Computer and Information Technology (CIT)

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 academic for the betterment of the society.

Mission:

- To produce best quality Information Technology and professional and researchers by providing state of the art training, hands on experience and healthy research environment.
- To collaborate with industry and academic around the globe for achieving quality technical education and excellence in research through active participation of all the stakeholders.
- To promote academic growth by offering inter-disciplinary postgraduate and doctoral programs.
- 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.

Programme Educational Objectives (PEOs)

The educational objectives of department of Information Technology of VSSUT, Burla are to prepare its graduates:

PEO1: To prepare professionals who will have successful career in industries, academia, research and entrepreneurial endeavors.

PEO2: To prepare graduates who will demonstrate analytical, research, design and implementation skills offering techno-commercially feasible and socially acceptable solutions to real life problems.

PEO3: To prepare graduates who will thrive to pursue life-long learning and contribute to society as an ethical and responsible citizen.

	M1	M2	M3	M4
PEO-1	3	1	2	3
PEO-2	3	1	1	2
PEO-3	3	1	2	3

Programme Outcomes:

On completion of the M.Tech (CIT) programme, the students shall have:-

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	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.
PO4	An ability to identify the application of automated tools and techniques to solve different classes of engineering problems following ethical practices.
PO5	An ability to relate the knowledge of mathematical foundations, algorithms and principles of computer science and information technologies to design new computer models for applied engineering systems.
PO6	Students should be able tocomprehend, design and develop software projects conforming specifications and budgetary constraints.

Programme Specific Outcomes:

PSO1: To conceptualize domain specific problems, analyze and develop efficient algorithms using contemporary technologies to deliver solutions.

PSO2:To gain the ability to pursue higher studies, Research & Development and entrepreneurships in the modern computing environment.

Course Structure
for
PG Programmes to be introduced from July 2019
Specialization: M.Tech, Computer and Information Technology (CIT)

Semester I

Sl. No.	Core/ Elective	Subject Code	Subject Name	L	T	P	Credits
1	Core-1		Advanced Operating Systems	3	0	0	3
2	Core-2		Advanced Computer Architecture	3	0	0	3
3	PE-1		Cloud Architecture	3	0	0	3
			Soft Computing				
			Real Time System Design				
			Wireless Network and Mobile Computing				
			Social Network Analysis				
4	PE-2		Distributed Computing	3	0	0	3
			IOT				
			Cryptographic Foundation				
			Natural Language Processing				
			Human and Computer Interaction				
5	Common		Research Methodology & IPR	3	0	0	3
6	Lab-1		Computing Lab-I	0	0	3	2
7	Lab-2		Computing Lab-II	0	0	3	2
8	Audit -1						
Total Credits							19

Semester II

Sl. No.	Core/ Elective	Subject Code	Subject Name	L	T	P	Credits
1	Core-3		Advanced SoftwareEngineering	3	0	0	3
2	Core-4		Advanced Algorithms	3	0	0	3
3	PE-3		VLSI Design	3	0	0	3
			Cellular Automata Theory				
			Deep Learning				
			Data Analytics				
			Machine Learning				
4	PE-4		Embedded Systems	3	0	0	3
			Data Mining				
			Bio-informatics				
			Optimization Techniques				
			Fault Tolerant Systems				
			Network Security				
5	Common		Minor project & Seminar	0	0	4	2
6	Lab-3		Computing Lab-III	0	0	3	2
7	Lab-4		Computing Lab-IV	0	0	3	2
8	Audit -2						
Total Credits							18

Semester III

Sl. No.	Core/ Elective	Subject Code	Subject Name	L	T	P	Credits
1	PE-5		Image Processing	3	0	0	3
			Multi-core Architecture				
			AI & Robotics				
			Distributed Database				
			Service Oriented Architecture				
			Pattern Recognition				
2	OE-1			3	0	0	3
3	Minor Project		Dissertation (Phase-I)	0	0	20	10
Total Credits							16

Semester IV

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

GRAND TOTAL CREDITS: 19+18+16+16=69

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.

List of Open Electives

Sl. No.		Subject Name
1	OE-I	Network Security
2		Internet of Things
3		Soft Computing
4		Advance Computer Architecture
5		Cloud Architecture

1st SEMESTER

ADVANCED OPERATING SYSTEM

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

Module-I:

(08Lectures)

Fundamentals: What is a Distributed computing system, Evolution of Distributed Computing Systems, Distributed Computing Systems models, what are Distributed Computing Systems Gaining Popularity, Issues in Designing a Distributed Operating System, Introduction to distributed Computing Environment (DCE).

Message Passing: Introduction, Desirable Features of Good Message-Passing System, Isses in IPC by Message Passing, Synchronization, Buffering, Multidatagram Messages, Encoding and Decoding of Message Data, Process Addressing , Failure Handling , Group communication.

Module-II **(08 Lectures)**

Remote Procedure Calls:- Introduction, The RPC Model, Transparency of RPC, Implementing RPC Mechanism, Stub Generation, RPC Messages Marshaling Arguments and Results, Server Management, Parameter-Passing Semantics , Call Semantics, Communication protocols for RPCs. Complicated RPCs, Client-Server Binding, Exception handling, Security, Some Special types of RPCs, RPC in Heterogeneous Environments, Lightweight RPC.

Module-III:

(08 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, Heterogeneous DSM. Advantages of DSM.

Module-IV:

(08Lectures)Synchronization: Introduction, Clock Synchronization , Event ordering, Mutual Exclusion, Deadlock, Election Algorithms.

Resources 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: **(08 Lectures)**

Distributed file Systems: Introduction, Desirable Features of a good Distributed file Systems, File Models, File Accessing Models, File-Sharing Semantics, File-Caching Schemes, File Replication, fault Tolerance, Atomic Transactions, Design principles, Naming:Introduction, Desirable Features of a Good Naming Systems, Fundamentals Terminologies and Concepts, System-Oriented Names, Object-Locating Mechanisms, Human-Oriented Names, Name Caches, Naming and Security.
Security: Introduction, Potential Attacks to Computer Systems, Cryptography, Authentication, Access control, Digital Signatures, Design principles.

Text Books:

1. Distributed Operating System – Concept & Design, by – P.K.Sinha, PHI

Reference Books:

1. Operating System Concepts & Design, Milan Milenkovic, TMH.
2. Operating System, H.M.Beitel, Pearsons.

Course Outcomes:

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

CO1: Investigate the structure and concepts, various design issues like transparency, flexilibity etc in distributed operating systems.

CO2: Demonstrate important theoretical foundations including Process communication, Synchronization, Concurrency, Event ordering, Mutual Exclusion, Deadlock, Agreement Protocol, Security, Recovery and fault tolerance and Provide comprehensive coverage of the major developments in distributed Operating System

CO3: Analyze important theoretical foundations including Process Synchronization, Concurrency, and Event ordering, Mutual Exclusion, Deadlock, Agreement Protocol, Security, Recovery and fault tolerance.

CO4: Evaluate the major developments in distributed Operating System, Multi-processor scheduling, real time scheduling and designing of distributed file systems.

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CO5: Implement and Formulate the solutions to various algorithms required for resource management, scheduling, allocation and communication, file sharing mechanism in distributed Applications in preparation to entering the industry or in pursuit of postgraduate studies.

Course Articulation Matrix

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

ADVANCED COMPUTER ARCHITECTURE

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

Module – I **(08 Lectures)**

FUNDAMENTALS OF COMPUTER DESIGN
Review of Fundamentals of CPU, Memory and IO – Trends in technology, power, energy and cost, Dependability – Performance Evaluation

Module – II **(08 Lectures)**

INSTRUCTION LEVEL PARALLELISM
ILP concepts – Pipelining overview – Compiler Techniques for Exposing ILP – Dynamic Branch Prediction – Dynamic Scheduling – Multiple instruction Issue – Hardware Based Speculation – Static scheduling – Multi-threading – Limitations of ILP – Case Studies.

Module – III **(08 Lectures)**

DATA-LEVEL PARALLELISM
Vector architecture – SIMD extensions – Graphics Processing units – Loop level parallelism.

Module – IV **(08 Lectures)**

THREAD LEVEL PARALLELISM
Symmetric and Distributed Shared Memory Architectures – Performance Issues – Synchronization – Models of Memory Consistency – Case studies: Intel i7 Processor.

Module – V **(08 Lectures)**

TOPOLOGIES FOR PARALLEL PROCESSING

Static and Dynamic topologies for parallel processing.

Text Books:

1. Computer Architecture – A quantitative approach By J.L Hennessy and D.A.Patterson, Morgan Kaufmann

2. Advanced Computer Architecture, by Kai Hwang Mc Graw Hill.

Reference Books:

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

Course Outcomes:

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

1. Define the concept of parallelism,
2. Demonstrate Models of Parallelism and techniques to achieve parallelism.
3. Analyze Causes and Resolution of Hazards in pipelining,
4. Organize thread level parallelism.
5. Construct topologies for parallel processing.

1. **Course Articulation Matrix**

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

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

2. **Program Articulation Matrix row for this Course**

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

CLOUD ARCHITECTURE

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

Module – I **(08 Lectures)**

Cloud computing at a Glance: Vision, Reference Model, Characteristics, Benefits and Challenges Ahead, Developments: Virtualization, Web 2.0, Service-oriented Computing and Utility-Oriented Computing, Principles of Parallel and Distributed Computing: Eras of Computing, Elements of Parallel and Distributed Computing and Technologies for Distributed Computing.

Module – II **(08 Lectures)**

Virtualization: Characteristics of Virtualized Environments, Taxonomy, Pros and Cons and Technology Examples: Xen, VMware and Hyper-V, Cloud Computing Architecture: Reference Model, Types of Clouds, Open Challenges: Interoperability, Standards, Scalability, Fault Tolerance, Security, Trust and Privacy, Cloud Platforms in Industry: Amazon Web Services, Google App Engine and Microsoft Azure.

Module – III **(08 Lectures)**

Virtual Machine: Homogeneous and Heterogeneous, Task Scheduling, Mapping Heuristics: RR, CLS and CMMS

Module – IV **(08 Lectures)**

Workflow Scheduling: Workflow: Montage, Epigenomics, SIPHT, LIGO and CyberShake, Resource Allocation,Leases: Advance Reservation, Best Effort, Immediate, Deadline Sensitive and Negotiated, Haizea, Swapping and Backfilling, Resource Allocation Measures, Task Consolidation, Energy-Conscious Task Consolidation, MaxUtil, Energy-Aware Task Consolidation, Virtual Cluster, CPU Utilization Threshold and Sleep or Power Saving Mode, Virtual Machine Placement and Migration

Module – V **(08 Lectures)**

A Reference Model for Market-oriented Cloud Computing, Federated Clouds/Inter Cloud: Characterization, Federation Stack, Technologies for Cloud Federations, Cloud Applications: Healthcare, Protein Structure Prediction, Gene Expression Data Analysis for Cancer Diagnosis, Geoscience, Social Networking, Media Applications and Multiplayer Online Gaming.

Text Book:

1. R. Buyya, C. Vecchiola and S. ThamaraiSelvi, Mastering Cloud Computing: Foundations and Applications Programming, Morgan Kaufmann, Elsevier, 2013.

Reference Book:

1. B. Sosinsky, Cloud Computing Bible, Wiley, 2011.
2. D. N. Chorafas, Cloud Computing Strategies, CRC Press, Taylor and Francis Group, 2011.
3. P. K. Pattnaik, M. R. Kabat and S. Pal, Fundamentals of Cloud Computing, Vikas Publishing House Pvt. Ltd., 2015.

Course Outcomes

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

CO1	Develop and deploy cloud application using popular cloud platforms
CO2	Design and develop highly scalable cloud-based applications by creating and configuring virtual machines on the cloud and building private cloud.
CO3	Compare, contrast, and evaluate the key trade-offs between multiple approaches to cloud system design, and Identify appropriate design choices when solving real-world cloud computing problems.
CO4	Understand different cloud programming platforms and tools.
CO5	Be familiar with application development and deployment using cloud platforms

3. Course Articulation Matrix

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

CO4	3	3	2	3	2	2
CO5	3	3	2	3	2	2

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

4. **Program Articulation Matrix row for this Course**

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

SOFT COMPUTING

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

Module-I

(9 Lectures)

Overview of Soft Computing, Difference between Soft and Hard computing, Brief descriptions of different components of soft computing, Artificial neural networks Vs Biological neural networks, Basic building block of an artificial neuron, Activation functions, Introduction to Early ANN architectures (basics only)-McCulloch & Pitts model, Perception Network, Adaptive Linear Neuron (Adaline), Multiple Adaptive Linear Neuron ,

Module-II

(9 Lectures)

Artificial Neural Networks: Supervised Learning: Introduction and how brain works, Neuron as a simple computing element, The perceptron, Back propagation networks: architecture, multilayer perceptron, back propagation learning-input layer, accelerated learning in multilayer perceptron, The Hopfield network, Bidirectional associative memories (BAM), RBF Neural Network.

Module-III **(9 Lectures)**

Fuzzy Logic Basic concepts of fuzzy logic, Fuzzy sets: membership fuction, basic fuzzy set operations, Crisp relations: Cartisianproduct,other crisp relations, operations on relations, fuzzy relations: Fuzzy cartesian product operations on fuzzy relations, Fuzzy Systems: Crisp logic, predicate logic, fuzzy logic, fuzzy rule based system, Tolerance and Equivalence relatiuons, membership functions, Fuzzy decision making

Module-IV

(7 Lectures)

Introduction, Biological background, Traditional optimization and search techniques: Encoding, Fitness function, reproduction-Roulette wheel, Boltzmann, Tournament Selection, Crossover, Inversion and deletion , Mutation, Bit-wise operator, Convergence of GA, Applications.

Module -V **(6 Lectures)**

Hybrid soft computing techniques: Neuro fuzzy hybrid systems, Genetic Neuro-hybrid Systems, Genetic fuzzy hybrid and fuzzy genetic hybrid system, fuzzy back propagation networks, Fuzzy associative memories.

Text Books:

1. Computational Intelligence Principles, Techniques and Applications, AmitKonar, Springer publication.
2. Neural Networks, FuzzyLogic, and GeneticAlgorithm (synthèses and Application) S.Rajasekaran, G.A. VijayalakshmiPai, PHI
3. Principles of Soft Computing S.N.Sivanandam&S.N.Deepa,Wiley-India Edition

Reference Books:

1. Neuro Fuzzy and Soft Computing, J. S. R. JANG,C.T. Sun, E. Mitzutani, PHI
2. Soft-computing, D.K.Pratihar,AlphaScie

Course Outcomes:

Learner will be able to…

1. Define and analyse Soft computing concepts, technologies and applications.
2. Construct ANN and Back propagation network.
3. Define and analyze the concepts of fuzzy logic, fuzzy inference system.
4. Explain the techniques and applications on Genetic Algorithm.
5. To integrate various hybrid soft computing techniques.

Course Articulation Matrix

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	-	3	1	2	1
CO 2	3	-	3	1	2	1
CO 3	3	-	3	1	2	2
CO 4	3	-	3	1	2	2

CO 5	3	-	3	1	2	2

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

Program Articulation Matrix row for this Course

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
Course	3	-	3	1	2	2

REAL TIME SYSTEM AND DESIGN

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

Module-I **(08 Lectures)**

Introduction - Issues in Real Time Computing, Structure of a Real Time System, Task classes, Performance Measures for Real time Systems, Task Assignment and Scheduling – Classical uniprocessor scheduling algorithms, RM algorithm with different cases-Priority ceilingprecedence constraints- using of primary and alternative tasks.

Module-II **(08 Lectures)**

Uniprocessor scheduling of IRIS tasks, Task assignment, Utilization balancing – Next fit- Bin packing- Myopic off-line - Focused addressing and bidding- Buddy strategy- Fault Tolerant Scheduling.-Aperiodic scheduling - Spring algorithm, Horn algorithm- Bratley. - Sporadic scheduling.

Module-III **(08 Lectures)**

Introduction – VTCSMA – PB CSMA- Deterministic collision resolution protocol- DCR for multi packet messages- dynamic planning based- Communication with periodic and aperiodic messages.

Module-IV **(08 Lectures)**

Basic Definition, Real time Vs General purpose databases, Main Memory Databases, Petri nets and applications in real-time modeling, Air traffic controller system – Distributed air defense system.

Module-V **(08 Lectures)**

Transaction priorities, Transaction Aborts, Concurrency control issues, Disk Scheduling Algorithms, Twophase Approach to improve Predictability, Maintaining Serialization Consistency, Databases for Hard Real Time System.

References Books

1. C.M. Krishna, Kang G. Shin, "Real Time Systems", Tata McGraw - Hil, 2010.

2. Giorgio C. Buttazzo , "Hard real-time computing systems: predictable scheduling algorithms and applications" , Springer, 2008.

3. C. Siva Ram Murthy, G. Manimaran, "Resource management in real-time systems and networks", PHI, 2009

Course Outcomes

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

CO1	Explain fundamental principles for programming of real time systems with time and resource limitations.
CO2	Describe the foundation for programming languages developed for real time programming.
CO3	Account for how real time operating systems are designed and functions.
CO4	Describe what a real time network is.
CO5	Use real time system programming languages and real time operating systems for real time applications.

1. Course Articulation Matrix

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

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

2. **Program Articulation Matrix row for this Course**

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

WIRELESS NETWORK AND MOBILE COMPUTING

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

Module – I **(08 Lectures)**

Introduction to Wireless Network, Wired vs. Wireless Network, Applications, Satellite Communications: Parameters and Configurations, Orbit: Equatorial, Polar, Inclined, Geostationary, Medium Earth and Low Earth, , Frequency Bands, Capacity Allocation: Frequency Division, Time Division, Wireless Impairments, Hidden and Exposed terminal problem.

Module – II **(08 Lectures)**

Introduction to Cellular Wireless Networks, Principles: Organization, Reuse, Capacity, Operation, Handoff, Effect of Handoff and Power Control, First-Generation Analog: Spectral Allocation, Operation and Advanced Mobile Phone Service Control Channels, Second-Generation TDMA: First and Second-Generation Cellular Systems, Time Division Multiple Access, Mobile Wireless TDMA Design, Global System for Mobile Communications, Architecture, Entities, Call Routing in GSM, GSM Addresses and Identifiers and Mobility Management, Second-Generation CDMA: Code Division Multiple Access, Mobile Wireless TDMA Design, Hard and Soft Handoff, IS-95, General Packet Radio Service: Packet Data Network, Quality of Service, Network Architecture, Data Services, Limitations and Applications.

Module – III **(08 Lectures)**

Third-Generation Systems, Alternative Interfaces: Code Division Multiple Access-2000, Universal Mobile Telecommunications System, International Mobile Telecommunication-2000, Wireless LAN: Advantages, IEEE 802.11 Standards, Architecture, Frequency Hopping Spread Spectrum, Direct Sequence Spread Spectrum.

Module – IV **(08 Lectures)**

Emerging Technologies: Bluetooth, IEEE 802.15, Mobile IP, Mobile Ad Hoc Network, Routing, Wireless Sensor Networks, Wireless Application Protocol, Cordless System, Wireless Local Loop, Security in Wireless network.

Module-V **(08 Lectures)**

Pervasive web application architecture and server side programming.

Text Book

1. W. Stallings, "Wireless Communications & Networks", Second Edition, Pearson Education, 2007.
2. J. Schiller, "Mobile Communications", Second Edition, Pearson Education, 2010.

References

1. S. Singhal, "The Wireless Application Protocol", Addison Wesley, 2001.
2. T. S. Rappaport, "Wireless Communications: Principles & Practice", Second Edition, Pearson Education, 2002.
3. C. E. Perkins, "Ad Hoc Networking", Addison Wesley, 2000.

Course Outcomes:

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

1. Write various Wireless Network components and impairments, Evolution of Mobile System Architectures.
2. Demonstrate different Wireless Network Architecture and Protocols in different layers.
3. Organize the concepts behind evolution of sensor networks..
4. Analyze emerging technologies.
5. Construct server side programming.

Course Articulation Matrix

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

CO4	1	3	2	2	2	-
CO5	3	3	2	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	2	3	2	2	2	-

SOCIAL NETWORK ANALYSIS

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

MODULE-I **(08 Lectures)**

Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Statistical Properties of Social Networks -Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web-based networks.

MODULE-II **(08 Lectures)**

Visualizing Online Social Networks - A Taxonomy of Visualizations - Graph Representation - Centrality- Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix- Based Representations- Node-Link Diagrams - Hybrid Representations - Modelling and aggregating social network data – Random Walks and their Applications –Use of Hadoop and Map Reduce - Ontological representation of social individuals and relationships.

MODULE-III **(08 Lectures)**

Aggregating and reasoning with social network data, Advanced Representations – Extracting evolution of Web Community from a Series of Web Archive - Detecting Communities in Social Networks - Evaluating Communities – Core Methods for Community Detection & Mining - Applications of Community Mining Algorithms - Node Classification in Social Networks.

MODULE-IV **(08 Lectures)**

Evolution in Social Networks – Framework - Tracing Smoothly Evolving Communities - Models and Algorithms for Social Influence Analysis - Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing - Algorithms and Systems for Expert Location in Social Networks - Expert Location without Graph Constraints - with Score Propagation – Expert Team Formation - Link Prediction in Social Networks - Feature based Link Prediction – Bayesian Probabilistic Models - Probabilistic Relational Models.

MODULE-V **(08 Lectures)**

A Learning Based Approach for Real Time Emotion Classification of Tweets, A New Linguistic Approach to Assess the Opinion of Users in Social Network Environments, Explaining Scientific and Technical Emergence Forecasting, Social Network Analysis for Biometric Template Protection.

TEXT BOOK:

1. Ajith Abraham, Aboul Ella Hassanien, VáclavSnášel, ―Computational Social Network Analysis: Trends, Tools and Research Advances‖, Springer, 2012

2 .BorkoFurht, ―Handbook of Social Network Technologies and Applications‖, Springer, 1 st edition, 2011

REFERENCES BOOKS:

1. Charu C. Aggarwal, ―Social Network Data Analytics‖, Springer; 2014

2. Giles, Mark Smith, John Yen, ―Advances in Social Network Mining and Analysis‖, Springer, 2010.

3. GuandongXu ,Yanchun Zhang and Lin Li, ―Web Mining and Social Networking – Techniques and applications‖, Springer, 1st edition, 2012

4. Peter Mika, ―Social Networks and the Semantic Web‖, Springer, 1st edition, 2007.

5.Przemyslaw Kazienko, NiteshChawla,‖Applications of Social Media and Social Network Analysis‖, Springer,2015

Course Outcome:

At the end of the course students will be able to

1. The students should be able to analyze and Work on the internals components of the social network.
2. The students should be able to Model and visualize the social network.
3. The students should be able to mine the behavior of the users in the social network.
4. The students should be able to predict the possible next outcome of the social network.
5. The students should be analyze and able to apply social network in real time applications.

Course Articulation Matrix

	PO01	PO02	PO03	PO04	PO05	PO06
CO01	3	3	3	3	3	1
CO02	3	3	3	3	3	1
CO03	3	3	3	2	2	2
CO04	3	3	2	2	3	2

CO05	3	3	2	3	1	2

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

Program Articulation Matrix row for this Course

	PO01	PO02	PO03	PO04	PO05	PO06
COURSE	3	3	3	3	2	1

DISTRIBUTED COMPUTING

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

Module 1:

Introduction: Definition, Relation to parallel systems, synchronous vs asynchronous execution, design issues and challenges.

A Model of Distributed Computations: A Model of distributed executions, Models of communication networks, Global state of distributed system, Models of process communication.

Logical Time: Logical clocks, scalar time, vector time, efficient implementation of vector clocks, Jard-Jourdan's adaptive technique, Matrix time, virtual time, Physical clock synchronization: NTP.

Module 2:

Global state and snapshot recording algorithms: System model, Snapshot algorithms for FIFO channels, Variations of Chandy-Lamport algorithm, Snapshot algorithms for non-FIFO channels, Snapshots in a causal delivery system, Monitoring global state, Necessary and sufficient conditions for consistent global snapshots, finding consistent global snapshots in a distributed computation.

Message ordering and group communication : Message ordering paradigms, Asynchronous execution with synchronous communication, Synchronous program order on an asynchronous system, Group communication, Causal order (CO), Total order, A nomenclature for multicast, Propagation trees for multicast, Classification of application-level multicast algorithms, Semantics of fault-tolerant group communication, Distributed multicast algorithms at the network layer.

Termination detection: Introduction, System model of a distributed computation, Termination detection using distributed snapshots, Termination detection by weight throwing, A spanning-tree-based termination detection algorithm, Message-optimal termination detection, Termination

detection in a very general distributed computing model, Termination detection in the atomic computation model, Termination detection in a faulty distributed system

Module 3:

Distributed mutual exclusion algorithms: Preliminaries, Lamport's algorithm, Ricart–Agrawala algorithm, Singhal's dynamic information-structure algorithm, Lodha and Kshemkalyani's fair mutual exclusion algorithm, Quorum-based mutual exclusion algorithms, Maekawa's algorithm, Agarwal–El Abbadi quorum-based algorithm, Token-based algorithms, Suzuki–Kasami's broadcast algorithm, Raymond's tree-based algorithm.

Deadlock detection in distributed systems: Introduction, System model, Preliminaries, Models of deadlocks, Knapp's classification of distributed deadlock detection algorithms, Mitchell and Merritt's algorithm for the singleresource model, Chandy–Misra–Haas algorithm for the AND model, Chandy–Misra– Haas algorithm for the OR model, Kshemkalyani–Singhal algorithm for the P-out-of-Q model.

Module 4:

Authentication in distributed systems: Protocols based on symmetric cryptosystems, Protocols based on asymmetric cryptosystems, Password-based authentication, and Authentication protocol failures.

Module 5:

Self-stabilization: System model, Definition of self-stabilization, Issues in the design of self-stabilization algorithms, Methodologies for designing self-stabilizing systems, Communication protocols, Self-stabilizing distributed spanning trees, Self-stabilizing algorithms for spanning-tree construction, An anonymous self-stabilizing algorithm for 1-maximal independent set in trees, A probabilistic self-stabilizing leader election algorithm, The role of compilers in self-stabilization, Self-stabilization as a solution to fault tolerance, Factors preventing self-stabilization.

Text Book:

Ajay D. Kshemkalyani and MukeshSinghal, Distributed Computing: Principles, Algorithms, and Systems, Cambridge University Press

Vijay K. Garg, Elements of Distributed Computing, Wiley Paperback, 2014

Reference Book:

HagitAttiya, Jennifer Welch, Distributed Computing: Fundamentals, Simulations, and Advanced Topics, Wiley

Andrew S. Tanenbaum, Maarten van Steen, Distributed Systems: Principles and Paradigms, Prentice Hall of India

Course Outcomes

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

CO1	Explain the techniques used for data fragmentation, replication, and allocation during the distributed database design process.
CO2	Evaluate simple strategies for executing a distributed query to select the strategy that minimizes the amount of data transfer.
CO3	Explain how the two-phase commit protocol is used to deal with committing a transaction that accesses databases stored on multiple nodes.
CO4	Describe distributed concurrency control based on the distinguished copy techniques and the voting methods.
CO5	Assess the quality and ease of use of data modeling and diagramming tools.

1. Course Articulation Matrix

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

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

2. **Program Articulation Matrix row for this Course**

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

INTERNET OF THINGS

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

Module-I **(8Lectures)**

Introduction to Internet of Things Introduction-Definition & Characteristics of IoT , Physical Design of IoT- Things in IoT , IoT Protocols, Logical Design of IoT- IoT Functional Blocks, IoT Communication Models, IoT Communication APIs , IoT Enabling Technologies- Wireless Sensor Networks , Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems, IoT Levels & Deployment Templates.

Module-II **(8Lectures)**

Domain Specific IoTs. Home Automation: Smart Lighting, Smart Appliances, Intrusion Detection, Smoke/Gas Detectors, Cities-Smart Parking, Smart Lighting, Smart Roads, Structural Health Monitoring, Surveillance, Emergency Response, Environment-Weather Monitoring, Air Pollution Monitoring, Noise Pollution Monitoring, Forest Fire Detection, River Floods Detection, Energy- Smart Grids, Renewable Energy Systems, Prognostics, Retail-Inventory Management, Smart Payments, Smart Vending Machines, Logistics-Route Generation & Scheduling , Fleet Tracking , Shipment Monitoring, Remote Vehicle Diagnostics, Agriculture-Smart Irrigation,Green House Control,Industry -Machine Diagnosis & Prognosis. Indoor Air Quality Monitoring,Health& Lifestyle -Health & Fitness Monitoring.

Module-III **(8Lectures)**

Wearable Electronics IoT and M2M Introduction, M2M-Difference between IoT and M2M, SDN and NFV for IoT-Software Defined Networking, Network Function Virtualization

Module-IV **(8Lectures)**

IoT Platforms Design Methodology IoT Design Methodology-Purpose & Requirements Specification, Process Specification, Domain Model Specification, Information Model

Specification, Service Specifications, IoT Level Specification, Functional View Specification, Operational View Specification, Device & Component Integration, Application Development, Case Study on IoT System for Weather Monitoring, Motivation for Using Python IoT Physical Devices & Endpoints.

Module-V **(8 Lectures)**

IoT Device-Basic building blocks of an IoT Device, Exemplary Device: Raspberry Pi, About the Board, Linux on Raspberry Pi , Raspberry Pi Interfaces – Serial, SPI , I2C , Programming Raspberry Pi with Python-Controlling LED with Raspberry Pi , Interfacing an LED and Switch with Raspberry Pi ,Interfacing a Light Sensor (LDR) with Raspberry Pi , Other IoT Devices-pcDuino, Beagle Bone Black , Cubieboard.

Text Books: Internet of Things, A Hands-on Approach, by ArshdeepBahga& Vijay audisetti, University Press.

Reference Books: The Internet of Things, by Michael Millen, Pearson

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

1. Express usage of Internet of Things in different contexts.
2. Define the technology and standards relating to IoTs
3. Differentiate between the layers of IoT stack and protocols used in each layer.
4. Incorporate the IoT concepts with broader ICT industry and possible future trends
5. Apply the knowledge and skills acquired to build and test a complete working IoT system involving prototyping, programming and data analysis.

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 for this Course

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

CRYPTOGRAPHIC FOUNDATION

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

Module-I **(08 Lectures)**

Introduction to Security: Definition, Goal and Challenges, OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, Techniques, Model for Network Security,

Module-II **(08 Lectures)**

Mathematics of Cryptography: Integer Arithmetic, Modular arithmetic, Matrices, Linear Congruence, Algebraic Structures: Group, Ring, Field, Galois Field, Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Stream and Block Cipher, Steganography.

Module-III **(08 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, Use of Modern Block Ciphers: ECB, CBC, CFB, OFB, CTR, Use of Stream Ciphers: RC4, Key Management, Key Generation.

Module-IV **(08 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 **(08 Lectures)**

Message Authentication Codes (MACs): Formal Definition of Weak and Strong MACs, using a PRF as a MAC, Variable length MAC, Public Key Signature Schemes: Formal Definitions,

Signing and Verification, Formal Proofs of Security of Full Domain Hashing, Assumptions for Public Key Signature Schemes: One way functions Imply Secure One-time Signatures, Shamir's Secret Sharing Scheme, Formally Analyzing Cryptographic Protocols

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

1. Express principles of security and security services.
2. Identify security threats and determine efforts to counter them
3. Apply knowledge of computing and mathematics for developing efficient security algorithms.
4. Write code for relevant cryptographic algorithms.
5. Relate cryptographic primitives and their implementations for correctness, efficiency, and security.

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 for this Course

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

NATURAL LANGUAGE PROCESSING

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

Module I: **(10 Lectures)**

Introduction and Course Overview, Natural Language and Formal Language, Basic Text Processing, N-grams and Language Models.

Module II: **(10 Lectures)**

POS Tagging, HMMs and POS,Syntax, Parsing and Evaluation of POS taggers, Text Similarity, Vector Space model, Dimensionality Reduction

Module III: **(08 Lectures)**

Representing Meaning, Semantic Analysis, Word Sense Disambiguation, Machine Learning Approaches to NLP.

Module IV: **(06 Lectures)**

Text Classification, Summarization, Information Extraction, Information Retrieval and Question Answering.

Module V :(06 hours)

Machine Translation, Sentiment Analysis, Discourse Analysis.

Text Books:

1. Jurafsky and Martin. Speech and Language Processing, Prentice Hall, 2009.
2. Manning and Schűtze. Foundations of Statistical Natural Language Processing, MIT Press, 1999

Reference Books:

1. Bird, S., Klein, E., Loper, E. (2009). Natural Language Processing with Python. Sebastopol, CA: O'Reilly Media.

Course Outcomes

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

CO1	Understand text processing and language models.
CO2	Understand the different NLP techniques such as parsing, tagging etc.
CO3	Learning semantic analysis and machine learning approaches.
CO4	Study of different application such as IE, IR, text classification etc.
CO5	Study of applications machine translation, sentiment analysis etc.

1. 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

2. **Program Articulation Matrix row for this Course**

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

Human and Computer Interaction

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

Module-I (08 Lectures)

FOUNDATION OF HCI: The Human: I/O channels-memory-reasoning and problem solving; The computer: Devices-memory-processing and networks; Interaction: models-frameworks-ergonomics-styles-elements-interactivity-paradigm

Module-II(08 Lectures)

DESIGN AND SOFTWARE PROCESS: Interactive design basics-process-scenarios-navigation-screen design-iteration and prototyping; HCI in software process-software life cycle-usability engineering-prototyping in practice-design rationale. Design rules-principles, standards, guidelines,rules. Evaluation Techniques-Universal Design.

Module-III(08 Lectures)

MODELS AND THEORIES: Cognitive models-socio-organizational issues and stake holder requirements-communication and collaboration models-hypertext, multimedia and www.

Module-IV(08 Lectures)

MOBILE HCI: mobile ecosystem: platforms, application frameworks-types of mobile applications: widgets, applications, games-mobile information architecture, mobile 2.0, mobile design: elements of mobile design, tools.

Module-V(08 Lectures

WEB INTERFACE DESIGN: Designing web interfaces-drag and drop, direction selection, contextual tools, overlays, inlays and virtual pages, process flow. Case studies.

TEXT BOOKS:

1. Anal Dix, janetfinlay, Gregory Abowd, Russell Balae,"Human computer Interaction", 3rd Edition, pearson Education, 2004(unit I, unit II and unit III)
2. Brian Fling,"Mobile Design and development", First edition, O''Reilly Media Inc.,2009(unit IV)
3. Bill Scott and Theresa Neil ,"Designing Web Interfaces",First edition, O''Reilly, 2009(unit V)
4. Upon completion of the subject the students will demonstrate the ability to:

Course Outcomes

CO1	Design effective dialog for HCI.
CO2	Design usable and appropriate software based on psychological, social, and technical analysis.
CO3	design and evaluation methods used in interaction design, and will get experience with these methods in their project
CO4	Implement the HCI concepts for designing multimedia/ecommerce/e-learning web sites.
CO5	Develop meaningful user interface.

Course Articulation Matrix

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

COMPUTING LAB-I

L-T-P: 0-0-3 **Cr.-2**

Exposure to different:

- Web-based tools.
- Scripting languages.
- Develop GUI-based applications.
- File transfer and access using FTP, Telnet, etc.
- Implementation of real-time case studies, project, research and report submission.

Course Outcomes·

1. Analyze the given problem and write an algorithm to implement the same
2. Demonstrate the use of appropriate scripting languages to simulate the problem.
3. Develop GUI-based application to represent the given problem.
4. Planning of new and effective methods to achieve models with less computational time
5. Compile a report of the project or research carried out.

Course Articulation Matrix

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

Program Articulation Matrix row for this Course

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

Computing Lab-II

L-T-P: 0-0-3 **Cr.-2**

Students have exposure to

- Various simulation tools supporting to the elective papers offered
- Implement a project/research work and report submission

Course Outcomes:

At the end of the course students will be able to

1. Recognize the basic operations of the simulation tool.
2. Write programs for solving problem related to the subject.
3. Demonstrate the fundamental concepts acquired from the subject into program.
4. Analyze and compare the simulation results to identify the scope of further research.
5. Implement and write a project/research work in the respective field

Course Articulation Matrix

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	-	3	3	3	3
CO2	3	-	3	3	3	3
CO3	3	-	3	3	3	3
CO4	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 for this Course

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**

Course	3	3	3	3	3	3

2nd SEMESTER

ADVANCE SOFTWARE ENGINEERING

L-T-P: 3-1-0 **Cr.-4**

Module-I **(08 Lectures)**

Managing software projects: Overview to software Project, Software Product and Software Process, Project management concepts, Responsibility of Software Project Manager, Software Project Planning, Metrices for project size Estimation, Project Estimation Technique, Project scheduling technique (WBS, PERT, Gantt Chart, CPM) and tracking, Staffing, Overview to Risk Management, Risk Management Activities, Software Quality Assurance, Software Configuration management (SCM): Goals, Objectives, SCM Activities, SCM tools and Standards.

Module-II **(08 Lectures)**

Requirement Engineering and Specification: Requirement Engineering Definition, Req. Engineering Technique, Software Requirement and its objectives, Req. Engineering Activities, Software Requirement Specification (SRS): Goals, quality Quality and characteristics of good SRS, benefits, Uses and Components of SRS, SRS Structure, Specification technique, Formal Specification, Algebraic specification and Model based specification.

Module-III **(08Lectures)**

Software Design Strategies and Methods: What is good software Design? , Good Vs. Bad Design, Cohesion and Coupling: Classification of Cohesion and Coupling, Software Design Approach: Function Oriented Design and Object Oriented Design, Overview to SA/SD Methodology: Structure Analysis, Tools for structure Analysis, DFDs. Designing and Developing DFD Models Shortcoming of DFD, Extending DFD technique to Real time System, Structured Design, Tools for structure Design, Flow chart Vs. Structure chart, Transformation of DFD in to Structure Chart, Detail Design.

Module-IV **(08Lectures)**

Object Oriented Software Engineering: Conventional methods for software engineering: Design Concepts and principles. Architectural design, Component level Design, User Interface Design, software Coding and Testing Techniques, Software testing Strategies: Black box and White box testing, Integration and system testing, Object Oriented Concepts and principles, Object Oriented Analysis, Object Oriented Design, UML, UML Diagram: USE Case Model, CLASS Diagram, Inter action diagram, Activity Diagram, State Chart Diagram, Object Oriented Software Development and testing, Technical metrics for Object-Oriented Systems, Implementation and Maintenance.

Module-V **(10Lectures)**

Software Reliability and Quality Management: Software reliability, Software Quality, Software Quality Management system, ISO Certification.

Computer Aided Software Engineering: Overview to CASE, CASE Tool Classification of CASE Tool, Characteristics of Case Tools, CASE for Future.

Component Based Software Engineering: Overview, Component based Software Development, Advantage and Limitations.

Software Re-Engineering: What is Software Re-Engineering? Benefits of Software Re-Engineering, Re-Engineering Activities, Software Reverse Engineering: Goals, Types of Reverse Engineering, Program Re-Structuring, Source Code Translation, Data Re-Engineering.

Text Books:

1. Roger S. Pressman, "Software Engineering: A Practitioners Approach". Mc-Graw Hill Publication.
2. Rajib Mall, "Fundamental of Software Engineering", PHI
3. Ian Sommerville, "Software Engineering", Pearson Education Asia.

Course Outcome

After successful completion of this course, students will be able to :

CO1: Analyzethe basic concepts of engineering principles in software development

CO2: Demonstrate the features of different lifecycle models. Analyze and build an appropriate process model for a given project using engineering principles at various phases of software development.

CO3: Translate a specification into a design, and identify the components to build the architecture for a given problem, all using an appropriate software engineering methodology

CO4: Evaluate a Project Management and estimation Plan and tabulate appropriate Testing Plans at different levels during the development of the software and apply Unified Modeling Language (UML) for representation of an object-oriented system using different modeling views

CO5: Apply requirement mapping strategies and various testing methods for development of high quality software product with the practice software maintenance.

Course Articulation Matrix

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

ADVANCED ALGORITHMS

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

Module – I **(10 Lectures)**

Foundations**:** Analysis of algorithms, Time Complexity, Space Complexity, Asymptotic Notations, Growth Rate, Class-P & NP, NP- Complete, NP-hard, Reducibility, NP-Complete Problems.

Module –II **(10Lectures)**

Design and Analysis Techniques**:** Divide and Conquer, Dynamic Programming, Greedy, Amortized Analysis.

Module –III **(6 Lectures)**

Online Algorithms**:** Introduction, Basic Concepts, Optimization Problems, Competitive Analysis, Deterministic Algorithms, Randomized Algorithms, Optimum Offline Algorithms, Case Studies - Paging Problem, Graph Coloring Algorithms.

Module –IV **(8 Lectures)**

Approximation Algorithms**:** Introduction, Bounds, Polynomial Time Approximation Schemes, Hardness of Approximations,

Module-V **(6 Lectures)**

Approximate Algorithm Case Studies- Vertex Cover Problem, Steiner Tree &Traveling Salesman Problem, Knapsack Problem, Bin Packing Problem, Minimum Makespan Scheduling Problem.

TEXT BOOKS:

1. *Introduction to Algorithms* - Thomas H. Cormen, Charles E. Leiserson,Ronald L. Rivest, and Clifford Stein, 3rd Edition, MIT Press, Cambridge, 2009.
2. *Online Computation and Competitive Analysis* - A. Borodin and R. El-Yaniv, Cambridge Univ. Press, 1998.
3. *Approximation Algorithms* - Vijay V. Vazirani, Springer Verlag, 2003.

REFERENCE BOOKS :

1. *Computers and Intractability: A Guide to the Theory of NP-Completeness*-Michael R. Garey, and David S. Johnson, W.H. Freeman, 1979.
2. *Online Algorithms: The State of the Art* (LNCS 1442), A. Fiat and G. Woeginger, eds., Springer-Verlag, 1998.

3 .Approximation Algorithms for NP-Complete Problems, D.S. Hochbaum, ed., PWS, 1997

Course Outcomes

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

CO1	Conceptualize the foundations of analysis and different classes of problems.
CO2	Explore, implement and design the different algorithm techniques.
CO3	Learning the different online algorithms.
CO4	Analyzing the concepts of approximation algorithms
CO5	Study of different case studies of approximation algorithm.

1. Course Articulation Matrix

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

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

2. **Program Articulation Matrix row for this Course**

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

VLSI DESIGN

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

Module – I **(8 Lectures)**

VLSI physical design: VLSI design cycle, Physical design cycle, *Design styles*: Full custom, Standard cell, Gate arrays, FPGA, *System Packaging styles*: Die package style, PCB, Multichip modules, Wafer scale integration, design rules.

Design and Fabrication: Fabrication materials, Transistor fundamentals, Fabrication processes.

Module – 2 **(6 Lectures)**

Partitioning: Levels of partitioning, *Partitioning Algorithms*: Kernighan-Lin algorithm, F-M algorithm, Goldberg-Burstein algorithm, Component replication, Ratio cut.

Module – 3 **(6 Lectures)**

Floor planning: Floor plans, Floor planning problems, *Sliceable floor plans*: Slicing trees, Normalized postfix notations, Rectangular Dualization, *Non-Sliceable floor plans*: Z-cuts, Sequence pair, O-tree, Corner block list, Twin binary sequence.

Module – 4 **(8 Lectures)**

Placement: Levels of placement, objectives, placement for hi-performance systems, *Methods for VLSI placement*: Cluster growth, Partitioning based VLSI placement algorithm, Simulated Annealing, Simulated Evolution, Force-Directed method.

Module – 5 **(12 Lectures)**

Routing: Objectives, Constraints, Design specifications, Steps of routing, Phases of routing.

Global routing: Grid graph model, Checker's board model, Channel intersection graph model, *Global routing algorithms*: Maze routing algorithms, Lee's algorithm, Souk up's algorithm, Line probe algorithm.

Detailed routing: Routing region, Routing models, Terminologies, HCG, VCG, *Two layer channels routing algorithms*: Left edge algorithm, Constraint graph based routing algorithms, Greedy channel router.

Text:

1. Algorithms for VLSI Physical Design Automation.
   By Naveed A. Sherwani, Springer.

References:

1. VLSI Design
   By D. Das, Oxford University press
2. An Introduction to VLSI Physical Design.
   By M. Sarrafzadeh and C. K. Wong, McGraw-Hill.
3. Algorithms for VLSI design automation.
   By S. H. Gerez, Wiley.

Course Outcomes:

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

1. Organize different Design and Packaging style of VLSI physical design.
2. Understand different levels of partitioning.
3. Demonstrate the Floor planning concepts for VLSI design.
4. Analyze the levels and methods of placement.
5. Formulate different Routing problems.

Course Articulation Matrix

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

CELLULAR AUTOMATA THEORY

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

Module -I **(08 Lectures)**

INTRODUCTION:Cellular Automata, Applications of Cellular Automata: Initial phase of development, CA based model, New phase of Development in CA: Polynomial Algebraic Characterization of CA Behaviour, Matrix Algebraic Characterization of CA

Module -II **(08 Lectures)**

CHARACTERIZATION of CA: Group CA, Characterization of the State-Transition Behaviour, Group Properties of CA, A Class of Null Boundary Group CA, Group Properties of Periodic Boundary CA (PBCA) with Rules 90 and 150, Analysis of Intermediate Boundary CA (IBCA), Phase Shift of PN-Sequences Generated by CA, Programmable CA (PCA),

Module-III **(08 Lectures)**

Non group CA, General Characterization of Linear Nongroup CA, Characterization of Linear Multiple-Attractor Cellular Automata, Characterization of Complemented Additive CA, Behaviour of Complemented CA Derived from Multiple-Attractor Linear CA, Characterization of D1*CA

Module –IV **(08 Lectures)**

CA AS A UNIVERSAL PATTERN GENERATOR, Pseudo exhaustive Pattern Generation, On-Chip Deterministic Test Pattern Generation, Exhaustive Two-and Three-Pattern Generation Capability of a CA, CA-BASED ERROR CORRECTING CODE, Review of Error Correcting Codes, Design of Random Bit Error Correcting Codes, CA-Based Byte Error Correcting Code, CA Array-Based Diagnosis of Board-Level Faults, DESIGN OF CA-BASED CIPHER SYSTEM, Permutation Groups, Permutation Representation of CA States, Definition of Fundamental Transformations, PCA-Based Block Cipher Scheme, Stream Cipher Strategy

Module –V **(08 Lectures)**

THEORY AND APPLICATION OF TWO-DIMENSIONAL CA: Introduction to Two-Dimensional Cellular Automata, Parallel PRPG Using 2-D CA, Design of Pseudo associative Memory Using Cellular Automata, CA-based hashing scheme

Text Books:

1. Chaudhuri, Parimal Pal. *Additive cellular automata: theory and applications*. Vol. 1. John Wiley & Sons, 1997.

References:

1. Wolfram, Stephen. *A new kind of science*. Vol. 5. Champaign: Wolfram media, 2002.

Course Outcomes:

After completing this course the students should be able to:

1. Memorize the basic concepts of Cellular Automata.
2. Differentiate Group CA and Nongroup CA with their characterization
3. Apply cellular Automata to make independent and critical assessments.
4. Relate concept of Cellular automata to solve real world problems
5. Identify, formulate and solve complex problems in the field of science and engineering using the CA based 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 for this Course

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

DEEP LEARNING

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

Module-I **(08 Lectures)**

Introduction: Various paradigms of earning problems, Perspectives and Issues in deep learning framework, review of fundamental learning techniques.

Module-II **(08 Lectures)**

Fundamental Concepts in Deep Learning, Introduction to Artificial Neural Networks, Classification with Two-Layers Artificial Neural Networks, Feedforward neural network: Artificial Neural Network, activation function, multi-layer neural network.

Training Neural Network: Risk minimization, loss function, backpropagation, regularization, model selection, and optimization.

Module-III **(08 Lectures)**

Conditional Random Fields: Linear chain, partition function, Markov network, Belief propagation, Training CRFs, Hidden Markov Model, Entropy.

Deep Learning: Deep Feed Forward network, regularizations, training deep models, dropouts, Convolutional Neural Network, Recurrent Neural Network, Deep Belief Network.

Module-IV **(08 Lectures)**

Probabilistic Neural Network: Hopfield Net, Boltzman machine, RBMs, Sigmoid net, Autoencoders.

Deep Learning research: Object recognition, sparse coding, computer vision, natural language processing.

Module-V **(08 Lectures)**

Deep Learning Tools: Caffe, Theano, Torch

Text Books

T1. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016..

T2. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.

Reference Books

R1. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.

R2. Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013.

R3. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

Books on Optimization Techniques

A. Ravindran, K. M. Ragsdell , and G. V. Reklaitis , ENGINEERING OPTIMIZATION: Methods and Applications , John Wiley & Sons, Inc. , 2016..

A. Antoniou, W. S. Lu, PRACTICAL OPTIMIZATION Algorithms and Engineering Applications, Springer, 2007.

COURSE OUTCOME:

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

CO1	Gain knowledge of Deep learning along with its functions, operations, and the execution pipeline
CO2	Implement linear regression and gradient descent
CO3	Understand the concept of artificial neural networks, convolutional neural networks, and recurrent neural networks

CO4	Discuss how to speed up neural networks along with regularization techniques to reduce overfitting
CO5	Implement deep learning algorithms, and learn how to train deep networks

1. Course Articulation Matrix

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

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

2. **Program Articulation Matrix row for this Course**

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

DATA ANALYTICS

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

Module-I **(08 Lectures)**

Inferential Statistics Inferential Statistics through hypothesis tests Permutation & Randomization Test

Regression & ANOVA Regression ANOVA (Analysis of Variance)

Machine Learning: Introduction and Concepts

Differentiating algorithmic and model based frameworks Regression : Ordinary Least Squares, Ridge Regression, Lasso Regression, K Nearest Neighbours Regression & Classification

Module-II **(08 Lectures)**

Supervised Learning with Regression and Classification techniques -1

Bias-Variance Dichotomy, Model Validation Approaches, Logistic Regression, Linear Discriminant Analysis, Quadratic Discriminant Analysis, Regression, Classification Trees, Support Vector Machines

Supervised Learning with Regression and Classification techniques -2

Ensemble Methods: Random Forest Neural Networks Deep learning

Module-III **(08 Lectures)**

Unsupervised Learning and Challenges for Big Data Analytics

Clustering

Associative Rule Mining

Challenges for big data anlalytics

Module-IV **(08 Lectures)**

Prescriptive analytics

Creating data for analytics through designed experiments creating data for analytics through Active learning creating data for analytics through Reinforcement learning

Module-V **(08 Lectures)**

Case studies on:

Retail Location Analysis: Analysis report detailing results of data cleaning, EDA, variable selection for optimal retail location, description of multi-variate regression model with location recommendation

Market Research (Factor Analysis): Research report on survey design and how it facilitates factor analysis. Include discussion on validity and reliability, defining constructs/dimensions/ and sampling design

Automated Medical Diagnosis: Analysis report detailing results of EDA, variable selection for automated medical diagnosis (decision tree) model. Presentation of findings.

Text Book:

1. Hastie, Trevor, et al. the elements of statistical learning. Vol. 2. No. 1. New York: springer, 2009.

2. Montgomery, Douglas C., and George C. Runger. The Applied statistics and probability for engineers. John Wiley & Sons, 2010

References:

1. Predictive Analytics, Data Mining and Big Data: Myths, Misconceptions and Methods (Business in the Digital Economy),Author: Finlay, S.,Publisher: Palgrave Macmillan; 2014 edition
2. Storytelling with Data: A Data Visualization Guide for Business Professionals Author: Cole NussbaumerKnaflic Publisher: John Wiley & Sons; 1 edition, Publication Date: 20 November 2015
3. Data Mining and Business Analytics with R, by Johannes Ledolter; Publisher: Wiley (2013), ISBN-13: 978-1118447147; Available in Johns Hopkins online library: https://catalyst.library.jhu.edu/catalog/bib_4637122
4. An Introduction to Statistical Learning with Application in R, by Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani; Publisher: Springer (2013); ISBN-13: 978-1461471370;Available in Johns Hopkins online library: https://catalyst.library.jhu.edu/catalog/bib_6591386
5. Elements of Statistical Learning: Data Mining, Inference, and Prediction, by Trevor Hastie, Robert Tibshirani and Jerome Friedman, but it requires some mathematical sophistication and goes beyond the material we will be covering. The book is free at https://web.stanford.edu/~hastie/Papers/ESLII.pdf

COURSE OUTCOME:

CO1- Organize sufficient relevant data, conduct data analytics
CO2- Demonstrate a sophisticated understanding of the concepts and methods for decision making using data analytics skills
CO3- Incorporate advanced techniques to conduct thorough and interpret the results
CO4- Develop substantial understanding of the real problems
CO5- Apply data analysis methods to address business problems from real world case studies

Course Articulation Matrix

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

MACHINE LEARNING

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

Module-I **(8 Lectures)**

Introduction:

Basic concepts, Learning Problems, Designing Learning systems, Perspectives and Issues, Concept Learning, Version Spaces and Candidate Elimination Algorithm, Inductive bias;

Module-II **(8 Lectures)**

Supervised learning:

Supervised learning setup, LMS, Logistic regression, Perceptron, Exponential family, Generative learning algorithms, Gaussian discriminant analysis, Naive Bayes, Support vector machines, Model selection and feature selection, Ensemble methods: Bagging, boosting, Evaluating and debugging learning algorithms;

Module-III **(8 Lectures)**

Learning theory:

Bias/variance tradeoff, Union and Chernoff/Hoeffding bounds, VC dimension, Worst case (online) learning;

Module-IV **(6 Lectures)**

Unsupervised learning:

Clustering K-means, EM. Mixture of Gaussians, Factor analysis, PCA (Principal components analysis), ICA (Independent components analysis);

Module-V **(10 Lectures)**

Reinforcement learning and control:

MDPs. Bellman equations, Value iteration and policy iteration, Linear quadratic regulation (LQR), LQG, Q-learning. Value function approximation, Policy search. Reinforce. POMDPs.

Text Book:

1. EthemAlpaydin, Introduction to Machine Learning, Second Edition, PHI, 2010

References:

1. Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (INDIAN EDITION), 2013.
2. T. Hastie, R. Tibshirani, J. H. Friedman, "The Elements of Statistical Learning", Springer; 1st edition, 2001.
3. P. Langley, Elements of Machine Learning, Morgan Kaufmann, 1995.

Course Outcomes:

Upon completion of this course, students should be able to:

1. Define fundamental issues of machine learning.
2. Create challenges in data, model selection, model complexity, etc.
3. Demonstrate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning.
4. Analyze the strengths and weaknesses of many popular machine learning approaches.
5. Develop and implement various machine learning algorithms in a range of real-world applications.

Course Articulation Matrix

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

EMBEDDED SYSTEMS

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

Module – I **(12 Lectures)**

Introduction: Features of Embedded systems, Design matrices, Embedded system design flow.

ARM**:** An advanced Micro Controller, Brief history, ARM pipeline, Instruction Set Architecture (ISA): Registers, ARM Instructions, THUMB, FPGA.

Module – II (06 Hours)

Interfacing: Devices and device drivers, Serial peripheral interfaces (SPI), Inter Integrated Circuit (IIC), RS232C, RS422, RS485, USB, Infrared communication (IrDA), Bluetooth.

Module – III (10 Hours)

Real time operating system: Hard real time, Firm real time, Soft real time, Task periodicity: Periodic task, Sporadic task, Aperiodic task, Task scheduling, Scheduling algorithms: Clock driven scheduling, Event driven scheduling, Commercial Real-time operating systems.

Module – IV (06 Hours)

Hardware and software partitioning: K-L partitioning, Partitioning using Genetic Algorithm, Particle Swarm Optimization, Hardware software co-simulations.

Module – V (06 Hours)

Low power embedded system design: Dynamic power dissipation, Static power dissipation, Power reduction techniques, system level power management.

Text Books:

1. "Embedded System Design" S. Chattopadhyay, PHI.
2. "Embedded system architecture, programming and design" Raj Kamal, TMH.

Reference Books:

1. "Hardware software co-design of Embedded systems" Ralf Niemann, Kulwer Academic.
2. "Embedded real time system programming" Sriram V Iyer, Pankaj Gupta, TMH.
3. "Real-Time Systems-Theory and practice" Rajib Mall, Pearson Education
4. "Embedded System Design" Peter Marwedel, Springer
5. "Designing Embedded Hardware" John Catsoulis, O'Reilly

Course Outcomes:

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

1. Define and memorize about embedded system design flow and ARM architecture.
2. Incorporate different Interfacing devices for embedded system design.
3. Apply the concept of various scheduling algorithms for Real Time Operating for efficient embedded system design.
4. Analyze, compare and differentiate efficient Hardware Software partitioning algorithm for a particular embedded system design.
5. Design various low power devices for embedded system.

Course Articulation Matrix

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

DATA MINING

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

Module-I: **(08 Lectures)**

Data Mining Concepts: Introduction, Data mining and knowledge discovery, Types ofDatabases for data mining, Basic data mining functionalities, Data mining primitives, Data MiningQuery Language(DMQL), Major issues in data mining, Data Preprocessing: Data cleaning, Dataintegration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation. Data Warehousing: Basic concepts, A Multidimensional Data Model, Data WarehouseArchitecture, Data Warehouse Design and Implementation, Online Analytical Processing (OLAP)Systems: Basic concepts, OLAP queries, Types of OLAP Servers, OLAP Operations, etc.

Module-II: **(08 Lectures)**

Association Analysis: Association rule mining, Apriori Algorithm, Generating Association Rules from Frequent Itemsets, Improving the efficiency of Apriori, FP Growth algorithm.Classification: By Decision Tree Induction, Bayesian Classification, Classification By Backpropagation, K-Nearestest Neighbor Classifiers, Genetic Algorithms, Fuzzy Set Approaches, Linear and Multiple Regression, NonLinear Regression, Prediction.

Module-III: **(08Lectures)**

Cluster analysis: 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, Partitioning Methods in Large Databases: k-Medoids, Hierarchical Methods, Agglomerative and Divisive Hierarchical Clustering, Clustering Using Wavelet Transformation, Clustering High-Dimensional Space, Model-Based Clustering Methods, Statistical Approach, Neural Network Approach, LVQ, SOM, Applications and Trends in Data Mining – Data Mining Applications, Data Mining System Products.

Module-IV: **(08Lectures)**

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, RBFN, Defining a Network Topology, Classification Based of Concepts from Association Rule Mining, Other Classification Methods, k-Nearest Neighbor Classifiers, Genetic Algorithms, Fuzzy Set Approaches, Prediction, Linear and Multiple Regression, Nonlinear Regression, Other Regression Models, Classifier Accuracy,

UNIT-V **(08 Lectures)**

Mining Complex Types of Data: Multidimensional Analysis and Descriptive Mining of Complex, Data Objects, Mining Spatial Databases, Mining Multimedia Databases, Mining Time-Series and Sequence Data, Mining Text Databases, Mining the World Wide Web.

TextBooks:

1. Data Mining: – Concepts and Techniques by Jiawei Han and Micheline Kamber, -- Morgan Kaufmann Publisher (Elseviers)

2. Data Mining Concepts, Models, Methods and Algorithms By Mehmed Kantardzic Wiley Interscience, IEEE Press.

Course Outcome:

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

CO1: Understand the basic principles, concepts and applications of Data Mining and data warehousing, Data Pre processing and Data Mining Primitives

CO2: Understand and apply Association Rule Mining, Multilevel Association Rules, and Correlation Analysis.

CO3: Understand and apply a wide range of estimation, prediction and classification, MLP, RBFN and GeneticAlgorithms.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	-	3	2	2	1
CO 2	3	-	3	2	2	1

CO4: Understand and apply a wide range of Clustering algorithm and different approaches of Neural Network, LVQ, SOM for data clustering

CO5: Ability to do Conceptual, Logical, and Physical design of Data Warehouses with OLAP applications with applying the current trends of data mining techniques such as text mining, and other current issues and explore Multidimensional Analysis and Descriptive Mining of Complex Data Objects.

Course Articulation Matrix

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

CO 3	3	-	3	2	2	1
CO 4	3	-	3	2	2	2
CO 5	3	-	3	2	2	2
Course	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6

Program Articulation Matrix row for this Course

BIOINFORMATICS

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

Module-I **(08 Lecture)**

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).

Module-II **(08 Lecture)**

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

Module-III **(08 Lecture)**

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.

Module-IV **(08 Lecture)**

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, BLOSOM, substitution matrices .

Module-V **(08 Lecture)**

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

Text Books:

1. N.C. Jones & P.A. Pevzner – An introduction to Bioinformatics Algorithms. The MIT Press-2004.

2. D. Gusifield-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.

Course Outcomes:

At the end of the course students will be able to

1. Describe the contents and properties of the most important bioinformatics databases, perform text- and sequence-based searches, and analyze and discuss the results in light of molecular biological knowledge.
2. To acquire the knowledge of the application of bioinformatics and biological databases.
3. Express the major steps in pairwise and multiple sequence alignment, explain the principle for, and execute pairwise sequence alignment by dynamic programming.
4. Predict the secondary and tertiary structures of protein sequences.

5. Use the different computational tools for automation of complex problem solving in real research problems.

Course Articulation Matrix

	PO01	PO02	PO03	PO04	PO05	PO06
CO01	3	3	3	3	2	1
CO02	3	3	3	2	3	1
CO03	3	3	3	3	2	1
CO04	3	3	2	2	3	1
CO05	3	3	3	3	3	1

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

Program Articulation Matrix row for this Course

	PO01	PO02	PO03	PO04	PO05	PO06
COURSE	3	3	3	3	3	1

Optimization Techniques

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

Module-I **(06 Lecture)**

Statement of an Optimizationproblem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems

Module-II **(10 Lecture)**

Classical Optimization Techniques: Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable

Optimization with equality constraints. Solution by method of Lagrange multipliers – Multivariable Optimization with inequality constraints – Kuhn – Tucker conditions.

Module-III **(08 Lecture)**

Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm.

Module-IV **(08 Lecture)**

Transportation Problem: Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel's approximation method – testing for optimality of balanced transportation problems.

Module-V **(08 Lecture)**

One dimensional minimization methods, Classification, Fibonacci method and Quadratic interpolation method Unconstrained Optimization Techniques: Univariant method, Powell's method and steepest descent method

Text Books:

1. Singiresu S. Rao, Engineering Optimization: Theory and Practice by John Wiley and Sons, 4th edition, 2009.
2. H. S. Kasene& K. D. Kumar, Introductory Operations Research, Springer (India), Pvt. Ltd., 2004

Reference Book:

1. George Bernard Dantzig, MukundNarainThapa, "Linear programming", Springer series in operations research 3rd edition, 2003.
2. H.A. Taha, "Operations Research: An Introduction", 8th Edition, Pearson/Prentice Hall, 2007.
3. Kalyanmoy Deb, "Optimization for Engineering Design – Algorithms and Examples", PHI Learning Pvt. Ltd, New Delhi, 2005.

Course Outcomes

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

CO1	Explain the need of optimization of engineering systems
CO2	Conceptualize optimization of electrical and electronics engineering problems
CO3	Apply classical optimization techniques, linear programming, simplex algorithm, transportation problem
CO4	Apply unconstrained optimization and constrained non-linear programming and dynamic programming
CO5	Formulate optimization problems.

1. **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

2. **Program Articulation Matrix row for this Course**

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

Fault Tolerant Systems

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

Module I – INTRODUCTION **(06 Lecture)**

Definition of fault tolerance, Redundancy, Applications of fault-tolerance, Fundamentals of dependability. Reliability, availability& safety.

ModuleII- IMPAIRMENTS **(06 Lecture)**

Faults, errors and failures, Means: fault prevention, removal and forecasting

Module III - DEPENDABILITY EVALUATION (08 Lecture)

Common measures: failures rate, mean time to failure, mean time to repair, etc. Reliability. block diagrams ,Markov processes.

Module IV - REDUNDANCY (10 Lecture)

Hardware redundancy, Redundancy schemes, Evaluation and comparison, Applications, Information redundancy, Codes: linear, Hamming, cyclic, unordered, arithmetic, etc., Encoding and decoding techniques ,Applications , Time redundancy

ModuleV- PROGRAMMING (10 Lecture)

Software fault tolerance, Specific features, Software fault tolerance techniques: N-version. programming, recovery blocks, self-checking software, etc.

Text Books

1 Anderson, T., and P.A. Lee, Fault-Tolerant Principles and Practices, Prentice-Hall

2 Hwang, K., and F.A. Briggs, Computer Architecture and Parallel Processing, McGraw-Hill. Jalote, P.

3. Fault-Tolerance in Distributed Systems, ISBN 0-13-301367-7, Prentice-Hall,

Reference Book

1. Johnson, B.W., Design and Analysis of Fault-Tolerant Systems, Addison Wesely

2. Leveson, Nancy G., Safeware, system safety and computers, Addison Wesely.

3. Pradhan, D.K., Fault-Tolerant Computing — Theory and Techniques, (2 Volumes), Prentice-Hall.

4. Pradhan, Dhiraj K., Fault-Tolerant Computer System Design, ISBN 0-13-057887-8, Prentice-Hall

Course Outcomes:

At the end of the course students should be able:

1. To analyse different types of redundancy and its application for the design of computer systems being able to function correctly even under presence of faults and data errors.

2. To analyse different types ofTerminology and definitions, Design techniques for fault-tolerance, Analysis of fault-tolerant system, Project management and development processes, System examples.

3. To analyse how fault-tolerant systems are used in applications that require high dependability, such as safety-critical control systems in vehicles and airplanes, or business-critical systems for e-commerce, automatic teller machines and financial transactions.

4. To plan howto calculate reliability of a system. Use of tools for reliability modelling

5. To analyse the various methods for SW fault tolerance. NVP, recovery blocks, run-time checks, problem of predicate detection.

Course Articulation Matrix

	PO01	PO02	PO03	PO04	PO05	PO06
CO01	3	3	3	3	3	3
CO02	3	3	3	3	2	2
CO03	3	3	3	3	2	1
CO04	3	3	2	2	1	2
CO05	3	3	3	3	3	2

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

Program Articulation Matrix row for this Course

	PO01	PO02	PO03	PO04	PO05	PO06
COURSE	3	3	3	3	1	2

NETWORK SECURITY

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

Module I **(08 Lectures)**

Overview: Computer Security concepts, The OSI Security architecture, Security attacks. Security services, Security Mechanisms, Network Security model, Review of Symmetric and Asymmetric key cryptography

Module II **(08 Lectures)**

Security at Application Layer: E-Mail Architecture, E-Mail Security, PGP, Application of PGP, MIME, S/MIME, Application of S/MIME

Module III **(08 Lectures)**

Security at Transport Layer: Web Security issues, Secure Socket Layer (SSL): Architecture, services, Four Protocols, SSL Message format, Transport layer security (TLS), TLS protocols, HTTPS

Module IV **(08 Lectures)**

Wireless Network Security: IEEE 802.11 wireless LAN overview, IEEE 802.11i Wireless LAN security, Wireless application protocol overview, wireless transport layer security, WAP End-to-End security

Module V **(08 Lectures)**

Security at the Network Layer: IP Security overview, IP Security (IPSec) modes, AH and ESP protocol, IPv4 and IPv6, AH versus ESP, services provided by IPSec, Security association, Security policy, Internet Key Exchange (IKE), ISAKMP, Firewalls: Firewalls – Types, Comparison of Firewall Types, Firewall Configurations.Planning and Enforcing Security Policies: Planning Security Policies, Risk Analysis, Security Policies for an Organization, External Security.

Text Books:

1. Cryptography and Network Security – by AtulKahate – TMH.
2. Data Communications and Networking- by Behourz A Forouzan

Reference Book:

1. Cyber Security Operations Handbook – by J.W.Rittiaghouse and WilliamM.Hancok – Elseviers.

Course Outcomes:

At the end of the course students should be able to

1. Explain the principles of Security
2. Identify the security issues in the network and resolve it.
3. Implement different security algorithm
4. Analyze and classify various security protocols used in different layers.
5. Analyse the vulnerabilities in any computing system and hence be able to design a security solution for an organization.

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 for this Course

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

COMPUTING LAB-III

L-T-P: 0-0-3 **Cr.-2**

Exposure to different:

- Software Engineering Tools like IBM Rational Rose
- Development of SRS according to a case study
- Design of DFD/UML diagram.
- Implementation of project/research work and report submission

Course Outcomes·

1. Demonstrate the use of different tools.
2. Analyse different particular case study
3. Design of SRS and diagram.
4. Solve different newer problems
5. Compile a report of the project or research carried out.

Course Articulation Matrix

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

Program Articulation Matrix row for this Course

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

COMPUTING LAB-IV

L-T-P: 0-0-3 **Cr.-2**

Exposure to different:

- Different Simulation tools for implementing research work
- Implementation of project/research work and report submission

Course Outcomes·

1. Demonstrate the use of different tools.
2. Analyse different particular case study
3. Solve different newer problems
4. Planning of new and effective methods to achieve models with less computational time
5. Compile a report of the project or research carried out.

Course Articulation Matrix

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

Program Articulation Matrix row for this Course

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

3rd SEMESTER

IMAGE PROCESSING

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

Course Objectives:

- To study the image fundamentals and mathematical transforms necessary for image processing.

- To design and implement algorithms that perform basic image processing (e.g., noise removal and image enhancement)
- design and implement algorithms for advanced image analysis (e.g., image compression, image segmentation & image representation);
- To expose students to current applications in the field of image processing.

Module-I **(08 Lectures)**

What Is Digital Image Processing? The Origins of Digital Image Processing. Examples of Fields that Use Digital Image Processing. Fundamental steps in Digital Image Processing. Components of an Image Processing System. Image Sampling and Quantization. Some Basic Relationships between Pixels. Linear and Nonlinear Operations.

Module-II) **(08 Lectures)** Some Basic Gray Level Transformations, Histogram,Processing.Enhancement Using Arithmetic/Logic Operations.Basics of Spatial Filtering.Smoothing Spatial Filters. Sharpening Spatial Filters.Combining Spatial Enhancement Methods.

Module-III **(08Lectures)**

Introduction to the Fourier Transform and the Frequency Domain. Smoothing Frequency-Domain Filters. Sharpening Frequency Domain Filters. Homo-morphic Filtering.

Module-IV **(08 Lectures)**

Dilation and erosion, opening and closing, Hit-or-Miss transformations, basic morphological algorithms, Detection of discontinues, edge linking and boundary detection, thresh holding, region –based segmentation.

Module-V **(08 Lectures)** Image Compression: Need for data compression, Compression Techniques,Huffman, Run Length Encoding, shift codes, Arithmetic coding, Vector Quantization, Transform coding, JPEG standard, MPEG.

Text books:

1. Rafael C Gonzalez and Richard E Woods, Digital Image Processing, Pearson Education, 2002.

2. . Khalid Sayood, Introduction to Data Compression, Morgan Kaufmann,5th Edition

Reference Books:

1. Anil K Jain, Fundamental of Digital Image Processing, Prentice Hall of India, 2004.

2. William K Pratt, Digital Image Processing PIKS Scientific Inside, 4th Edition, Wiley

3. Vipul Singh, Digital Image Processing With Matlab&LabView, Reed Elsevier India Pvt Ltd, 2013

Course Outcomes:

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

CO1	Analyse the concepts of image formation and the role human visual system plays in perception of gray and color image data.
CO2	Analyze intensity transformations and spatial filtering.
CO3	Incorporate various signal processing algorithms and techniques for image enhancement.
CO4	Evaluate the methodologies for image segmentation, restoration etc.
CO5	Implement the compression techniques to compress the different raw data

Course Articulation Matrix

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

MULTI-CORE ARCHITECTURES (3-1-0) Cr-4(40 Hours)

Course objectives:

- to understand the challenges in parallel and multi-threaded structure.
- to learn about the various parallel programming paradigms, and solutions.

Module-I **(**8 Lectures)

Introduction towards Single and Multi-core processor architecture along with working mechanism like Shared Memory Architecture, Cache, Intercommunication and queuing policies, Performance issues of single vs. multicore architecture.

Module-II(8 Lectures)

Parallel programming challenges of operating system's resource allocation, data sharing, synchronization, deadlock and semaphore, Signal, Pipes and Threads on Multicore processing.

Module-III(8 Lectures)

Introduction toNoC, communication Infrastructure, Routing, application mapping strategies. Introduction of a program execution in multi core processor.

Module-IV(8 Lectures)

Outline towards shared memory programming through Open MP, Writing an OpenMP Application Programming Interface's simple program and procedure, Preliminary idea on C language to write simple programs using Open MP API.

Module-V(8 Lectures)

Parallel program case studies like n-Body solvers with basic and reduced solvers and Tree search to find a tour plan of a travelling salesman problem through depth-first search, the Message Passing Interface standards in OpenMP libraries.

Text books:

1. P. Krishna Sankar, N. P. Shangaranarayanee," Multicore Architecture and Programming", ARS publication, 2019
2. SantanuChokrabarthy, SantanuKundu, " Network on Chip", CRC press, 2014

Reference books:

1. David A Patterson, John. A. Hannesy, " Computer Architecture : A quantitative Approach", Morgan Kauffman 5th edition.
2. Kai Hwang, Fayes A. Briggs, " Computer Architecture and Parallel processing", TMH

Course Outcomes:

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

1. Compare the difference between single and multi-core architecture.
2. Understand parallel programming challenges with respect to various perspectives.
3. Conceptualize the execution of a program in multi core architecture and the support of NoC towards the same environment.

4. Design simple programs for open MP API.
5. Analyze different case studies of open MP.

Course Articulation Matrix

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

ARTIFICIAL INTELLIGENCE AND ROBOTICS

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

Module-I **(**8 Lectures)

Introduction: Artificial Intelligence, AI problems, AI Techniques, The level of the model, Criteria for the success,Defining the Problem as a State Space Search, Problem Characteristics, Production Systems,

Search: Issues in The Design of Search Programs, Un-Informed Search, BFS, DFS; Heuristic Search Techniques: Generate-And- Test, Hill Climbing, Best-First Search, A* Algorithm, Problem Reduction, AO*Algorithm, Constraint Satisfaction, Means-Ends Analysis.

Module-II **(08 Lectures)**

Knowledge Representation: Procedural Vs Declarative Knowledge, Representations & Approaches to Knowledge Representation, Forward Vs Backward Reasoning, Matching Techniques, Partial Matching, Fuzzy Matching Algorithms and RETE Matching Algorithms;

Symbolic Logic: Propositional Logic, First Order Predicate Logic: Representing Instance and is-a Relationships, Computable Functions and Predicates, Syntax & Semantics of FOPL, Normal Forms, Unification &Resolution, Representation Using Rules, Natural Deduction; Structured Representations of Knowledge: Semantic Nets, Partitioned Semantic Nets, Frames, Conceptual Dependency, Conceptual Graphs.

Module-III **(08 Lectures)**

Reasoning under Uncertainty: Introduction to Non-Monotonic Reasoning, Truth Maintenance Systems, Logics for Non-Monotonic Reasoning, Model and Temporal Logics; Statistical Reasoning: Bayes Theorem, Certainty Factors and Rule-Based Systems, Bayesian Probabilistic Inference, Bayesian Networks, Dempster-Shafer Theory, Fuzzy Logic: Crisp Sets ,Fuzzy Sets, Fuzzy Logic Control, Fuzzy Inferences & Fuzzy Systems.

Experts Systems: Overview of an Expert System, Structure of an Expert Systems, Different Types of Expert Systems- Rule Based, Model Based, Case Based and Hybrid Expert Systems, Knowledge Acquisition and Validation Techniques, Black Board Architecture, Knowledge Building System Tools, Expert System Shells, Fuzzy Expert systems.

Module-IV **(08 Lectures)**

Machine Learning: Knowledge and Learning, Learning by Advise, Examples, Learning in problem Solving, Symbol Based Learning, Explanation Based Learning, Version Space, ID3 Decision Based Induction Algorithm, Unsupervised Learning, Reinforcement Learning, Supervised Learning: Perceptron Learning, Back propagation Learning, Competitive Learning, Hebbian Learning.

Module-V **(08 Lectures)**

Control systems and components,Robot end effectors,machine vision,Robot programming,Robot languages, Robot applications in manufcaturing,Social issues and future of robotics

Text Books

1. Artificial Intelligence, George F Luger, Pearson Education Publications
2. Mikell P. Groover , Mitchell Weiss , Roger N. Nagel , Nicholas G. Odrey Industrial Robotics: Technology, Programming, and Applications , 1st edition, McGraw-Hill International Edition

Reference Books

1. Artificial Intelligence, Elaine Rich and Knight, Mcgraw-Hill Publications
2. K.S.Fu, R.C Gonzalez, C.S.G.Lee , ROBOTICS , Control, Sensing , Vision and Intelligence , 1st edition, McGraw-Hill International Edition

Course Outcomes:

After successful completion of the course, the students will be able to :

CO1: Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents.

CO2: Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game based techniques to solve them.

CO3: Develop intelligent algorithms for constraint satisfaction problems.

CO4: Estimate the capability to represent various real life problem domains using logic based techniques and use this to perform inference or planning.

CO5: Demonstrate working of robots features, mechanism and applications in real life.

Course Articulation Matrix

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

Program Articulation Matrix row for this Course

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

DISTRIBUTED DATABASE

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

Course Objective:

The course has two objectives.

1. The first is an in-depth study of the classical distributed database management issues such as distribution design, distributed query processing and optimization, and distributed transaction management.
2. The second objective is to study more current distributed database management topics such as pervasive compuitng, Web data management, different distribution models (push versus pull), interoperability and componentization, and data mining on the web.

Module-I: Introductory concepts and design of (DDBMS) (08 Lectures)

Data Fragmentation; Replication; and allocation techniques for DDBMS; Methods for designing and implementing DDBMS, designing a distributed relational database; Architectures for DDBMS: cluster federated, parallel databases and client server architecture.

Module-II: Query processing & Transaction Management (08 Lectures)

Overview Of Query Processing: Query processing problem; Objectives of Query Processing; Complexity of Relational Algebra operations; characterization of Query processors; Layers of Query Processing Introduction To Transaction Management: Definition of Transaction, Properties of Transaction, types of transaction ; Distributed Concurrency Control: Serializability theory; Taxonomy of concurrency control mechanisms; locking bases concurrency control algorithms.

Module-III: Distributed Object Database Management systems (08 Lectures)

Fundamental Object concepts and Object models; Object distribution design; Architectural issues; Object management; Distributed object storage; Object query processing

Module-IV: Current trends & developments related to Distributed database applications technologies (08 Lectures)

Distributed Object/component-based DBMS; Database Interoperability including CORBA; DCOM and Java

Module-V:Remote Method Invocation (08 Lectures)

RMI; Distributed document-based systems; XML and Workflow management. Parallel Database; Mobile database; Multimedia Database; Spatial Database and Web Databases.

Text:

1.Distributed Databases - Principles and Systems; Stefano Ceri; GuiseppePelagatti; Tata McGraw Hill; 1985.

2.Fundamental of Database Systems; Elmasri&Navathe; Pearson Education; Asia

3.Database System Concepts; Korth&Sudarshan; TMH

4.Principles of Distributed Database Systems; M. Tamer Özsu; and Patrick Valduriez Prentice Hall

References:

1.Data Base Management System; Leon & Leon; Vikas Publications

2.Introduction to Database Systems; Bipin C Desai; Galgotia

Course Outcomes

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

CO1	Explain the techniques used for data fragmentation, replication, and allocation during the distributed database design process
CO2	Evaluate simple strategies for executing a distributed query to select the strategy that minimizes the amount of data transfer.
CO3	Explain how the two-phase commit protocol is used to deal with committing a transaction that accesses databases stored on multiple nodes.
CO4	Describe distributed concurrency control based on the distinguished copy techniques and the voting methods.
CO5	Assess the quality and ease of use of data modeling and diagramming tools

1. **Course Articulation Matrix**

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

CO3	3	3	2	3	1	3
CO4	3	3	2	3	1	3
CO5	3	3	2	3	1	3

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

2. **Program Articulation Matrix row for this Course**

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

Service Oriented Architecture

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

Course Objective

1. Learn XML fundamentals.

2. Be exposed to build applications based on XML.
3. Understand the key principles behind SOA.
4. Be familiar with the web services technology elements for realizing SOA.
5. Learn the various web service standards.

Module-I **(**8 Lectures)

Introduction To Xml : XML document structure – Well-formed and valid documents, Namespaces, DTD, XML Schema, X-Files.

Module-II **(**8 Lectures)

Building Xml- Based Applications: Parsing XML – using DOM, SAX, XML Transformation and XSL, XSL Formatting, Modeling Databases in XML.

Module-III **(**8 Lectures)

Service Oriented Architecture: Characteristics of SOA, Comparing SOA with Client-Server and Distributed architectures. Benefits of SOA -- Principles of Service orientation, Service layers.

Module-IV **(**8 Lectures)

Web Services: Service descriptions, WSDL, Messaging with SOAP, Service discovery, UDDI, Message Exchange Patterns, Orchestration, Choreography, WS Transactions.

Module-V **(**8 Lectures)

Building Soa-Based Applications: Service Oriented Analysis and Design, Service Modeling, Design standards and guidelines. Composition – WS-BPEL , WS-Coordination , WS-Policy, WS-Security , SOA support in J2EE.

Text Books:

1. Ron Schmelzer et al. "*XML and Web Services"*, Pearson Education,2002.
2. Thomas Erl, "*Service Oriented Architecture: Concepts, Technology, and Design"*, Pearson Education, 2005.

References

1. Frank P.Coyle, "*XML, Web Services and the Data Revolution*", Pearson Education,2002.
2. Eric Newcomer, Greg Lomow, "*Understanding SOA with Web Services*", Pearson Education,2005.
3. Sandeep Chatterjee and James Webber, "*Developing Enterprise Web Services: An Architect's Guide"*, Prentice Hall,2005.
4. James McGovern, Sameer Tyagi, Michael E.Stevens, Sunil Mathew, "*Java Web Services Architecture"*, Morgan Kaufmann Publishers,2003.

Course Outcomes

1. Infer the XML Schema, Name Space and Document Structure.
2. Build Applications based on XML.
3. Outline the SOA Principles and Service Layers.
4. Develop Web service using Technology elements.
5. Build SOA based applications for intra and inter enterprise applications. Resolve the security issues in XML.

Course Articulation Matrix

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

PATTERN RECOGNITION

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

Course Objectives:

1. The course aims to provide mathematical and statistical techniques and linear classifier of pattern recognition and Machine learning.
2. To become familiar with non-linear classifier used in pattern recognition.
3. To get the ideas of feature selection in pattern recognition and machine learning areas.

4. To enable students to identify, formulate and solve machine learning problems that arise in real life problems.
5. Learn various basic clustering algorithms of pattern recognition.

Syllabus

L-T-P: 3-1-0 Cr.-4

Module 1: (10 Lectures)

Probability Distributions: Binary variables, multinomial variables, The Gaussian distribution, Bayes decision theory, Bayesian Classification for Normal Distributions, Maximum Likelihood Parameter Estimation, Maximum a Posteriori Probability Estimation, Maximum Entropy Estimation, Linear Classifiers: Introduction, Linear Discriminant functions, Least square Methods, Mean Square Estimation Revised

Module 2: (9 Lectures)

Non-Linear Classifiers: Two-Layer Perceptron, Three –Layer Perceptrons, Algorithm based on Exact Classification of the Training Set, The Backpropagation Algorithm, Variations on the Backpropagation Theme, Radial Basis Function Networks (RBF).

Module 3: (8 Lectures)

Feature Selection: Introduction, Pre-processing, Feature selection based on statistical hypothesis testing, The Receiver Operating Characteristics CROC Curve, Feature generation: Introduction, Basic vectors and images, The singular value decomposition

Module 4: (7 Lectures)

Template matching: Introduction, Measure based on Optimal path Searching Techniques,Measures based on Correlations, Context-dependent Classification: Introduction, The Bayesian classifier, Markov chain models, Hidden Markov Models, System evaluation.

Module 5: (6 Lectures)

Clustering Algorithms: Sequential algorithm, Agglomerative algorithm based on matrix theory, Fuzzy clustering algorithm, k-Means, Clustering using Genetic algorithm, Cluster validity: Introduction, Hypothesis testing in cluster validity, Relative criteria,

Text Books:

1. SergiosTheodoridis, Konstantinos Koutroumba,s Pattern Recognition, Elsevier
2. Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer.

Reference Books:

1. Pattern Recognition Principles by J.T. Tou and R.C. Gonzalez, Addison Wesley
2. Pattern Recognition and Image Analysis by Gose, Johnsonbaugh, Jost, PHI

Course Outcomes:

Learner will be able to…

1. Define mathematical and statistical techniques used in pattern recognition
2. Demonstrate basic Non-linear classifier
3. Analyze various feature selection techniques used in pattern recognition
4. Construct machine learning algorithms in real life problems.
5. Implement the various clustering algorithms

Course Articulation Matrix

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

CO5	3	-	3	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