recurrence equations – solving recurrence equations, amortized analysis, NP completeness – P, NP, NP-hard, NP Complete.

**Module II**

Search, Heap and Multimedia Data Structures: AVL trees, 2-3 trees, 2-3-4 trees, Red-black trees, B-trees, Splay trees – Tries, Min-max heaps, Deaps, Leftist heaps, Binomial heaps, Fibonacci heaps, Skew heaps, Segment trees, k-d trees, Quad trees, R-trees.

**Module III**

Applications: Set representation, Set union and find operations, counting binary trees Huffman coding, Topological sort, Garbage Collection and Compaction, Min cut -max flow algorithm, Activity networks.

**Module IV**

Online Algorithms: Basic Concepts, Optimization Problems, Competitive Analysis, Deterministic Algorithms, Randomized Algorithms, Optimum Offline Algorithms, Case Study - Ski Rental Problem

**Module V**

Approximation Algorithms: Basic Concepts, Bounds, Polynomial Time Approximation Schemes, Hardness of Approximations, Case Study - Vertex Cover Problem

**TEXT BOOK**

1. Introduction to Algorithms, Thomas H.Corman, Charles E.Leiserson, Ronald L. Rivest, Second Edition, PHI 2003.
2. Data structures and Algorithm Analysis in C++, Mark Allen Weiss, Pearson Education, 3<sup>rd</sup> Ed, 2007.
3. *Online Computation and Competitive Analysis* - A. Borodin and R. El-Yaniv, Cambridge Univ. Press, 1998.
4. *Approximation Algorithms* - Vijay V. Vazirani, Springer Verlag, 2003.

**Course Outcomes**

1. Understand basic data structures and calculating complexity.
2. Gain an understanding of different heaps and multimedia data structure.
3. Understand the application of various data structure in solving real-time problems.
4. Understand online algorithms and randomised algorithms.
5. Understand approximation algorithms with case study.

**Course Articulation Matrix**

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	2	2	2
CO2	3	3	3	2	1	1
CO3	3	3	2	2	2	3
CO4	3	3	3	2	3	2
CO5	3	3	3	2	2	1

## Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6
CO	3	3	3	2	2	2

### Core2 : ADVANCED COMPUTER ARCHITECTURE

L-T-P 3-0-0

Cr. -3

#### UNIT-1

Flynn's classification: SISD, SIMD, MISD, MIMD, Parallel Processing: Definition, Theory of Parallelism. Parallel Computer Models, Parallelism in Uni-processor computers, Implicit Parallelism vs. explicit parallelism, Levels of parallelism. Software Parallelism, Hardware Parallelism, Amdahl's law, Overview of RISC and CISC architecture

#### UNIT-2

**Pipelining:** Linear pipe line processor, Asynchronous and Synchronous models, speed up, Efficiency, Throughput, Pipelining in MIPS architecture, Non-linear pipe line processor, Instruction pipeline, Arithmetic pipeline.

**Conditions of Parallelism:** Data and Resource Dependencies, Control Dependence, Resource dependence, Bernstein's condition, Hardware and software parallelism, pipeline hazards and their Resolution Mechanisms like data forwarding, Delayed Branch, Branch Prediction, Dynamic Branch Prediction(Two state machine, four state machine), loop unrolling, dynamic scheduling, Software pipelining.

#### UNIT-3

Loosely coupled and tightly coupled system, Parallel Interconnection Systems: Static and Dynamic Networks, Linear Array, Ring, Star, Tree, Mesh, Systolic Array, Chordal ring, Completely connected network, Cube connected cycles, Torus, K-ary-n cube, Barrel shifter, single stage interconnection network, Multistage Interconnection Networks, Control Structure, Node degree, diameter, Bisection width, symmetric, functionality, Network Latency, Bandwidth, Scalability, Data routing functions:- Permutation, Perfect shuffle exchange, Hypercube Routing function.

#### UNIT-4

Memory hierarchy, Cache Design Issues, Memory Interleaving

#### UNIT-5

Case studies on commercial processors like Pentium and Power PC.

#### **Text Books:**

1. Advanced Computer Architecture, by Kai Hwang Mc Graw Hill.
2. Computer Architecture – A quantitative approach By J.L Hennessy and D.A.Patterson, Morgan Kaufmann

#### Reference Books:

1. Introduction to Parallel Computing, 2nd Edition, Pearson Education by AnanthGrama, Anshul Gupta, George Karypis, Vipin Kumar.

#### **Course Outcomes:**

1. To have a thorough understanding of parallel processing concepts
2. To identify the problems in pipelining and their hardware and software solutions.
3. To understand different static and dynamic interconnection networks
4. To design different cache memory system and their performance issues.
5. Compare different commercial processors like Pentium and Power PC as case study.

## Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	3	2
CO2	3	3	3	2	3	2
CO3	3	3	3	2	2	2
CO4	3	3	3	2	3	-
CO5	3	-	3	2	3	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

### Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6
Course	3	3	3	2	3	2

## PE- 1 : OPTIMIZATION TECHNIQUES

L-T-P 3-0-0

Cr. -3

- I. Introduction, Concept of optimization – classification of optimization – problems.
- II. LINEAR PROGRAMMING : Examples of linear programming problems – formulation simplex methods variable with upper bounds – principle duality -dual simplex method - sensitivity analysis – revised simplex procedure – solution of the transportation problem – assignment – network minimization – shortest route problem – maximal two problem – L.P. representation of networks.
- III. QUEUING THEORY : Queuing Model, poisson and exponential distributions -Queues with combined arrivals and departures-random and series queues.
- IV. UNCONSTRAINED OPTIMIZATION 9 Maximization and minimization of convex functions. Necessary and sufficient conditions for local minima – speed and order of convergence – univariate search – steepest and descent methods- metcher reeves method - conjugate gradient method.
- V. CONSTRAINED OPTIMIZATION 9 Necessary and sufficient condition – equality constraints, inequality constraints -kuhu – tucker conditions – gradient projection method – penalty function methods – cutting plane methods of sibel directions.

### TEXT BOOK(S)

1. Rao S.S,”Optimization – Theory and applications”, Wiley Easter Ltd., 1979.
2. REFERENCE BOOKS:
  1. David G.Luerbeggan, “Introduction to Linear and Non Linear Programming”, Addison Wesley Publishing Co. 1973.
  2. Hadley G. “Nonlinear and – dynamic programming” Addison Wesley Publishing Co. 1964.
  3. Cordan C.C. Beveridge and Robert S. Schedther, “Optimization, Theory and Practice” McGraw Hill Co.1970.
  4. HarndyA.Tahh. “operations Research, An Introduction”, Macmillan Publishers Co.NewYork,1982.
  5. Beightferand S. others, “Foundations of Optimization Pill”, New Delhi, 1979.

### Course Outcomes:

1. Understanding the Concept of optimization and classification of optimization problems.
2. Formulation simplex methods variable with upper bounds
3. Study the Queuing Model, poisson and exponential distributions
4. Understand the maximization and minimization of convex functions

5. To study equality constraints, inequality constraints.

**Course Articulation Matrix**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>
<b>CO1</b>	3	-	3	3	-	-
<b>CO2</b>	3	-	3	2	-	-
<b>CO3</b>	3	-	3	2	-	-
<b>CO4</b>	3	-	3	2	-	-
<b>CO5</b>	3	-	3	2	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>
<b>CO</b>	3	-	3	2	-	-

## PE- 2 : CRYPTOGRAPHY and DATA SECURITY

L-T-P 3-0-0

Cr. -3

### Module-I

(6 LECTURES)

Introduction to Security: Definition, Goal and Challenges, OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, Techniques, Model for Network Security, Mathematics of Cryptography: Integer Arithmetic, Modular arithmetic, Matrices, Linear Congruence, Algebraic Structures: Group, Ring, Field, Galois Field.

### Module-II

(6 LECTURES)

Modern Symmetric Key Ciphers: Modern Block Ciphers, Modern Stream Ciphers, Data Encryption Standard (DES): DES Structure, DES Analysis, Multiple DES, Security of DES, Advanced Encryption Standard (AES), AES Transformation functions, Analysis of AES.

### Module-III

(6 LECTURES)

Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Stream and Block Cipher, Steganography. Use of Modern Block Ciphers: ECB, CBC, CFB, OFB, CTR, Use of Stream Ciphers: RC4, Key Management, Key Generation.

### Module-IV

(6 LECTURES)

Number Theory: Prime Numbers, Fermat's and Euler's Theorems, Testing of Primality, Shinese Remainder Theorem, Exponentiation and Logarithm, RSA Algorithm, Elgamal Cryptosystem, Elliptic Curve Cryptography, Diffe-Hellman Key Exchange.

### Module-V

(6 LECTURES)

Message Integrity and Message authentication: Application of Cryptographic Hash Functions, Two Simple Hash functions, Requirements and security, Secure Hash Algorithm (SHA), Message Authentication Requirements, Message authentication functions, Message Authentication Codes (MAC), Security of MAC, Digital Signature, Digital Signature Standards.

### Text Book:

1. B. A. Forouzan, *Cryptography & Network Security*, McGraw Hill, Special Indian Edition, 2007.
2. W. Stallings, *Cryptography and Network Security*, Pearson Education, 3rd Ed, 2006.

### References:

1. R. E. Smith, *Internet Cryptography*, AWL.
2. A. J. Menezes, *Handbook of Applied Cryptography*, CRC Press.
3. J. Hershey, *Cryptography Demystified*, McGraw Hill.
4. J. Knudsen, *Java Cryptography*, O'Reilly.

### Course Outcomes:

- CO 1: Understand the basics of security and apply knowledge of computing and mathematics for developing efficient security algorithms.
- CO 2: Understand the concept of symmetric cryptography.
- CO 3: Insight into classical and modern block cipher techniques.
- CO 4: Gain concept of asymmetric cryptography.
- CO5: application of cryptographic techniques for authentication of a system

### Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	2	1
CO2	3	3	3	3	2	1
CO3	3	3	3	3	2	1
CO4	3	3	3	3	2	1
CO5	3	3	3	3	2	1

**1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation**

### Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6
Course	3	3	3	3	2	1

## PE-3 : REAL TIME SYSTEMS

L-T-P 3-0-0

Cr. -3

### Module - I [6Hrs]

Introduction: What is real time, Applications of Real-Time systems, A basic model of Realtime system, Characteristics of Real-time system, Safety and Reliability, Types of Real-time tasks, timing constraints, Modelling timing constraints.

### Module II [6Hrs]

Real-Time Task Scheduling: Some important concepts, Types of Real-time tasks and their characteristics, Task scheduling, Clock-Driven scheduling, Hybrid schedulers, Event-Driven scheduling, Earliest Deadline First (EDF) scheduling, Rate monotonic algorithm (RMA). Some issues Associated with RMA. Issues in using RMA practical situations.

### Module - III [6Hrs]

Handling Resource Sharing and dependencies among Real-time Tasks: Resource sharing among real-time tasks. Priority inversion. Priority Inheritance Protocol (PIP), Highest Locker Protocol (HLP). Priority Ceiling Protocol (PCP). Different types of priority inversions under PCP. Important features of PCP. Some issues in using a resource sharing protocol. Handling task dependencies. Scheduling Real-time tasks in multiprocessor and distributed systems: Multiprocessor task allocation, Dynamic allocation of tasks. Fault tolerant scheduling of tasks. Clock in distributed Real-time systems, Centralized clock synchronization.

### Module - IV [6Hrs]

Commercial Real-time operating systems: Time services, Features of a Real-time operating system, Unix as a Real-time operating system, Unix-based Real-time operating systems, Windows as a Real-time operating system, POSIX, A survey of contemporary Real-time operating systems. Benchmarking real-time systems.

Real-time Databases: Example applications of Real-time databases. Review of basic database concepts, Real-time databases, Characteristics of temporal data. Concurrency control in real-time databases. Commercial real-time databases.

### Module - V [6Hrs]

Real-time Communication: Examples of applications requiring real-time communication, Basic concepts, Real-time communication in a LAN. Soft Real-time communication in a LAN. Hard real-time communication in a LAN. Bounded access protocols for LANs. Performance comparison, Real-time communication over packet switched networks. Qos framework, Routing, Resource reservation, Rate control, Qos models.

### Text Books

1. Real-time Systems Theory and Practice by Rajib Mall, Pearsons Publication.

### Reference Books:

1. J.W.S.Liu, "Real-Time Systems", Pearson Education, 2000
2. Alan Burns, Andy Wellings, "Real-Time Systems and Programming Languages 3/e", Addison Wesley.
3. Raymond A.Buhr and Donald L.Baily, "Introduction to Real-Time Systems", Prentice Hall.
4. Nissanke, "Real-Time System", Prentice Hall.

### **Course Outcomes:**

1. Enumerate the need and the challenges in the design of hard and soft real time systems.
2. Compare different scheduling algorithms and the schedulability criteria.
3. Determine schedulability of a set of periodic tasks given a scheduling algorithm.
4. Develop algorithms to decide the admission criterion of sporadic jobs and the schedule of aperiodic jobs.
5. Integrate resource access mechanisms with the scheduling techniques and develop integrated schedulability criteria.

## Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	3	1	1
CO2	3	1	3	3	1	1
CO3	3	1	3	3	1	1
CO4	3	1	3	3	1	1
CO5	3	1	2	3	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

## Program Articulation Matrix row

	PO1	PO2	PO3	PO4	PO5	PO6
CO	3	1	3	3	1	1

## PE – 4 : Artificial Intelligence and Expert Systems

L-T-P 3-0-0

Cr. -3

- I. Scope of AI: games, theorem proving, natural language processing, vision & speech processing, robotics, expert systems, AI techniques-search knowledge, abstraction. Problem solving: State space search: Production Systems, Search space control: dept-first, breadth-first search, heuristic search – Hill climbing, best-first search, branch & bound. Problem Reduction, Constraint Satisfaction End, Means-End Analysis
- II. Knowledge Representation: Predicate Logic: Unification, modus ponens, resolution, dependency directed backtracking. Rule based Systems: Forward Reasoning: conflict resolution, backward reasoning: use of no backtracks. Structured Knowledge Representation: Semantic Nets: slots, exceptions & default frames, conceptual dependency, scripts.
- III. Handling uncertainty on-Monotonic Reasoning, Probabilistic reasoning, use of certainty factors, fuzzy logic.
- IV. Learning: Concept of learning, learning automation, genetic algorithm, learning by inductions, neural net
- V. Expert Systems: Need & justification for Expert Systems, knowledge acquisition, Case Studies: MYCIN, RI.

### Text Books

1. E. Rich & K. Knight, “Artificial Intelligence”, TMH, 2nd Edition, 1992.
2. N.J. Nilsson, “Principles of AI”, Narosa Publications House, 1990.

### Reference Books:

1. D.W. Patterson, “Introduction to AI & Expert Systems”, PHI, 1992.
2. Peter Jackson, “Introduction to Expert Systems”, AWP, M.A., 1992.
3. R.J. Schalkoff, “Artificial Intelligence - An Engineering Approach”, McGraw Hill International Edition, Singapore, 1992.
4. M. SasiKumar, S. Ramani, “Rule Based Expert Systems”, Narosa Publishing House, 1994.

### Course Outcome

CO1 : Understand the basics of State space search problems (Hill Climbing, Heuristics search etc.) in computer science.

CO2 : Understand the various types of Knowledge Representation technique.

CO3 : Understand the relationship between monotonic & non monotonic reasoning.

CO4 : Understand advanced learning techniques.

CO5 : Solve various problems using Expert system.

### Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	3	3	-	-
CO2	2	2	3	3	-	-
CO3	2	1	3	3	-	-
CO4	3	2	3	3	-	-
CO5	1	2	3	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

### Program Articulation Matrix row

	PO1	PO2	PO3	PO4	PO5	PO6
CO	2	1	3	3	-	-

## PE- 5 : EMBEDDED SYSTEMS

L-T-P 3-0-0

Cr. -3

### UNIT-1 (08hrs)

**Introduction:** Embedded system, Features of Embedded Systems, Design Metrics, Embedded System Design flow, Processor in the system, Other hardware units, Software embedded into a system, Exemplary embedded systems, Embedded System-on-chip (SOC) and in VLSI circuit.

### UNIT-2(08hrs)

**Devices and Device Drivers:** Serial communication using the 'I2C', 'CAN' Parallel communication between the networked I/O multiple devices using the ISA, PCI, PCI-X Device drivers, Interrupt servicing (Handling) mechanism.

Processor selection for an embedded system, Memory selection for an embedded system, Inter process communication.

### UNIT-3(08hrs)

**Real Time Operating System:** Types of Real-time tasks, Task Periodicity, Task Scheduling, Classification of Scheduling algorithms, Clock driven scheduling, Event driven scheduling, Features of RTOS, Commercial RTOS, Windows CE, LynxOS, VxWorks, Introduction to micro/OS-II

### UNIT-4(08hrs)

**Case Studies of Programming with RTOS:** Case study of an embedded system for a smart card.

**Hardware and Software Co-design:** Embedded system project management, Embedded system design and co-design issues in system development process, Design cycle in the development phase for an embedded system

### UNIT-5(08hrs)

**Low power Embedded system Design:** Sources of Power Dissipation, Dynamic power dissipation, Static power dissipation, Power reduction techniques, System level power management.

### **Course Outcome:**

CO1: To Know embedded system, processor in the system, other hardware and software units exemplarily embedded system-on-chip (SOC) and VLSI circuit.

CO2: Study devices and device drivers, I/O devices, timer and counting devices, serial communication using the IC, CAN and advance I/O buses between the networked multiple devices.

CO3: To obtain knowledge on various Real Time Operating system along with scheduling algorithms.

CO4: To do Case studies of programming with RTOS and case study of an embedded system for a smart card hardware and software co-design.

CO5 : To learn design of low power embedded system .

**Text Books:**

1. Embedded Systems-Architecture, Programming and Design – Raj Kamal, TMH
2. Embedded system design – Santanu Chattopadhyay, PHI

**References:**

1. Hardware Software Co-design of Embedded Systems – Ralf Niemann, Kluwer Academic.
2. Design Principles of Distributed Embedded Applications – Hermann Kopetz, kluwer Academic.
3. Embedded Real-Time Systems Programming – Sriram V. Iyer and Pankaj Gupta, TMH.

**CO1:** To know embedded system, processor in the system, other hardware and software units exemplary embedded system-on-chip (SOC) and VLSI circuit.

**CO2:** Study devices and device drivers, I/O devices, timer and counting devices, serial communication using the IC, CAN and advance I/O buses between the networked multiple devices.

**CO3:** To obtain knowledge on various Real Time Operating system along with scheduling algorithms.

**CO4:** To do case studies of programming with RTOS and case study of an embedded system for a smart card hardware and software co-design.

**CO5:** To learn design of low power embedded system.

**Course Articulation Matrix**

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	3	1	1
CO2	3	1	3	3	1	1
CO3	3	1	3	3	1	1
CO4	3	1	3	3	1	1
CO5	3	1	2	3	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

	PO1	PO2	PO3	PO4	PO5	PO6
CO	3	1	3	3	1	1

**PE – 6 : INTRUSION DETECTION SYSTEMS**

**L-T-P 3-0-0**

**Cr. -3**

**Module – I**

INTRODUCTION: Basic Concepts of Security, Introduction to Intrusions, Need of Intrusion Detection, Taxonomy of Intrusion Detection Systems, Theoretical Background of Intrusion Detection.

**Module – II**

HOST-BASED INTRUSION DETECTION: Host Vulnerability and Exploits – Denial of Service (DoS), Gaining Unauthorized Access to Host, Case Study – Research in Host-Based Intrusion Detection Systems.

### Module – III

NETWORK-BASED INTRUSION DETECTION: Network Vulnerabilities and Attacks – ARP Attacks, IP Attacks, ICMP Attacks, UDP Attacks, TCP Attacks, DNS Attacks, Case Study – Research in Network-Based Intrusion Detection Systems.

### Module – IV

DATABASE AND APPLICATION-SPECIFIC INTRUSION DETECTION: Limitations of Existing Intrusion Detection Systems, Requirements of Application-Specific and Database Intrusion Detection, Case Study – Research in Application-Specific and Database IDS.

### Module – V

ANOMALY DETECTION: Principles of Anomaly Detection, Advantages & Limitations of Anomaly Detection, Anomaly Detection Techniques, Case Study – Research in Anomaly Detection Systems.

MISUSE DETECTION: Principles of Misuse Detection, Advantages & Limitations of Misuse Detection, Misuse Detection Techniques, Case Study – Research in Misuse Detection Systems.

#### Text Book(s):

This is a research oriented course and currently no existing textbook on intrusion detection is appropriate. The course is mainly based on recent papers on intrusion detection systems published in academic conferences and journals.

#### Reference Books:

1. Matt Bishop, “Computer Security: Art and Science”, Addison-Wesley Professional, 2003.
2. R. D. Pietro & L. V. Mancini, “Intrusion Detection Systems”, Handbook of Advances in Information Security, Springer, 2008.
3. Carl Endorf, Eugene Schultz and Jim Mellander, “Intrusion Detection & Prevention”, 1<sup>st</sup> Edition, Tata McGraw-Hill, 2004.
4. Stephen Northcutt, Judy Novak, “Network Intrusion Detection”, 3<sup>rd</sup> Edition, New Riders Publishing, 2002.

## COURSE OUTCOMES

**CO1:** A comprehensive knowledge on the concepts of intrusion, intrusion detection as well as the challenges, taxonomy and limitations of intrusion detection systems.

**CO2:** Understand the various types of host-based attacks and case study of few representative host-based intrusion detection researches.

**CO3:** Understand the various types of network-level attacks and case study of few representative host-based intrusion detection researches.

**CO4:** Knowledge on the importance of application-specific and database intrusion detection systems and case study of few representative intrusion detection systems in this domain.

**CO5:** An exposure to the principles and techniques of anomaly and misuse intrusion detection approaches and state of the art of anomaly-based and misuse-based intrusion detection research.

#### Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	1	3	2	2
CO2	3	3	1	3	2	2
CO3	3	3	1	3	2	2
CO4	3	3	1	3	2	2
CO5	3	3	1	3	2	2

**1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation**

**Program Articulation Matrix row for this Course**

	PO1	PO2	PO3	PO4	PO5	PO6
Course	3	3	1	3	2	2

## PE – 7 : PATTERN RECOGNITION

L-T-P: 3-0-0

Cr.-3

### Course Objective:

Students will understand basic concepts in pattern recognition and to Explain and compare a variety of pattern classification, structural pattern recognition, and pattern classifier combination techniques. Analyze classification problems probabilistically and estimate classifier performance. Understand the principles of Bayesian parameter estimation and apply them in relatively simple probabilistic models.

### Module-I

Introduction: Machine Perception, Pattern Recognition Systems, Design Cycle, Learning And Adaptation, Training And Learning In Pattern Recognition Approach, Applications Of Pattern Recognition, Patterns And Features, Different Types Of Pattern Recognition

### Module-II

Probability: Introduction, Probability Of Events, Random Variables, Joint Distributions And Densities, Moments Of Random Variables, Estimation Of Parameters From Samples, Minimum Risk Estimators.

### Module-III

Statistical decision making: introduction, baye's theorem, multiple features, conditionally independent features, decision boundaries, unequal costs of error, estimation of error rates, the leaving one- out technique. Characteristic curves, estimating the composition of populations.

### Module-IV

Nonparametric decision making: introduction, histograms, kernel and window estimators, nearest neighbor classification techniques, adaptive decision boundaries, adaptive discriminate functions, minimum squared error discriminate functions, choosing a decision making technique.

### Module-V

Unsupervised Learning And Clustering: Unsupervised Bayesian Learning, Data Decryption And Clustering, Criterion Functions And Clustering, Hierarchical Clustering, Online Clustering, Component Analysis.

### Text Books:

1. Pattern Classification Duda R. O., AndHart P E., And Stork D G., Wiley Publishers 2. Pattern Recognition AndImage Analysis, Earl Gose, Richard J And Steve J, PHI 3. Pattern Recognition (Statistical, Structural AndNeural Approaches), Robert Schalkoff.

### Course Outcome:

CO1: Understand basic concepts in pattern recognition and to Explain and compare a variety of pattern classification, structural pattern recognition, and pattern classifier combination techniques.

CO2: Analyse classification problems probabilistically and estimate classifier performance.

CO3: Understand the principles of Bayesian parameter estimation and apply them in relatively simple probabilistic models.

CO4: Learn decision making techniques and different function.

CO5: Gain knowledge about different types of clustering technique and its implementation in real life problems.

## Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	3	-	-	-	-
CO2	3	3	3	3	-	-
CO3	3	3	2	3	3	-
CO4	3	3	3	3	3	-
CO5			3	3	3	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

## Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6
Course	3	3	3	3	3	-

## PE – 8 : Bio-informatics

**L-T-P: 3-0-0**

**Cr.-3**

### Unit -I ( 8 lectures )

Basic concepts of Molecular Biology:

Cellular Architecture, Nucleic Acids (RNA & DNA), DNA replication, Repair Cellular and recombination. Transcription, Translation, Genetic code, Gene expression, Protein structure and function, Molecular biology tools. Statistical methods: Estimation, Hypothesis testing, Random walks, Markov Models (HMM).

### Unit -II ( 8 lectures )

Suffix Trees: Definitions and examples, Ukkonen's linear-time suffix tree algorithm, Applications (exact string matching, longest common sub strings of two strings, Recognizing DNA contaminatin).

### Unit -III ( 8 lectures )

Pair-wise Sequence Alignment (Edit distance Dynamic Programming Calculation of edit distance, string similarity, gaps). Pair-wise sequence alignment (local), HMM for pair-wise alignment.

### Unit -IV ( 8 lectures )

Multiple String Alignment: Need of MSA, Family & Super family representation, multiple sequence comparison for structural inferences, multiple alignments with sum-of-pairs, consensus objective functions. Profile HMM for multiple sequence alignment. Database searching for similar sequence (FASTA, BLAST), PAM, BLOSUM, substitution matrices .

### Unit -V ( 8 lectures )

Phylogenetic Reconstruction: Phylogenetic Trees, Parsimony methods, Distance methods, Evolutionary models, Hierarchical clustering method, Maximum Likelihood method, Model comparison, Fragment Assembly Problem.

### Books Recommended:

1. N.C. Jones & P.A. Pevzner – An introduction to Bioinformatics Algorithms. The MIT Press-2004.
2. D. Gusfield-Algorithms on Strings, Trees and sequences, Cambridge University Press, 1997.
3. R. Durbin, S. Eddy, A. Krugh, G. Mithison-Biological Sequence analysis, Cambridge University Press,1998.
4. J. Setubal and J. Meidanis-Introduction to Computational Molecular Biology PWS Publishing Company, 1997.

5. W.J. Ewens & G.R. Grant-Statistical methods in Bioinformatics-Springer-1989.

**Reference Book:**

1. M.S. Waterman – Introduction to Computational Biology – Chapman & Hall CRC.
1. Understanding the importance of different biological databases.

Students will be able to use the different software's and tools.

**Course Outcome:**

1. Knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics.
2. Existing software effectively to extract information from large databases and to use this information in computer modeling
3. Problem-solving skills, including the ability to develop new algorithms and analysis methods
4. An understanding of the intersection of life and information sciences, the core of shared concepts, language and skills.
5. The ability to speak the language of structure-function relationships, information theory, gene expression, and database queries

**Course Articulation Matrix**

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	2	2	2
CO2	3	3	3	2	1	1
CO3	3	3	2	2	2	3
CO4	3	3	3	2	3	2
CO5	3	3	3	2	2	1

**Program Articulation Matrix row for this Course**

	PO1	PO2	PO3	PO4	PO5	PO6
CO	3	3	3	2	2	2

## Simulation Using MATLAB

1. Understand the main features and importance of the MATLAB/ SCI LAB mathematical programming environment.
2. Apply working knowledge of MATLAB/ SCI LAB package to simulate and solve numerical problems and Applications.
3. Solve, Simulate and Analyse various traditional Optimization Techniques.
4. Solve, Simulate and Analyse various Nature inspired Optimization Techniques.
5. Solve, Simulate and Analyse various Multi-objective optimization techniques

**Course Articulation Matrix**

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	-	-
CO2	3	3	3	3	-	-
CO3	3	3	3	3	-	-
CO4	3	3	3	3	-	-
CO5	3	3	3	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row**

	PO1	PO2	PO3	PO4	PO5	PO6
CO	3	3	3	3	-	-

# Advanced Computing Laboratory

1. Understand the main features and importance of the Advance Java.
2. Apply working knowledge of Advance Java package to simulate and solve numerical problems and Applications.
3. Solve, Simulate and Analyse various Data base connectivity Techniques.
4. Solve, Simulate and Analyse various Evolutionary computation Techniques.
5. Solve, Simulate and Analyse various Internet and web programming techniques.

## Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	-	-
CO2	3	3	3	3	-	-
CO3	3	3	3	3	-	-
CO4	3	3	3	3	-	-
CO5	3	3	3	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

## Program Articulation Matrix row

	PO1	PO2	PO3	PO4	PO5	PO6
CO	3	3	3	3	-	-

## 2<sup>nd</sup> Semester

### Core -1

## DISTRIBUTED OPERATING SYSTEMS

L-T-P 3-0-0

Cr. -3

### Module-I

[8 LECTURES]

**Fundamentals:** Introduction to parallel and distributed computing system, Evaluation of Distributed Computing Systems, Distributed Computing System Models, Issues in Distributed a distributed Operating System. Computer Networks: Network Types, LAN Technologies, WAN Technologies, Communication Protocols, Internetworking, ATM Technology.

### Module-II

[8 LECTURES]

**Message Passing:**Issues in IPC by Message Passing, Synchronization, Buffering, Multidatagram Messages, Encoding and Decoding of Message Data, Process Addressing, Failure Handling. **Remote Procedure Calls:**The RPC Model, Implementing RPC Mechanism, Stub Generation, RPC Messages, Marshaling Arguments and Results, Server Management, Parameter-Passing Semantics, Call Semantics, Communication Protocols for RPCs.

### Module-III

[8 LECTURES]

**Distributed Shared Memory:** Introduction, General Architecture of DSM Systems, Design and Implementation Issues of DSM, Granularity, Structure of Shared Memory Space, Consistency Models, Replacement Strategy, Thrashing, Other Approaches to DSM, Advantages of DSM. **Synchronization:** Introduction, Clock Synchronization, Event Ordering, Mutual Exclusion, Deadlock, Election Algorithms.

### Module- IV

[8 LECTURES]

**Resource Management:** Introduction, Desirable Features of a Good Global Scheduling Algorithm, Task Assignment Approach, Load-Balancing Approach, Load-Sharing Approach. **Process Management:** Introduction, Process Migration, Threads.

**Module-V**

[8 LECTURES]

**Distributed File Systems:** Introduction, Desirable Features of a Good Distributed File System, File Models, File-Accessing Models, File-Sharing Semantics, File-Caching Schemes, File Replication, Atomic Transactions, Design Principles. **Naming:** Introduction, Desirable Features of a Good Naming System, Fundamental Terminologies and Concepts, Naming and Security.

**Course Outcome:**

- CO 1: Examine the fundamental principles of distributed systems and Networks  
 CO 2: Understand the concept of message passing and remote procedural calls.  
 CO 3: Design of distributed shared memory and analyze synchronization problems.  
 CO 4: Application of distributed operating system in resource and process management.  
 CO 5: Gain the concept of distributed file system and naming techniques.

**Text Books:**

1. P. K. Sinha, Distributed Operating Systems, IEEE Press.
2. G. Coulouroris, J. Dollimore& T. Kindberg, Distributed Systems: Concepts and Design, Addison-Wesley.
3. M. Singhal& N. G. Shivaratri, Advanced Concepts in Operating Systems, McGraw Hill.

**Reference Books:**

1. H. F. Jordan, Fundamentals of Parallel Processing, Pearson.
2. C. Hughes & T. Hughes, Parallel and Distributed Programming Using C++, Pearson.
3. W. Buchanan, Distributed Systems and Networks, Tata McGraw Hill.

**Course Outcome:**

- Upon completion of the subject, the students will demonstrate the ability to:
- CO 1: Examine the fundamental principles of distributed systems and Networks  
 CO 2: Understand the concept of message passing and remote procedural calls.  
 CO 3: Design of distributed shared memory and analyse synchronization problems.  
 CO 4: Application of distributed operating system in resource and process management.  
 CO 5: Gain the concept of distributed file system and naming techniques.

**Course Articulation Matrix**

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	2	2	2
CO2	3	3	3	2	2	2
CO3	3	3	3	2	2	2
CO4	3	3	3	2	2	2
CO5	3	3	3	2	2	2

**1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation**

**Program Articulation Matrix row for this Course**

	PO1	PO2	PO3	PO4	PO5	PO6
Course	3	3	3	2	2	2

## Core-2 : ADVANCES IN DATABASE SYSTEMS

L-T-P 3-0-0

Cr. -3

### COURSE OBJECTIVES

1. To review the concepts of database architecture, schema and data models.
2. Revisiting the theory of normalization and various normal forms.
3. Develop proficiency in query processing and optimization.
4. To provide students with knowledge of database transaction processing, concurrency control and recovery from database failure.
5. To develop competence in students for designing and implementing a database for any real life application.
6. To expose students to advance topics and techniques those have promising research directions.

### SYLLABUS

#### Unit I:

Data Models, Schema and Instances, Three-Level Schema Architecture & Data Independence, E-R Modelling: Specialization, Generalization, Aggregation, Functional Dependencies, Decomposition, Concept of Normalization and Normal Forms

#### Unit II:

Basic Steps in processing an SQL Query, Catalog Information for Cost Estimation, Measures of Query Cost, Selection and Join Operations, Query Optimization: Overview, Transformation of Relational Expressions by Equivalence Rules.

#### Unit III:

Transaction concept, Transaction state, Implementation of Atomicity and durability, Concurrent executions, Serializability.

#### Unit IV:

Concurrency Control Schemes: Lock-based, Timestamp based, Validation based protocol, Multiple granularity, Multiversion schemes, Deadlock handling, Recovery System.

#### Unit V:

Advanced Topics: Data Mining, Data Warehousing, Parallel Databases, Distributed Databases, Mobile Databases, Multimedia Databases, Spatial database, Temporal databases.

#### Text Books:

- [1] Silberschatz, Korth, and Sudarshan, "Database system Concepts, 4/e", Tata-Mc-Graw Hill.
- [2] RamezElmasri, Shamkant B. Navathe, Fundamentals of Database Systems, 6th Edition, Pearson Education India.

#### References Books:

- [1] Bipin C. Desai: Introduction to Data Base Systems, Galgotia Publications.
- [2] C. J Date, "Introduction to database Systems, 7/e", Pearson Education India.

### COURSE OUTCOMES

**CO1:** Compare and evaluate alternative database architectures and models in different application contexts.

**CO2:** Apply normalization steps in database design for minimizing redundancy and data anomalies.

**CO3:** For a given transaction-processing system, determine the transaction atomicity, consistency, isolation, and durability.

**CO4:** Implement the isolation property, including locking, time stamping based on concurrency control and serializability of scheduling.

**CO5:** Develop an understanding and apply the advanced database techniques for modeling, designing, and implementing a DBMS.

## Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	2	2
CO2	3	3	3	3	2	2
CO3	3	3	3	3	2	2
CO4	3	3	3	3	2	2
CO5	3	3	3	3	2	2

**1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation**

### Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6
Course	3	3	3	3	2	2

## PE – 9 : ADVANCED NETWORKING

**L-T-P 3-0-0**

**Cr. -3**

### Module -I

*Introduction: Designing of a Computer networks, classifications of computer networks, layered network structures, Network performance (BW, delay x BW, RTT), Data Link Layers: Services and design issues, framing techniques(PPP, HDLC, SONET),*

**Module -II** error handling (One and Two Dimensional Parity Checks, CRC, Hamming code, Framing: Bit and Character Stuffing) and flow control, stop and wait, sliding window. *LANs and their Interconnection: Basic concepts, Ethernet802.3, Ring 802.5,FDDI,RPR, Bluetooth, WI-Fi, WIMAX; Repeaters and Bridges. ATM: ATM switches and AAL layer protocols.*

**Module -III** *Network Layer: Design issues, routing (IP protocol, Internet control protocols— ICMP, ARP and RARP, Internet routing protocols— RIP, OSPF, BGP, DVMRP, PIM and CIDR.).*

### Module -IV

*Network Structure: Concepts of subnets, global internet, backbone and local access; Channel sharing, techniques-FDM, TDM; congestion control techniques (General principles. Congestion Prevention Policies, Traffic Shaping, Leaky-Bucket Algorithm, Token Bucket Algorithm),TCP, UDP*

### Module -V

*Application Layer: Name Services(DNS), Electronic mails(SMTP, MIME, IMAP), HTTP, Multimedia applications(SIP,H.323) PGP, SSH(Secure Shell), Transport layer security, IP security, Wireless security*

### Text Books:

1. L. L. Peterson and B. S. Davie: Computer Network, Morgan Kaufman, San Mateo, 2009.
2. J. F. Kurose, K. W. Ross : Computer Networking: A Top-Down Approach, 6th Edition, Pearson, 2013

### References:

3. A. Tannenbaum, Wetherall: Computer Networks, 5<sup>th</sup> ed., Pearson, 2010.
4. W. Stallings: Data and Computer Communications, Pearson, 2013.
5. Kaufman, R. Perlman and M. Speciner: Network Security, Pearson, 2002.
6. L. Gracial and I. Widjaja: Communication Networks, Tata-McGraw Hill, New Delhi, 2000.
7. Prakash C. Gupta: Data Communication and Computer Network, PHI Learning Pvt. Ltd. 2006

## Course Outcomes:

Students successfully completing this course will demonstrate that they can:

1. Have a understanding on underlying principle of the layering architecture with performance evaluation in computer network.
2. Differentiate between different LAN-based forwarding devices so that they can make suggestions on how to build a network.
3. Apply knowledge of the TCP/IP layering model to intelligently debug networking problems.
4. Write networking code that uses TCP and UDP in client-server applications.
5. Able to discuss relevant management issues and devise adequate network management solutions.

## Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	2	1	-
CO2	3	3	3	2	1	-
CO3	3	3	3	2	1	-
CO4	3	3	3	2	1	-
CO5	3	3	3	2	1	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

## Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6
Course	3	3	3	2	1	-

## PE – 10 : SELECTED TOPICS ON THEORY OF COMPUTATION

L-T-P 3-0-0

Cr. -3

UNIT – I: Regular Languages –Finite Automata, Formal definition of finite automaton, Examples of finite automata, Formal definition of computation, Designing finite automata, The regular operations, Non determinism, formal definition of nondeterministic finite automaton, equivalence of NFAs and DFAs, closure under the regular operations, Regular Expressions, formal definition of a regular expression, equivalence with finite automata, Nonregular languages, The pumping lemma for regular languages.

UNIT – II : Context-Free languages, Context-free grammars, formal definition of a Context-free grammar, Examples of context-free grammars, Designing context-free grammars, Ambiguity, Chomsky normal form, Pushdown Automata, Examples of pushdown Automata, Equivalence with context-free grammars, Non-context-free languages, The pumping lemma for context-free languages.

UNIT – III : The Church-Turing Thesis – Turing machines, Formal definition of turing machine, Examples of turing machines, Variants of turing machines, Multitape turing machines, Nondeterministic turing machine, Enumerators, Equivalence with other models, The definition of algorithm, Hilbert’s problem Terminology of describing turing machines.

UNIT – IV: Decidability –Decidable languages, Decidable problems concerning regular languages, Decidable problems concerning context-free languages, The halting problem, The diagonalization method, The halting method is undecidable, A turing –unrecognizable language, Reducibility – Undecidable problems for language theory, Reductions via computations histories,

A simple undecidable problem, Mapping reducibility, computable functions, Formal definition of mapping reducibility.

UNIT – V: Time Complexity –Measuring complexity, Big – O and small-o notation, Analyzing algorithms, Complexity relationships among models, The class P, Polynomial time, examples of problems in P, The class NP, Examples of problems in NP, The P versus NP question, NP-Completeness, polynomial time reducibility, Definition of NP-Completeness, The Cook-Levin Theorem, Additional NP Complete problems, The vertex cover problem, The Hamiltonian path problem, The subset sum problem.

**TEXTBOOKS:**

- Introduction to the theory of computation, Micheal Sipser, Third Edition, Cengage Learning.

**REFERENCES:**

- Introduction to Languages and The Theory of Computation, John C Martin, TMH.
- Introduction to Computer Theory, Daniel I.A. Cohen, John Wiley.
- A Text book on Automata Theory, P. K. Srimani, Nasir S. F. B, Cambridge University Press.
- Introduction to Formal languages Automata Theory and Computation Kamala Krithivasan, Rama R, Pearson.
- Theory of Computer Science – Automata languages and computation, Mishra and Chandrashekar, 2nd edition, PHI.

**Course Outcomes**

1. Able to understand the concept of abstract machines and their power to recognize the languages.
2. Able to employ finite state machines for modeling and solving computing problems.
3. Able to design context free grammars for formal languages.
4. Able to distinguish between decidability and undecidability.
5. Able to gain proficiency with mathematical tools and formal methods.

**Course Articulation Matrix**

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	1	2	-	-
CO2	1	1	2	2	-	-
CO3	2	2	2	2	-	-
CO4	2	1	1	3	-	-
CO5	1	1	2	1	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

	PO1	PO2	PO3	PO4	PO5	PO6
CO	2	2	2	2	-	-

**Module-I (Hours - 8)****Supervised Learning (Regression/Classification)**

Basic methods: Distance-based methods, Nearest-Neighbors, Decision Trees, Naive Bayes  
 Linear models: Linear Regression, Logistic Regression, Generalized Linear Models Support  
 Vector Machines, Nonlinearity and Kernel Methods Beyond Binary Classification: Multi-  
 class/Structured Outputs, Ranking

**Module –II (Hours - 8)****Unsupervised Learning**

Clustering: K-means/Kernel K-means, Dimensionality Reduction: PCA and kernel  
 PCAMatrix Factorization and Matrix Completion, Generative Models (mixture models and  
 latent factor models)

**Module – III (Hours - 8)**

Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical  
 Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)

**Module – IV (Hours - 8)**

Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and  
 Feature Representation Learning

**Module –V (Hours - 8)**

Scalable Machine Learning (Online and Distributed Learning), A selection from some other  
 advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning,  
 Inference in Graphical Models, Introduction to Bayesian Learning and Inference

**References:**

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.

**COURSE OUTCOMES**

CO1: To understand the concepts of supervised learning.

CO2: To analyses the technique of unsupervised learning.

CO3: To understand statistical learning and Boosting Techniques.

CO4: To learn Deep Learning Concepts.

CO5: To understand advanced learning techniques.

**Course Articulation Matrix**

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2	1	-
CO2	3	3	1	3	1	-
CO3	3	2	1	3	-	-
CO4	2	2	1	2	-	-
CO5	2	3	2	2	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>
<b>CO</b>	3	2	1	2	1	-

## PE – 12 : RANDOMISED ALGORITHM

L-T-P: 3-0-0

Cr.-3

### Course Objective:

An algorithm which uses random choices during its execution is called a randomized algorithm. A randomized algorithm for a problem is usually simpler and/or faster than their deterministic counterpart. Surprisingly, there are just a handful of probability tools which are used to analyze a randomized algorithm. However, their use is quite nontrivial and is based on careful insight. In this course, firstly the student will be taught the probability tools required to design and analyze a randomized algorithm.

### Module I

An overview of randomized algorithms and their importance, Elementary probability theory, Random Variable, linearity of expectation and application. Markov Inequality, Chebyshev Inequality, Chernoff Bound. Proof for extremely low deviation of the running time of quick sort.

### Module II

Random Sampling for divide and conquer - median finding algorithm, Random sampling for estimating parameters - estimating size of transitive closure of a directed graph in  $O(m \log n)$  time, Random sampling for computing witnesses – faster algorithm for Boolean product witness matrix

### Module III

Randomized Incremental Construction and backward analysis: closest pair problem, trapezoidal decomposition. Algebraic Techniques: Fingerprinting and Freivalds' technique Min cut algorithm, Analyzing a randomized experiment/algorithm by breaking it into stages: rumor spreading, client server problem.

### Module IV

Principle of deferred decision and applications, Load Balancing: Power of two choices, Hashing with worst case constant search time, Random walk in a graph, relation between cover time of a graph and electric networks.

### Module V

Probabilistic methods, Method of Bounded Difference, Embedding arbitrary metric into tree metric, Discussion of many recent and important randomized algorithms.

### Text Book :

1. Randomized algorithms by Rajeev Motwani and Prabhakar Raghavan, Cambridge press (Indian edition available).
2. Introduction to Probability theory and Its Applications (volume 1) by William Feller (Indian edition available).

### Course Outcome:

**CO1:** Learn randomized algorithms and their importance .

**CO2:** Analyze Random Sampling for divide and conquer and computing witnesses

**CO3:** Be familiar with Randomized Incremental Construction and backward analysis

**CO4:** Gain knowledge about Principle of deferred decision and applications.

**CO5:** Learn load balancing and probabilistic methods.

### Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	3	1	-
CO2	3	1	2	3	1	-

<b>CO3</b>	3	1	1	2	-	-
<b>CO4</b>	3	2	1	2	-	-
<b>CO5</b>	3	2	1	2	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>
<b>CO</b>	3	2	1	2	1	-

**PE – 13 : COMPUTER VISION**

L-T-P: 3-0-0

Cr.-3

**Module I**

**(6 Lectures)**

Digital Image Formation and low-level processing: Overview and State-of-the-art, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, etc; Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing.

Depth estimation and Multi-camera views: Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration.

**Module II**

**(6 Lectures)**

Feature Extraction: Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.

Image Segmentation: Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection.

**Module III**

**(6**

**Lectures)** Object Recognition: Structural, model-based, appearance and shape-based methods; probabilistic paradigms; discriminative part-based models; BOW, ISM, Learning methods.

Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods.

**Module IV**

**(6 Lectures)**

Motion Analysis: Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation.

Shape from X: Light at Surfaces; Phong Model; Reflectance Map; Albedo estimation; Photometric Stereo; Use of Surface Smoothness Constraint; Shape from Texture, color, motion and edges.

**Module V**

**(6 Lectures)**

Miscellaneous: Applications: CBIR, CBVR, Activity Recognition, computational photography, Biometrics, stitching and document processing; Modern trends - super-resolution; GPU, Augmented Reality; cognitive models, fusion and SR&CS.

**Course outcome:**

CO1: Gain knowledge in Digital Image Formation and low-level processing and Learn techniques of Depth estimation and Multi-camera views.

CO2: Analyze Feature Extraction and Scale-Space Analysis.

CO3: Learning Object Recognition and pattern analysis.

CO4: Learn the various techniques of motion analysis.

CO5: Learning various applications of motion analysis and object recognition.

## Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	3	3
CO2	3	3	3	3	3	3
CO3	2	2	2	2	2	2
CO4	3	3	3	3	2	2
CO5	-	-	3	3	2	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

## Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6
Course	3	3	3	3	2	2

## PE – 14 : DATA MINING AND DATA WAREHOUSING

L-T-P: 3-0-0

Cr.-3

### Course Outcome

1. To understand the concepts of Data Mining
2. To design the data mining decisions using the association rule mining
3. To analyze different supervised techniques: Prediction and Classifications
4. To apply the unsupervised data mining techniques for clustering
5. To evaluate data mining techniques while solving real world problems

### Module – I

**Data Mining Overview:** What Defines a Data Mining Task? Task-Relevant Data, The Kind of Knowledge to be Mined, KDD, Data Preprocessing – Data Integration and Transformation, Data Reduction, Data Mining Primitives, System Architectures.

### Module – II

**Mining Association Rules** in Large Databases, Association Rule Mining, Market Basket Analysis: Association Rule Mining, Basic Concepts, Association Rule Mining A Road Map, Mining Association Rules from Frequent Itemsets, Mining Multilevel Association Rules from Transaction Databases, Multilevel Association Rules, Approaches to Mining Multilevel Association Rules, Mining Distance-Based Association Rules, Association Mining and Correlation Analysis.

### Module – III

**Classification and Prediction** – What is Classification? What Is Prediction? Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Bayes Theorem, Classification by Back propagation, A Multilayer Feed-Forward Neural Network, MLP, Classification Based of Concepts from Association Rule Mining, k-Nearest Neighbor Classifiers, Fuzzy Set Approaches, Linear and Multiple Regression, Nonlinear Regression, Classifier Accuracy evaluation methods.

### Module –IV

**Cluster Analysis** – What Is Cluster Analysis, Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Classical Partitioning Methods: k-Means and k-Medoids, Hierarchical Methods, Agglomerative and Divisive Hierarchical Clustering,

Clustering Using Wavelet Transformation, Clustering High-Dimensional Space, Model-Based Clustering Methods, Fuzzy C-Means clustering, Cluster evaluation metrics.

### **Module-V**

Case study on Data Mining techniques in engineering applications: Brain Tumor detection, Time series data analysis, Fraud detection, Sentiment analysis, Market Profit Analysis etc. (Some recent research papers on the above may be used for case study.)

#### **Text Book:**

1. Data Mining: – Concepts and Techniques by Jiawei Han and Micheline Kamber, -- Morgan Kaufmann Publisher (Elsevier)
2. Data Mining Concepts, Models, Methods and Algorithms By Mehmed Kantardzic Wiley Interscience, IEEE Press.

### **Course Articulation Matrix**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>
<b>CO1</b>	2	-	3	1	-	-
<b>CO2</b>	2	-	3	1	-	-
<b>CO3</b>	2	-	3	1	-	-
<b>CO4</b>	2	-	3	3	-	-
<b>CO5</b>	3	3	3	1	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

### **Program Articulation Matrix row**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>
<b>CO</b>	2	1	3	2	-	-

## **PE – 15 : PRIVACY AND SECURITY IN SOCIAL NETWORKS**

L-T-P: 3-0-0

Cr.-3

### **Module – I: Evolution of Social Network**

Limitations of current Web - Development of Semantic Web-Emergence of the Social Web-Social Network analysis: Development of Social Network Analysis -Key concepts and measures in network analysis - Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities - Web- based networks - Applications of Social Network Analysis. Types of networks,

### **Module – II: Structural Properties of Networks**

Notions of centrality, cohesiveness of subgroups: clique, n-cliques, n-clans, n-clubs, k- flexes and k-cores. Roles and positions, structural equivalence, regular equivalence, automorphic equivalence, equitable partitions, stochastic block models and community structure in networks.

### **Module – III: Cascading Properties of Networks**

Information/influence diffusion on networks, maximizing influence spread, power law and heavy tail distributions, preferential attachment models, small world phenomenon

### **Module –IV: Community Mining in Social Network:**

Community and cluster detection: basic concept of communities, community vs clustering, Methods for community detection and mining Evaluating communities detection algorithms-  
 - Applications of community mining algorithms -Tools for detecting communities social network infrastructures and communities Decentralized online social networks, random walks, spectral methods, Label Propagation , Girvan Newman algorithm

**Module –V: Visualization and Applications of Social Network**

Graph theory, Centrality, Clustering, Node-Edge Diagrams, Matrix representation, Visualizing online social networks, visualizing social networks with matrix-based representations, Matrix and Node-Link Diagrams, Hybrid representations, Applications, Cover networks, Community welfare, Collaboration networks, Co-Citation networks.

**Text Books:**

1. Stanley Wasserman, Katherine Faust. Social network analysis: methods and applications. Cambridge University Press, 1994.
2. Peter Mika, “Social Networks and the Semantic Web”, First Edition, Springer 2007.

**References**

1. Peter R. Monge, Noshir S. Contractor, Theories of communication networks. Oxford University Press, 2003.
2. Duncan Watts. Six degrees: the science of a connected age. Norton, 2004.

**Course Outcome**

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

- CO1: Understand the concepts Social Network and its analysis.
- CO2: Understand the structural properties and cohesiveness of different sub groups.
- CO3: Understand the cascading properties of different networks.
- CO4: Analysis of communities mining in online social networks.
- CO5: Understand the visualization approach for real world social network

**Course Articulation Matrix**

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2	3	2
CO2	2	2	1	2	2	1
CO3	2	2	1	1	2	1
CO4	2	2	1	1	1	1
CO5	3	2	2	1	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

	PO1	PO2	PO3	PO4	PO5	PO6
CO	2	2	1	1	2	1

**Course Objective:**

The objective of the course is to introduce the major concept areas of language translation and compiler design, enrich the knowledge in various phases of compiler and its use, code optimization techniques, machine code generation, and use of symbol table, extend the knowledge of parser by parsing LL parser and LR parser, and provide practical programming skills necessary for constructing a compiler.

**Module I**

Compiler Overview and Lexical Analysis: Overview of language processing: preprocessors, compiler, assembler, interpreters, linkers, Bootstrap loaders and cross compiler. Structure of a compiler: phases of a compiler. Lexical Analysis: Role of Lexical Analysis, Input buffering, Regular Expressions, NFA, DFA, Minimization of DFA, Transition diagram for tokens, reserved words and identifiers. Lexical error and its recovery, LEX.

**Module II**

Syntax Analysis Role of a parser, Top down parsing, derivation, ambiguity, left recursion, left factoring, backtracking parsing, recursive decent parsing, predictive parsing, LL(1) Grammars. Bottom up parsing, Shift Reduce Parsing, handle, handle pruning, Operator precedence parser, precedence function, LR Parsers, Construction of SLR, CLR, LALR Parsing tables, parser conflicts, Dangling ELSE Ambiguity, Error recovery in Parsing. YACC.

**Module III**

Semantic Analysis and Intermediate code generation: Semantic analysis, SDD and SDTS, evaluation of semantic rules, implementation of S-attributed and L-attributed definition. Type analysis and type checking. Intermediate code, three address code, quadruples, triples, indirect triplet, abstract syntax trees, Declarations, Assignment statements, Boolean expressions, Case statements, Back patching, Procedure calls. Symbol tables, use of symbol tables. Runtime Environment: storage organization, stack allocation, access to non-local data, heap management, parameter passing mechanisms.

**Module IV**

Optimization: Machine independent code optimization: Common sub expression elimination, constant folding, copy propagation, dead code elimination, strength reduction, loop optimization, basic blocks, data flow analysis.

**Module V**

Code generation: Issues in the design of code generation, The target machine, A simple code generator, DAG representation of basic blocks. Machine dependent code optimization: Peephole optimization, register allocation, instruction scheduling, inter procedural optimization, garbage collection via reference counting.

**Text books:**

1. Compilers, Principles Techniques and Tools- Alfred V Aho, Monical S Lam, Ravi Sethi, Jeffrey D. Ullman, 2<sup>nd</sup> ed, Pearson, 2007.
2. Principles of compiler design, V. Raghavan, 2<sup>nd</sup> ed, TMH, 2011.

**Reference books:**

1. Compiler construction, Principles and Practice, Kenneth C Loudon, CENGAGE
2. Compiler Design, O. G. Kakde, University Science Press.
3. Compiler Design, K. Muneeswaram, Oxford University Press.
4. Allen I. Holub “Compiler Design in C”, Prentice Hall of India, 2003

**Course Outcome:**

CO1: Identify the role of compiler and its phases and Role of the lexical analysis

CO2: Role of the top-down and bottom-up parser

CO3: Distinguish s-attributed and l-attributed definition

CO4: Analyze different ways of code optimization

CO5: Issues of a code generator

**Course Articulation Matrix**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>
<b>CO1</b>	3	2	2	-	1	-
<b>CO2</b>	3	3	3	1	1	-
<b>CO3</b>	3	2	3	2	2	-
<b>CO4</b>	3	2	1	1	2	-
<b>CO5</b>	3	2	2	2	1	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>
<b>CO</b>	3	2	2	1	1	-

## PE – 18 : INFORMATION AND CODING THEORY

L-T-P: 3-0-0

Cr.-3

UNIT I INFORMATION THEORY: Information – Entropy, Information rate, classification of codes, Kraft McMillan inequality, Source coding theorem, Shannon-Fano coding, Huffman coding, Extended Huffman coding - Joint and conditional entropies, Mutual information - Discrete memory less channels – BSC, BEC – Channel capacity, Shannon limit.

UNIT II SOURCE CODING: TEXT, AUDIO AND SPEECH Text: Adaptive Huffman coding, Arithmetic Coding, LZW algorithm – Audio: Perceptual coding, Masking techniques, Psychoacoustic model, MEG Audio layers I,II,III, Dolby AC3 - Speech: Channel Vocoder, Linear Predictive Coding

UNIT III SOURCE CODING: IMAGE AND VIDEO Image and Video Formats – GIF, TIFF, SIF, CIF, QCIF – Image compression: READ, JPEG – Video Compression: Principles-I,B,P frames, Motion estimation, Motion compensation, H.261, MPEG standard

UNIT IV ERROR CONTROL CODING: BLOCK CODES Definitions and Principles: Hamming weight, Hamming distance, Minimum distance decoding - Single parity codes, Hamming codes, Repetition codes - Linear block codes, Cyclic codes - Syndrome calculation, Encoder and decoder – CRC

UNIT V ERROR CONTROL CODING: CONVOLUTIONAL CODES, Convolutional codes – code tree, trellis, state diagram - Encoding – Decoding: Sequential search and Viterbi algorithm – Principle of Turbo coding

### TEXT BOOKS

1. R Bose, “Information Theory, Coding and Crptography”, TMH 2007
2. Fred Halsall, “Multimedia Communications: Applications, Networks, Protocols and Standards”, Perason Education Asia, 2002

### REFERENCES

1. K Sayood, “Introduction to Data Compression” 3/e, Elsevier 2006
2. S Gravano, “Introduction to Error Control Codes”, Oxford University Press 2007
3. Amitabha Bhattacharya, “Digital Communication”, TMH 2006

### Course Outcomes:

After completion of the course, the student is able to

CO1: Design the channel performance using Information theory.

CO2: Comprehend various error control code properties

CO3: Apply linear block codes for error detection and correction

CO4: Apply convolution codes for performance analysis & cyclic codes for error detection and correction.

CO5: Design BCH & RS codes for Channel performance improvement against burst errors.

### Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	3	2	2	1
CO2	2	1	2	3	2	2
CO3	1	1	3	1	2	2
CO4	2	1	2	2	2	1

<b>CO5</b>	2	1	2	2	2	1
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**Program Articulation Matrix row for this Course**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>
<b>CO</b>	2	1	2	2	2	1

## PE – 19 : DIGITAL FORENSIC

**L-T-P: 3-0-0**

**Cr.-3**

1. Introduction of Cybercrime: Types of cybercrime, categories of cybercrime , Computers' roles in crimes, Prevention from Cyber crime, Hackers, Crackers, Phreakers Ethical Hacking :Difference between Hacking and Ethical hacking : Steps of Ethical Hacking, Exploring some tools for ethical hacking: reconnaissance tools, scanning tools
2. Digital Forensic, Rules for Digital Forensic The Need for Digital Forensics, Types of Digital Forensics, Ethics in Digital Forensics, Digital Evidences : Types and characteristics and challenges for Evidence Handling
3. Introduction to Computer Security Incident Goals of Incident response, Incident Response Methodology, Formulating Response Strategy, IR Process – Initial Response, Investigation, Remediation, Tracking of Significant ,Investigative Information, Reporting Pre Incident Preparation, Incident Detection and Characterization. Live Data Collection : Live Data Collection on Microsoft Windows Systems: Live Data Collection on Unix-Based Systems
4. Forensic Duplication Forensic Image Formats, Traditional Duplication, Live System Duplication, Forensic Duplication tools Disk and File System Analysis: Media Analysis Concepts, File System Abstraction Model The Sleuth Kit : Installing the Sleuth Kit , Sleuth Kit Tools Partitioning and Disk Layouts : Partition Identification and Recovery, Redundant Array of Inexpensive Disks Special Containers : Virtual Machine Disk Images , Forensic Containers Hashing, Carving : Foremost , Forensic Imaging : Deleted Data , File Slack , dd , dcfldd , dc3dd Data Analysis Analysis Methodology Investigating Windows systems , Investigating UNIX systems , Investigating Applications, Web Browsers, Email, Malware Handling: Static and Dynamic Analysis
5. Technical Exploits and Password Cracking , Introduction to Intrusion Detection systems, Types of IDS Understanding Network intrusion and attacks , Analyzing Network Traffic, Collecting Network based evidence, Evidence Handling. Investigating Routers, Handling Router Table Manipulation Incidents, Using Routers as Response Tools

**Text Books:** 1. Jason Luttgens, Matthew Pepe, Kevin Mandia, “Incident Response and computer forensics”,3rd Edition Tata McGraw Hill, 2014.

2. Nilakshi Jain, Dhananjay Kalbande, ”Digital Forensic : The fascinating world of Digital Evidences ” Wiley India Pvt Ltd 2017.

### **References:**

1. Clint P Garrison “Digital Forensics for Network, Internet, and Cloud Computing A forensic evidence guide for moving targets and data , Syngress Publishing, Inc. 2010
2. Bill Nelson,Amelia Phillips,Christopher Steuart, “Guide to Computer Forensics and Investigations” . Cengage Learning, 2014

**Course Outcomes:** Student will able to:

1. Define the concept of ethical hacking and its associated applications in Information Communication Technology (ICT) world.
2. Underline the need of digital forensic and role of digital evidences .
3. Explain the methodology of incident response and various security issues in ICT world, and identify digital forensic tools for data collection .
4. Recognize the importance of digital forensic duplication and various tools for analysis to achieve adequate perspectives of digital forensic investigation in various applications /devices like Windows/Unix system.
5. Apply the knowledge of IDS to secure network and performing router and network analysis

### Course Articulation Matrix

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>
<b>CO1</b>	3	3	2	2	1	-
<b>CO2</b>	3	3	2	2	1	-
<b>CO3</b>	3	3	2	2	1	-
<b>CO4</b>	3	3	2	2	1	-
<b>CO5</b>	3	3	2	2	1	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

### Program Articulation Matrix row for this Course

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>
<b>Course</b>	3	3	2	2	1	-

**L-T-P: 3-0-0****Course outcomes:**

1. To understand the basic of IoT like components, security, challenges etc.
2. To learn about different protocols of IoT.
3. To understand about the resource management of IoT.
4. To understand the different case study and motivate towards development of IoT application.
5. To understand the amalgamation of web of things and cloud computing.

**MODULE 1 (6 lectures)**

Introduction: Definition – Foundations – Challenges and Issues - Identification - Security. Components in internet of things: Control Units – Sensors – Communication modules – Power Sources – Communication Technologies – RFID – Bluetooth – Zigbee – Wifi – Rflinks – Mobile Internet – Wired Communication – IoT Platform Overview – Raspberry pi – Arduino boards.

**Module II (6 lectures)**

IoT Protocols: Protocol Standardization for IoT – M2M and WSN Protocols – SCADA and RFID Protocols – Issues with Iot Standardization – Protocols – IEEE 802.15.4 – BACNet Protocol – Zigbee, Architecture – Network layer – APS Layer – Security.

**Module III (6 lectures)**

Resource Management in the Internet of Things: Clustering - Software Agents - Data Synchronization - Clustering Principles in an Internet of Things Architecture - The Role of Context-Design Guidelines - Software Agents for Object – Data Synchronization - Types of Network Architectures - Fundamental Concepts Of Agility and Autonomy - Enabling Autonomy and Agility by the Internet of Things - The Evolution from the RFID-based EPC Network to an Agent based Internet of Things - Agents for the Behaviour of Objects.

**Module IV (6 lectures)**

Case Study and IoT Application Development: IoT Applications in home – infrastructures security – Industries – IoTelectronic equipments. Use of Big Data and Visualization in IoT Industry 4.0 concepts – Sensors and sensor Node – Interfacing using Raspberry Pi / Arduino – Web Enabled Constrained Devices.

**Module V (6 lectures)**

Web of Things: Web of Things versus Internet of Things - Architecture Standardization for WoT - Platform Middleware for WoT - WoT Portals and Business Intelligence - Cloud of Things: Grid/SOA and Cloud Computing - Cloud Standards – Cloud of Things Architecture - Open Source e-Health sensor platform.

**Text Books:**

1. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective" — CRC Press-2012.
2. Dieter Uckelmann, Mark Harrison, "Architecting the Internet of Things", Springer-2011.
3. Arshdeep Bahga, Vijay Madiseti, "Internet of Things (A Hands-On Approach)", VPT, 2014.
5. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012.

**References:**

1. Luigi Atzori, Antonio Lera, Giacomo Morabito, "The Internet of Things: A Survey",
2. Journal on Networks, Elsevier Publications, October, 2010.
3. <http://www.theinternetofthings.eu/what-is-the-internet-of-things>.

**Course outcomes:**

1. To understand the basic of IoT like components, security, challenges etc.
2. To learn about different protocols of IoT.
3. To understand about the resource management of IoT.

4. To understand the different case study and motivate towards development of IoT application.

To understand the amalgamation of web of things and cloud computing.

### Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	-	3	3	-	-
CO2	2	-	3	3	-	-
CO3	2	-	3	3	-	-
CO4	2	-	3	3	-	-
CO5	3	3	3	3	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

### Program Articulation Matrix row

	PO1	PO2	PO3	PO4	PO5	PO6
CO	2	1	3	3	-	-

## OE – 1 : MACHINE LEARNING

**L-T-P: 3-0-0**

**Cr.-3**

### Course Objectives

Students have understanding of issues and challenges of Machine Learning.

Understanding of the strengths and weaknesses of many popular machine learning approaches.

Evaluation of machine learning algorithms and model selection.

### Module I

Basics Concepts of Machine Learning: Brief Introduction to Machine Learning Concepts, Machine Learning Terminology, Machine Learning vs. Statistics, Types of Machine Learning Algorithms, Supervised Learning vs. Unsupervised Learning, Applications of Machine Learning.

### Module II

Supervised Learning: Basic concepts of Supervised Learning, Decision tree induction, Evaluation of classifiers, Rule induction, Classification using association rules, Naïve Bayesian classification, Naïve Bayes for text classification, Support vector machines, Combining Classifiers Ensemble methods: Bagging and Boosting, Applications of Supervised Learning.

### Module III

Unsupervised Learning: Clustering - K-means, Representation of clusters, Hierarchical clustering, Distance functions, Gaussian Mixture Model (GMM), Spectral Clustering, Expectation Maximization (EM), Principal Components Analysis (PCA).

### Module IV

Introduction to Reinforcement Learning and Deep Learning: Reinforcement Learning Tasks and their types in reinforcement learning, Approaches to Reinforcement Learning and Examples, Machine Learning vs. Deep Learning, Introduction to Deep Learning and its applications.

### Module V

Ensemble Methods and Evaluation of Machine Learning Models: Machine Learning for Time-Series Analysis, Ensemble Methods – Bagging, Boosting, Stacking, Evaluating

Machine Learning Models - Training, Validation and Testing, K-fold Cross validation, Confusion Matrix, Evaluation Metrics, Hypothesis Testing.

**Textbooks:**

1. Tom Mitchell, Machine Learning.
2. Christopher Bishop, Pattern Recognition and Machine Learning.

**Course Outcomes:**

- CO1:** Understand the basics of machine learning and applications of machine learning.
- CO2:** Understand a wide variety of supervised learning algorithms.
- CO3:** Understand a wide variety of unsupervised learning algorithms.
- CO4:** Understand the basic concepts of Reinforcement Learning and Deep Learning.
- CO5:** Learn how to apply the machine learning algorithms on a dataset; perform evaluation of the algorithms and model selection.

**Course Articulation Matrix**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>
<b>CO1</b>	3	2	2	2	1	-
<b>CO2</b>	3	3	1	3	1	-
<b>CO3</b>	3	2	1	3	-	-
<b>CO4</b>	2	2	1	2	-	-
<b>CO5</b>	2	3	2	2	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

**Program Articulation Matrix row for this Course**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>
<b>CO</b>	3	3	2	2	1	-

**OE – 2 : CRYPTOGRAPHY and DATA SECURITY**

**L-T-P 3-0-0**

**Cr. -3**

**Module-I**

**(6 LECTURES)**

Introduction to Security: Definition, Goal and Challenges, OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, Techniques, Model for Network Security, Mathematics of Cryptography: Integer Arithmetic, Modular arithmetic, Matrices, Linear Congruence, Algebraic Structures: Group, Ring, Field, Galois Field.

**Module-II**

**(6 LECTURES)**

Modern Symmetric Key Ciphers: Modern Block Ciphers, Modern Stream Ciphers, Data Encryption Standard (DES): DES Structure, DES Analysis, Multiple DES, Security of DES, Advanced Encryption Standard (AES), AES Transformation functions, Analysis of AES.

**Module-III**

**(6 LECTURES)**

Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Stream and Block Cipher, Steganography. Use of Modern Block

Ciphers: ECB, CBC, CFB, OFB, CTR, Use of Stream Ciphers: RC4, Key Management, Key Generation.

**Module-IV**

**(6 LECTURES)**

Number Theory: Prime Numbers, Fermat’s and Euler’s Theorems, Testing of Primality, Shinese Remainder Theorem, Exponentiation and Logarithm, RSA Algorithm, Elgamal Cryptosystem, Elliptic Curve Cryptography, Diffe-Hellman Key Exchange.

**Module-V**

**(6 LECTURES)**

Message Integrity and Message authentication: Application of Cryptographic Hash Functions, Two Simple Hash functions, Requirements and security, Secure Hash Algorithm (SHA), Message Authentication Requirements, Message authentication functions, Message Authentication Codes (MAC), Security of MAC, Digital Signature, Digital Signature Standards.

**Course Outcomes:**

CO 1: Understand the basics of security and apply knowledge of computing and mathematics for developing efficient security algorithms.

CO 2: Understand the concept of symmetric cryptography.

CO 3: Insight into classical and modern block cipher techniques.

CO 4: Gain concept of asymmetric cryptography.

CO5: application of cryptographic techniques for authentication of a system

**Text Book:**

1. B. A. Forouzan, *Cryptography & Network Security*, McGraw Hill, Special Indian Edition, 2007.
2. W. Stallings, *Cryptography and Network Security*, Pearson Education, 3rd Ed, 2006.

**References:**

1. R. E. Smith, *Internet Cryptography*, AWL.
2. A. J. Menezes, *Handbook of Applied Cryptography*, CRC Press.
3. J. Hershey, *Cryptography Demystified*, McGraw Hill.
4. J. Knudsen, *Java Cryptography*, O’Reilly.

**Course Outcomes:**

Upon completion of the subject, the students will demonstrate the ability to:

CO 1: Understand the basics of security and apply knowledge of computing and mathematics for developing efficient security algorithms.

CO 2: Understand the concept of symmetric cryptography.

CO 3: Insight into classical and modern block cipher techniques.

CO 4: Gain concept of asymmetric cryptography.

CO5: application of cryptographic techniques for authentication of a system

**Course Articulation Matrix**

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	2	1
CO2	3	3	3	3	2	1
CO3	3	3	3	3	2	1
CO4	3	3	3	3	2	1
CO5	3	3	3	3	2	1

**1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation**

**Program Articulation Matrix row for this Course**

	PO1	PO2	PO3	PO4	PO5	PO6
Course	3	3	3	3	2	1

## OE – 3 : DATA MINING AND DATA WAREHOUSING

L-T-P: 3-0-0

Cr.-3

### Course Outcome

1. To understand the concepts of Data Mining
2. To design the data mining decisions using the association rule mining
3. To analyze different supervised techniques: Prediction and Classifications
4. To apply the unsupervised data mining techniques for clustering
5. To evaluate data mining techniques while solving real world problems

### Module – I

**Data Mining Overview:** What Defines a Data Mining Task? Task-Relevant Data, The Kind of Knowledge to be Mined, KDD, Data Preprocessing – Data Integration and Transformation, Data Reduction, Data Mining Primitives, System Architectures.

### Module – II

**Mining Association Rules** in Large Databases, Association Rule Mining, Market Basket Analysis: Association Rule Mining, Basic Concepts, Association Rule Mining A Road Map, Mining Association Rules from Frequent Itemsets, Mining Multilevel Association Rules from Transaction Databases, Multilevel Association Rules, Approaches to Mining Multilevel Association Rules, Mining Distance-Based Association Rules, Association Mining and Correlation Analysis.

### Module – III

**Classification and Prediction** – What is Classification? What Is Prediction? Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Bayes Theorem, Classification by Back propagation, A Multilayer Feed-Forward Neural Network, MLP, Classification Based on Concepts from Association Rule Mining, k-Nearest Neighbor Classifiers, Fuzzy Set Approaches, Linear and Multiple Regression, Nonlinear Regression, Classifier Accuracy evaluation methods.

### Module –IV

**Cluster Analysis** – What Is Cluster Analysis, Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Classical Partitioning Methods: k-Means and k Medoids, Hierarchical Methods, Agglomerative and Divisive Hierarchical Clustering, Clustering Using Wavelet Transformation, Clustering High-Dimensional Space, Model-Based Clustering Methods, Fuzzy C-Means clustering, Cluster evaluation metrics.

### Module-V

Case study on Data Mining techniques in engineering applications: Brain Tumor detection, Time series data analysis, Fraud detection, Sentiment analysis, Market Profit Analysis etc. (Some recent research papers on the above may be used for case study.)

### Text Book:

3. Data Mining: – Concepts and Techniques by Jiawei Han and Micheline Kamber, -- Morgan Kaufmann Publisher (Elsevier)
4. Data Mining Concepts, Models, Methods and Algorithms By Mehmed Kantardzic Wiley Interscience, IEEE Press.

## Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	-	3	1	-	-
CO2	2	-	3	1	-	-
CO3	2	-	3	1	-	-
CO4	2	-	3	3	-	-
CO5	3	3	3	1	-	-

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

## Program Articulation Matrix row

	PO1	PO2	PO3	PO4	PO5	PO6
CO	2	1	3	2	-	-

## Project

- CO1 Implementing research/application projects independently to solve practical problems.
- CO2 Write and present a substantial technical report/document.
- CO3 Demonstrate a handy experience over broad area of Computer Science & Engineering.
- CO4 Apply appropriate techniques, resources, and modern hardware and software tools, including prediction and modeling, to complex engineering activities with an understanding of the limitations.
- CO5 Understanding the group dynamics, recognize opportunities and contribute positively to collaborative-multidisciplinary scientific research in order to achieve common goals.

## Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	3	3
CO2	3	3	3	3	3	3
CO3	3	3	3	3	3	3
CO4	3	3	3	3	3	3
CO5	3	3	3	3	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

## Program Articulation Matrix row

	PO1	PO2	PO3	PO4	PO5	PO6
CO	3	3	3	3	3	3