NEW HORIZON COLLEGE OF ENGINEERING

Autonomous College Permanently Affiliated to VTU, Approved by AICTE & UGC
Accredited by NAAC with 'A' Grade, Accredited by NBA

The Trust is a Recipient of Prestigious Rajyotsava State Award 2012 Conferred by the Government of Karnataka
Awarded Outstanding Technical Education Institute in Karnataka-2016
Ring Road, Bellandur Post, Near Marathalli, Bangalore -560 103, INDIA

Academic Year 2020-2021

M. Tech in Computer Science and Engineering

First and Second Semester

Scheme and Syllabus

Batch : 2020 – 2022

SCHEME OF FIRST SEMESTER 2020-2022

S. No	Course code	Course	BOS	Credit distribution			Overall credits	Contact Hours	Marks		
				L	T	P			CIE	SEE	TOTAL
1	19SCS11	ADVANCED OPERATING SYSTEMS	CSE	3	0	0	3	3	50	50	100
2	19SCS12	ARTIFICIAL INTELLIGENCE	CSE	3	0	0	3	3	50	50	100
3	19SCS13	ADVANCED COMPUTER NETWORKS&SECURITY	CSE	3	0	0	3	3	50	50	100
4	19SCS14x	SPECIALIZATION ELECTIVE-1	CSE	4	0	0	4	4	50	50	100
5	19SCS15	HUMAN COMPUTER INTERACTION	CSE	3	0	0	3	3	50	50	100
6	19SCS16	RESEARCH METHODOLOGY & IPR	CSE	2	0	0	2	2	25	25	50
7	19SCS17	MINI PROJECT IN ACN	CSE				2	-	25	25	50
8	19SCL18	ADVANCED OPERATING SYSTEMS LAB	CSE	0	0	2	2	4	25	25	50
Total							22	22	325	325	650

Specialization Elective-I	
Course code	**Course**
19SCS141	OBJECT ORIENTED SOFTWARE ENGINEERING
19SCS142	MULTI CORE ARCHITECTURE AND PROGRAMMING
19SCS143	DATAWAREHOUSING AND DATAMINING
19SCS144	PATTERN RECOGNITION AND IMAGE PROCESSING

SCHEME OF SECOND SEMESTER 2020-2022

S. No	Course code	Course	BOS	Credit distribution			Overall credits	Contact Hours	Marks		
				L	T	P			CIE	SEE	TOTAL
1	19SCS21	ADVANCED ALGORITHMS	CSE	3	0	0	3	3	50	50	100
2	19SCS22	CLOUD COMPUTING	CSE	3	0	0	3	3	50	50	100
3	19SCS23	BIG DATA ANALYTICS	CSE	4	0	0	4	4	50	50	100
4	19SCS24x	SPECIALIZATION ELECTIVE-2	CSE	4	0	0	4	4	50	50	100
5	19SCS25	MACHINE LEARNING	CSE	4	0	0	4	4	50	50	100
6	19SCS26	MINI PROJECT ON CLOUD COMPUTING	CSE				2	-	25	25	50
7	19SCL27	ADVANCED ALGORITHMS LAB	CSE	0	0	2	2	4	25	25	50
Total							22	22	300	300	600

Specialization Elective-2	
Course code	**Course**
19SCS241	SOFTWARE TESTING AUTOMATION
19SCS242	MIDDLEWARE TECHNOLOGIES IN WEB AND MOBILE DOMAIN
19SCS243	SERVICE ORIENTED ARCHITECTURE
19SCS244	PARALLEL ALGORITHMS

SEMESTER 1

ADVANCED OPERATING SYSTEM

Course Code	: 19SCS11	Credits	: 03
L:T:P	: 3:0:0	CIE Marks	: 50
Exam Hours	: 03	SEE Marks	: 50

Course Objectives:

1) To learn the fundamentals of Operating Systems
2) To gain knowledge on Distributed operating system concepts that includes architecture, Mutual exclusion algorithms, Deadlock detection algorithms and agreement protocols
3) To gain insight on to the distributed resource management components viz. the algorithms for implementation of distributed shared memory, recovery and commit protocols
4) To know the components and management aspects of Real time, Mobile operating Systems.

Module 1

Operating System Objectives and Functions, The Evolution of Operating Systems, Major Achievements, Developments Leading to Modern Operating Systems, Microsoft Windows Overview, Traditional UNIX Systems, Modern UNIX Systems, Linux, What is a Process?, Process States, Process Description, Process Control, Execution of the Operating System, Security Issues, UNIX SVR4 Process Management. **9 Hrs**

Module 2

Threads, SMP, and Microkernel, Virtual Memory: Processes and Threads, Symmetric Multiprocessing (SMP), Micro kernels, Windows Vista Thread and SMP Management, Solaris Thread and SMP Management, Linux Process and Thread Management. Hardware and Control Structures, Operating System Software, UNIX and Solaris Memory Management, Linux Memory Management, Windows Vista Memory Management Summary. **9 Hrs**

Module 3

Multiprocessor and Real-Time Scheduling: Multiprocessor Scheduling, Real-Time Scheduling, Linux Scheduling, UNIX PreclsSl) Scheduling, Windows VistaScheduling, Process Migration, Distributed Global States, Distributed Mutual Exclusion, Distributed Deadlock. **9 Hrs**

Module 4

Embedded Operating Systems: Embedded Systems, Characteristics of Embedded Operating Systems, eCOS, TinyOS, Computer Security Concepts, Threats, Attacks, and Assets, Intruders, Malicious Software Overview, Viruses, Worms, and Bots, Rootkits **9 Hrs**

Module 5

Kernel Organization: Using Kernel Services, Daemons, Starting the Kernel, Control in the Machine, Modules and Device Management, MODULE Organization, MODULE Installation and Removal, Process and Resource Management, Running Process Manager, Creating a new Task, IPC and Synchronization, The Scheduler , Memory Manager , The Virtual AddressSpace, The Page Fault Handler , File Management.

The windows NT/2000/XP kernel: Introduction, The NT kernel, Objects , Threads, Multiplication Synchronization,Traps, Interrupts and Exceptions, The NT executive , Object Manager, Process and Thread Manager , Virtual MemoryManager, I/o Manager, The cache Manager, Kernel local procedure calls and IPC, The native API, subsystems. **8 Hrs**

Text Books:

1. William Stallings: Operating Systems: Internals and Design Principles, 6th Edition, Prentice Hall, 2013.
2. Gary Nutt: Operating Systems, 3rd Edition, Pearson, 2014.

Reference Books:

1. Silberschatz, Galvin, Gagne: Operating System Concepts, 8th Edition, Wiley, 2008
2. Andrew S. Tanenbaum, Albert S. Woodhull: Operating Systems, Design and Implementation, 3rdEdition, Prentice Hall, 2006.
3. Pradeep K Sinha: Distribute Operating Systems, Concept and Design, PHI, 2007

Expected Course Outcome:

At the end of the course graduate will be able to:

- Demonstrate the Mutual exclusion, Deadlock detection and agreement protocols of Distributed operating system
- Learn the various resource management techniques for distributed systems
- Identify the different features of real time and mobile operating systems
- Modify existing open source kernels in terms of functionality or features used.
- Demonstrate the shell.
- Demonstrate the Mutual exclusion, Deadlock detection and agreement protocols of Distributed operating system.
- Understand the various virus detection techniques.

ARTIFICIAL INTELLIGENCE

Course Code	:19SCS12	Credits	: 03
L:T:P	: 3:0:0	CIE Marks	: 50
Exam Hours	: 03	SEE Marks	: 50

Course Objectives:

1) To familiarize students with Artificial Intelligence techniques for building well-engineered and efficient intelligent systems.
2) To develop the student's understanding of the issues involved in trying to define and simulate intelligence.
3) To familiarize the student with specific, well known Artificial Intelligence methods, algorithms and results.
4) To provide the student additional experience in the analysis and evaluation of complicated systems.
5) To provide the student with paper and proposal writing experience.

Module 1

Introduction: What is AI? Intelligent Agents: Agents and environment; Rationality; the nature of environment; the structure of agents. Problem-solving: Problem-solving agents; Example problems; Searching for solution; Uninformed search strategies Learning: Forms of Learning; Inductive learning; Learning decision trees; Ensemble learning; Computational learning theory. **9 Hrs**

Module 2

Search strategies, Logical Agents: Informed search strategies; Heuristic functions; On-line search agents and unknown environment. Constraint satisfaction problems; Backtracking search for CSPs, Adversial search: Games; Optimal decisions in games; Alpha-Beta pruning. Knowledge-based agents; Logic; propositional logic Reasoning patterns in propositional logic; Effective Propositional inference; Agents based on propositional logic. AI: Present and Future Agent architectures. **9 Hrs**

Module 3

First-Order Logic, Inference in First-Order Logic: Representation revisited; Syntax and semantics of first-order logic; Using first-order logic; Knowledge engineering in first-order logic. propositional versus first-order inference; Unification and lifting; Forward chaining; Backward chaining; Resolution. **9 Hrs**

Module 4

Knowledge Representation and Planning: Ontological engineering; Categories and objects; Actions, situations and events; Mental events and mental objects; The Internet shopping world; Reasoning systems for categories, Reasoning with default information; Truth

maintenance systems. The planning problem; Planning with state-space approach; Planning graphs; Planning with prepositional logic. **9 Hrs**

Module 5

Uncertainty, Probabilistic Reasoning: Uncertainty: Acting under certainty ;Inference using full joint distributions; Independence; Bayes ' rule and its use; Probabilistic Reasoning: Representing knowledge in an uncertain domain; The semantics of Bayesian networks; Efficient representation of conditional distributions; Exact inference in Bayesian networks; Approximate inference in Bayesian Networks; Extending probability to first-order representations; Other approaches to Uncertain Reasoning. **8 Hrs**

Text Book:

1. Stuart Russel, Peter Norvig: Artificial Intelligence a Modern Approach, 2nd Edition, Pearson Education, 2003.

Reference Books:

1. Elaine Rich, Kevin Knight: Artificial Intelligence, 2nd Edition, and Tat McGraw Hill, 1991.

2. Nils J.Nilsson: Principles of Artificial Intelligence, Elsevier, 1986

Expected Course Outcome:

At the end of the course graduate will be able to:

- understand the history, development and various applications of artificial intelligence
- familiarize with propositional and predicate logic and their roles in logic programming
- understand the programming language Prolog and write programs in declarative programming style
- learn the knowledge representation and reasoning techniques in rule-based systems, case-based systems, and model-based systems
- appreciate how uncertainty is being tackled in the knowledge representation and reasoning process, in particular, techniques based on probability theory and possibility theory (fuzzy logic)
- master the skills and techniques in machine learning, such as decision tree induction, artificial neural networks, and genetic algorithm
- apply and integrate various artificial intelligence techniques in intelligent system development as well as understand the importance of maintaining intelligent systems

ADVANCED COMPUTER NETWORKS& SECURITY

Course Code	: 19SCS13	Credits	: 03
L:T:P	: 3:0:0	CIE Marks	: 50
Exam Hours	: 03	SEE Marks	: 50

Course Objectives:

1) To become familiar with the basics of Computer Networks and learn Network architectures.
2) To learn Concepts of fundamental protocols.
3) To gain the knowledge of internetworking concepts.
4) To understand the knowledge of internetworking concepts in various applications.
5) To acquire knowledge of implementation concepts in congestion control and error detections.
6) To get an overview of security and firewalls.

Module 1

Foundation: Building a Network, Requirements, Perspectives, Scalable Connectivity, Cost-Effective Resource sharing, Support for Common Services, Manageability, Protocol layering, Performance, Bandwidth and Latency, Delay X Bandwidth Product, Perspectives on Connecting, Classes of Links, Reliable Transmission, Stop-and-Wait , Sliding Window, Concurrent Logical Channels. **9 Hrs**

Module 2

Internetworking- I: Switching and Bridging, Datagram's, Virtual Circuit Switching, Source Routing, Bridges and LAN Switches, Basic Internetworking (IP), What is an Internetwork ?, Service Model, Global Addresses, Datagram Forwarding in IP, sub netting and classless addressing, Address Translation(ARP), Host Configuration(DHCP), Error Reporting(ICMP), Virtual Networks and Tunnels **9 Hrs**

Module 3

Internetworking- II: Network as a Graph, Distance Vector(RIP), Link State(OSPF), Metrics, The Global Internet, Routing Areas, Routing among Autonomous systems(BGP), IP Version 6(IPv6), Mobility and Mobile IP. **9 Hrs**

Module 4

End-to-End Protocols: Simple De-multiplexer (UDP), Reliable Byte Stream(TCP), End-to-End Issues, Segment Format, Connecting Establishment and Termination, Sliding Window Revisited, Triggering Transmission, Adaptive Retransmission, Record Boundaries, TCP Extensions, Queuing Disciplines, FIFO, Fair Queuing, TCP Congestion Control, Additive Increase/ Multiplicative Decrease, Slow Start, Fast Retransmit and Fast Recovery.

Congestion Control and Resource Allocation: Congestion-Avoidance Mechanisms, DEC bit, Random Early Detection (RED), Source-Based Congestion Avoidance. The Domain Name System(DNS), Electronic Mail(SMTP, POP, IMAP, MIME),World Wide Web(HTTP), Network Management(SNMP). **9 Hrs**

Module 5

An Overview of Computer Security-Security Services-Security Mechanisms-Security Attacks-Access Control Matrix, Policy-Security policies, Confidentiality policies, Integrity policies and Hybrid policies. Network security Practice: Authentication applications; Kerberos, X.509 Directory Authentication Service, Electronic Mail Security; PGP, S/MIME, IP Security; Web Security, SSL and TLS, SET. System Security: Intruders, Viruses, worms and Related Threats. Firewalls; Firewall Design Principles, Trusted Systems **8 Hrs**

Text Books:

1. Larry Peterson and Bruce S Davis "Computer Networks :A System Approach" 5th Edition, Elsevier -2014
2. Douglas E Comer, "Internetworking with TCP/IP, Principles, Protocols and Architecture" 6th Edition, PHI – 2014
3. Charlie Kaufman, Radia Perlman, Mike Speciner, "Network Security: Private Communication in a PublicWorld", Prentice-Hall, 2002.
4. Wong, Angus, Yeung, Alan "Network Infrastructure Security", Springer, 2009

Reference Books:

1. Uyless Black "Computer Networks, Protocols , Standards and Interfaces" 2nd Edition - PHI
2. Behrouz A Forouzan"TCP/IP Protocol Suite" 4th Edition – Tata McGraw-Hill
3. William Stallings, "Cryptography and Network Security: Principles and Practices", Third Edition, Pearson Education, 2006.
4. Matt Bishop ,"Computer Security art and science ", Second Edition, Pearson Education, 2002
5. Wade Trappe and Lawrence C. Washington, "Introduction to Cryptography with Coding Theory" Second Edition, Pearson Education, 2007 Jonathan Katz, and Yehuda Lindell, Introduction to Modern Cryptography, CRC Press, 2007 39
6. Douglas R. Stinson, "Cryptography Theory and Practice", Third Edition, Chapman & Hall/CRC, 2006
7. Wenbo Mao, "Modern Cryptography – Theory and Practice", Pearson Education, First Edition, 2006.
8. Network Security and Cryptography, Menezes Bernard, Cengage Learning, New Delhi, 2011

Man Young Rhee, Internet Security, Wiley, 2003

Expected Course Outcome:

At the end of the course graduate will be able to:

- List and classify network services, protocols and architectures, explain why they are layered.

- Choose key Internet applications and their protocols, and apply to develop their own applications (e.g. Client Server applications, Web Services) using the sockets API.
- Explain develop effective communication mechanisms using techniques like connection establishment, queuing theory, recovery Etc.
- Explain various congestion control techniques.

OBJECT ORIENTED SOFTWARE ENGINEERING

Course Code	: 19SCS141	Credits	: 04
L:T:P	: 4:0:0	CIE Marks	: 50
Exam Hours	: 03	SEE Marks	: 50

Course Objectives:

1) To learn the fundamentals of OO Software Engineering
2) To learn about software prototyping, analysis and design
3) To learn the various OO Design models and Testing Objects
4) To apply principles to case studies
5) To learn modelling with UML along with focussing on users and their tasks

Module-1

INTRODUCTION- The nature of software, software engineering and as branch of engineering profession, stakeholders in software engineering, software quality, software engineering projects. Software Engineering Paradigms, Software Development process models, Project and Process, Project management, Process and Project metrics, Object Oriented concepts and Principles **9 Hrs**

M**odule-2**

PLANNING and SCHEDULING- Software prototyping, Software project planning, Scope, Resources, Software Estimation, Empirical Estimation Models, Planning, Risk Management, Software Project Scheduling, Object Oriented Estimation and Scheduling. **9 Hrs**

M**odule-3**

ANALYSIS and DESIGN- Analysis Modeling, Data Modeling, Functional Modeling and Information Flow, Behavioral Modeling, Structured Analysis, Object Oriented Analysis, Domain Analysis, Object Oriented Analysis process, Object Relationship Model, Object Behavior Model. Design Concepts and Principles, Design Process, Design Concepts, Modular Design, Design Effective Modularity, Introduction to Software Architecture, Data Design, Transform Mapping, Transaction Mapping, OOD, Design System design process, Object design process, Design Patterns. **9 Hrs**

Module-4

DESIGN MODELS and TESTING- Top-Down, Bottom-Up, Object oriented product Implementation and Integration. Software testing methods, White Box, Basis Path-Control Structure, Black Box, Unit Testing, Integration testing, Validation and System testing. Testing OOA and OOD models, Object oriented testing strategies. Maintenance process, System documentation, program evolution dynamics, Maintenance costs, Maintainability measurement, Case Studies **9Hrs**

Module-5

UML- Modeling with classes UML, essentials of UML class diagrams, associations and multiplicity, generalization, instance diagrams. **Focusing on users and their tasks** User-centred design, characteristics of users, developing use case models of systems, the basics of user interface design, usability principles, and evaluation users' interfaces **8 Hrs**

Text Books:

- Timothy C. Lethbridge & Robert Langaniere, "Object-Oriented Software Engineering Practical software development using UML and Java", Mcgraw-Hill, 2007.
- Bernd Bruegge & Allen H. Dutoit, "Object-Oriented Software Engineering", 3rd Edition, Prentice Hall, 2009.
- Ivar Jacobson, "Object-Oriented Software Engineering", Pearson Education, 2009.

Reference Books:

- Stephen R. Schach, "Object-Oriented Classical Software Engineering", Mc Graw Hill, 2010.
- Yogesh Singh, "Object-Oriented Software Engineering", 2012.

Expected Course Outcome: At the end of the course graduate will be able to:

- Apply the principles of object oriented techniques for software development

MULTI-CORE ARCHITECTURE AND PROGRAMMING

Course Code	: 19SCS142	Credits	: 04
L:T:P	: 4:0:0	CIE Marks	: 50
Exam Hours	: 03	SEE Marks	: 50

Course Objectives:

- Understand the challenges in parallel and multithreading programming
- Learn about the various parallel programming paradigms and solutions

Module-1

MULTI-CORE PROCESSORS

Single core to Multi-core architectures – SIMD and MIMD systems – Interconnection networks - Symmetric and Distributed Shared Memory Architectures – Cache coherence - Performance Issues – Parallel program design **8 Hrs**

Module-2

PARALLEL PROGRAM CHALLENGES

Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes, locks, semaphores, barriers) – deadlocks and livelocks – communication between threads (condition variables, signals, message queues and pipes) **9 Hrs**

Module-3

SHARED MEMORY PROGRAMMING WITH OpenMP

OpenMP Execution Model – Memory Model – OpenMP Directives – Work-sharing Constructs - Library functions – Handling Data and Functional Parallelism – Handling Loops - Performance Considerations **9 Hrs**

Module-4

DISTRIBUTED MEMORY PROGRAMMING WITH MPI

MPI program execution – MPI constructs – libraries – MPI send and receive – Point-to-point and Collective communication – MPI derived data types – Performance evaluation **9 Hrs**

Module-5

PARALLEL PROGRAM DEVELOPMENT

Case studies - n-Body solvers – Tree Search – OpenMP and MPI implementations and comparison **9 Hrs**

Text Books:

- Peter S. Pacheco, “An Introduction to Parallel Programming”, Morgan-Kauffman/Elsevier, 2011.
- Darryl Gove, “Multicore Application Programming for Windows, Linux, and Oracle Solaris”, Pearson, 2011 (unit 2)
- Michael J Quinn, “Parallel programming in C with MPI and OpenMP”, Tata McGraw Hill, 2003. 2. Shameem Akhter and Jason Roberts, “Multi-core Programming”, Intel Press, 2006.

Reference Books:

- Shameem Akhter and Jason Roberts, “Multi-core Programming”, Intel Press, 2006.
- John L. Hennessey and David A. Patterson, “ Computer architecture – A quantitative approach”, Morgan Kaufmann / Elsevier Publishers, 4th edition, 2007.
- https://www.open-mpi.org/ and http://www.openmp.org/

Expected Course Outcome: At the end of the course graduate will be able to:

- understand and interpret multi core processor concepts and parallel programming challenges
- Develop the programming solutions using OpenMP

DATA WAREHOUSING & DATA MINING

Course Code	: 19SCS143	Credits	: 04
L:T:P	: 4:0:0	CIE Marks	: 50
Exam Hours	: 03	SEE Marks	: 50

Course Objectives:

- To expose the students to the concepts of Data warehousing Architecture and Implementation
- To Understand Data mining principles and techniques and Introduce DM as a cutting edge business intelligence
- To learn to use association rule mining for handling large data
- To understand the concept of classification for the retrieval purposes
- To know the clustering techniques in details for better organization and retrieval of data.

Module 1

Introduction and Data Pre-processing: Why data mining, What is data mining, What kinds of data can be mined, What kinds of patterns can be mined, Which Technologies Are used, Which kinds of Applications are targeted, Major issues in data mining. Data Pre-processing: An overview, Data cleaning, Data integration, Data reduction, Data transformation and data discretization. **9 Hrs**

Module 2

Data warehousing and online analytical processing: Data warehousing: Basic concepts, Data warehouse modelling: Data cube and OLAP, Data warehouse design and usage, Data warehouse implementation, Data generalization by attribute-oriented induction **9 Hrs**

Module 3

Classification: Basic Concepts: Basic Concepts, Decision tree induction, Bays Classification Methods, Rule-Based classification, Model evaluation and selection, Techniques to improve classification accuracy **9 Hrs**

Module 4

Cluster Analysis: Basic concepts and methods: Cluster Analysis, Partitioning methods, Hierarchical Methods,Density-based methods, Grid-Based Methods, Evaluation of clustering. **9 Hrs**

Module 5

Data mining trends and research frontiers: Mining complex data types, other methodologies of data mining,Data mining applications, Data Mining and society. **8 Hrs**

Text Book:

1. Jiawei Han, MichelineKamber, Jian Pei: Data Mining Concepts and Techniques, ELSEVIER(MK)
3rd edition 2012.

Reference Books:

1. Alex Berson and Stephen J. Smith "Data Warehousing, Data Mining & OLAP", Tata McGraw –
Hill Edition, Tenth Reprint 2007.
2. K.P. Soman, ShyamDiwakar and V. Ajay "Insight into Data mining Theory and Practice", EasterEconomy Edition, Prentice Hall of India, 2006.
3. G. K. Gupta "Introduction to Data Mining with Case Studies", Easter Economy Edition, PrenticeHall of India, 2006.
4. Pang-Ning Tan, Michael Steinbach and Vipin Kumar "Introduction to Data Mining", PearsonEducation, 2007.

Expected Course Outcome:

At the end of the course graduate will be able to:

- Store voluminous data for online processing
- Pre-process the data for mining applications
- Apply the association rules for mining the data
- Design and deploy appropriate classification techniques
- Cluster the high dimensional data for better organization of the data
- Discover the knowledge imbibed in the high dimensional system

PATTERN RECOGNITION AND IMAGE PROCESSING

Course Code	: 19SCS144	Credits	: 04
L:T:P	: 4:0:0	CIE Marks	: 50
Exam Hours	: 03	SEE Marks	: 50

Course Objectives:

- Ability to process images and identify patterns from images.
- Capacity to adapt and innovate in pattern recognition and image processing problems to various other domains.
- Develop a system to process images for engineering requirements.
- Ability to think logically and apply to technical problems in computing systems.
- Provide technical solutions involving images and data with patterns by providing improved functions.

Module-1

INTRODUCTION TO PATTERN RECOGNITION

Introduction – Definitions, Pattern, image classification, Decision surfaces, Different Paradigms of Pattern Recognition, Representations of Patterns and Classes, Metric and non-metric proximity measures, Feature extraction, Different approaches to Feature Selection **8 Hrs**

Module-2

FEATURE SELECTION AND CLUSTERING

Feature selection: Divergence analysis, Bhattacharya and Mahalanobis distance, JM distance, and separability analysis.
Clustering: K-means clustering, Clustering Large datasets, Combination of Classifiers, Applications – Document Recognition **9 Hrs**

Module-3

CLASSIFICATION

Nearest Neighbour Classifier and variants, Efficient algorithms for nearest neighbour classification, Different Approaches to Prototype Selection, Bayes Classifier, Decision Trees, Linear Discriminant Function, Support Vector Machines, Classification accuracy estimation, Naïve measure, Kappa, Tau indices. **9 Hrs**

Module-4

IMAGE PROCESSING:

IMAGE ENHANCEMENT: Image histogram, point operations and look-up tables, False Color Composite (FCC), Density slicing, contrast enhancements, histogram equalization, and

histogram specification. Spatial and frequency filtering, linear and nonlinear filters, smoothing, sharpening, High/Low pass filters.

IMAGE SEGMENTATION : Segmentation concepts, point, line and Edge detection, Thresholding, region based segmentation **9 Hrs**

Module-5

IMAGE TRANSFORMATIONS:

Principal component analysis (standardized / unstandardized). Tasseled cap transformation, band ratios and vegetation indices, change detection.

IMAGE COMPRESSION: fundamentals – coding Redundancy, spatial and temporal redundancy. Compression models : Lossy and Lossless, Huffmann coding, Arithmetic coding, LZW coding, run length coding, Bit Plane coding, transform coding, predictive coding , wavelet coding, JPEG standards **9 Hrs**

Text Books:

- Devi V.S.; Murty, M.N.(2011) Pattern Recognition:An Introduction, Universities Press, Hyderabad.
- R. O. Duda,P.E. Hart and D. G.Stork,Pattern Classification, Wiley, 2000.
- Gonzaleze and Woods ,"Digital Image Processing ", 3rd edition , Pearson

Reference Books:

- Robert J.Schalkoff, Pattern Recognition Statistical, Structural and Neural Approaches, John Wiley & Sons Inc., New York, 1992.
- Tou and Gonzales, Pattern Recognition Principles, Wesley Publication Company, London, 1974.
- Duda R.O., and Har P.E., Pattern Classification and Scene Analysis, Wiley, New York, 1973.
- Morton Nadier and Eric Smith P., Pattern Recognition Engineering, John Wiley & Sons, New York, 1993.

Expected Course Outcome: At the end of the course graduate will be able to:

- Ability to process images and identify patterns from images.
- Capacity to adapt and innovate in pattern recognition and image processing problems to various other domains.
- Develop a system to process images for engineering requirements.
- Ability to think logically and apply to technical problems in computing systems.
- Provide technical solutions involving images and data with patterns by providing improved functions.

HUMAN COMPUTER INTERACTION

Course Code	: 19SCS15	Credits	: 03
L:T:P	: 3:0:0	CIE Marks	: 50
Exam Hours	: 03	SEE Marks	: 50

Course Objectives:

1) Determine the need for computers and evaluate the use of computers
2) identify the stages in software engineering that need to be modified for effectiveness of interacting with computers
3) discover the various models that can be used for designing systems
4) evaluate the design techniques by applying the apt statistical approach
5) design dialogue for representation to computers

Module 1

DESIGN PROCESS: Humans – Information process – Computer – Information Process – Differences and Similarities between them – Need for Interaction – Models – Ergonomics – Style – Context –Paradigms – Designing of Interactive systems – Usability – Paradigm shift – Interaction design basics – Design Process – Scenarios – Users need – Complexity of design **9 Hrs**

Module 2

DESIGN AND EVALUATION OF INTERACTIVE SYSTEMS: Software Process – Usability engineering– Issue based Information systems – Iterative design practices – Design rules – maximum usability –Principles – Standards and guidelines – design patterns – Programming Tools – Windowing systems– Interaction tool kit – User Interface management system – Evaluation techniques – evaluation design – Evaluating implementations – Observational Methods **9 Hrs**

Module 3

MODELS: Universal design principles – Multimodal systems – User Support – Presentation and Implementation Issues – types – requirements – approaches – Cognitive model – Hierarchical model – Linguistic model – physical and device models – Socio-technical models – communication and Collaboration models – Task models – Task analysis and design **9 Hrs**

Module 4

EXPERIMENTAL DESIGN AND STATISTICAL ANALYSIS OF HCI: Basic Design structure – Single independent variable – multiple independent variable – factorial design – split-plot design – random errors – experimental procedure – Statistical analysis – T tests – Analysis of Variance test –Regression – Chi-Square test – Survey – Probabilistic sampling – Non-probabilistic sampling –developing survey questions **9 Hrs**

Module 5

THEORIES: Dialogue notations and design – Dialogue need – dialogue design notations – Graphical– Textual - representing dialogue – formal descriptions – Dialogue analysis – System models –Interaction models – relationship with dialogue – Formalisms – Formal notations – Interstitial behavior – Virtual reality – Modeling rich interaction – Status Event analysis – Properties – Rich contexts – Sensor-based systems – Groupware – Applications – Ubiquitous computing – Virtual reality **8 Hrs**

Text Books:

1) Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale Human Computer Interaction, 3rd Edition Prentice Hall, 2004.
2) Jonathan Lazar Jinjuan Heidi Feng, Harry Hochheiser, Research Methods in Human-Computer Interaction, Wiley, 2010.

Reference Books:

1) Ben Shneiderman and Catherine Plaisant Designing the User Interface: Strategies for Effective Human-Computer Interaction (5th Edition, pp. 672, ISBN 0-321-53735-1, March 2009), Reading, MA: Addison-Wesley Publishing Co.

Expected Course Outcome: At the end of the course graduate will be able to:

- explain why it is important to design interactive products that are usable
- define key terms used in interaction design
- explain key theories used in the design of interactive products
- explain the importance of iteration, evaluation and prototyping in interaction design

RESEARCH METHODOLOGY AND IPR

Course Code	: 19SCS16	Credits	: 02
L:T:P	: 2:0:0	CIE Marks	: 25
Exam Hours	: 03	SEE Marks	: 25

Course objectives:

- To give an overview of the research methodology and explain the technique of defining a research problem
- To explain functions of the literature review in research.
- To explain carrying out a literature search, its review, developing theoretical and conceptual frameworks and writing a review.
- To explain various research designs and their characteristics.
- To explain the details of sampling designs, and different methods of data collections.
- To explain the art of interpretation and the art of writing research reports.
- To explain various forms of the intellectual property, its relevance and business impact in the changing global business environment.
- To discuss leading International Instruments concerning Intellectual Property Rights.

Module-1	**Teaching Hours**
Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India.	**05**
Bloom's Taxonomy Level	L_1 – Remembering, L_2 – Understanding.
Module-2	
Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration, **Reviewing the literature:** Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.	**05**
Bloom's Taxonomy Level	L_1 – Remembering, L_2 – Understanding.
Module-3	
Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.	**05**

Design of Sample Surveys: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs,

Bloom's Taxonomy Level L_1 – Remembering, L_2 – Understanding.

Module-4

Data Collection: Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method, **05**

Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout

Interpretation and Report Writing (continued): of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.

Bloom's Taxonomy Level L_1 – Remembering, L_2 – Understanding, L_3 – Applying, L_4 – Analysing.

Module-5

Intellectual Property: The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999,The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varieties and Farmers' Rights Act, 2001,The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992, Competing Rationales for Protection of IPRs, Leading International Instruments Concerning IPR, World Intellectual Property Organization (WIPO),WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition, Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Berne Convention for the Protection of Literary and Artistic Works, Basic Principles, Duration of Protection, Trade Related Aspects of Intellectual Property Rights(TRIPS) Agreement, Covered under TRIPS Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS, Copyright and Related Rights, Trademarks, Geographical indications, Industrial Designs, Patents, Patentable Subject Matter, Rights Conferred, Exceptions, Term of protection, Conditions on Patent Applicants, Process Patents, Other Use without Authorization of the Right Holder, Layout-Designs of Integrated Circuits, Protection of Undisclosed Information, Enforcement of Intellectual Property Rights, UNSECO **05**

Bloom's Taxonomy Level L_1 – Remembering, L_2 – Understanding, L_3 – Applying, L_4 – Analyzing.

Course outcomes:

At the end of the course the student will be able to:

- Discuss research methodology and the technique of defining a research problem
- Explain the functions of the literature review in research, carrying out a literature search, developing theoretical and conceptual frameworks and writing a review.
- Explain various research designs and their characteristics.
- Explain the art of interpretation and the art of writing research reports

Textbooks

1	Research Methodology: Methods and Techniques	C.R. Kothari, Gaurav Garg	New Age International	4th Edition, 2018
2	ResearchMethodologyastep-by-stepguideforbeginners. (For the topic Reviewing the literature under module 2)	Ranjit Kumar	SAGE PublicationsLtd	3rd Edition, 2011
3	Study Material (For the topic Intellectual Property under module 5)	Professional Programme Intellectual Property Rights, Law and Practice, The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament, September 2013		

Reference Books

1	Research Methods: the concise knowledge base	Trochim	Atomic Dog Publishing	2005
2	Conducting Research Literature Reviews: From the Internet to Paper	Fink A	Sage Publications	2009

MINI PROJECT in ACN

Course Code	: 19SCS17	Credits:	02
L:T:P	: 0:0:0	CIE Marks:	25
Exam Hours	: 03	SEE Marks:	25

The student shall be capable of identifying a problem related to the stream of Advanced Computer Networks and Security and carry out a mini project on the problem defined. Each student is expected to do the mini project individually. The code developed towards the project will be reviewed by a panel of experts during the course of the semester. Plagiarized projects will automatically get an **"F" GRADE** and the student will be liable for further disciplinary action. At the completion of a project the student will submit a project report, which will be evaluated by duly appointed examiner(s).

Sample Mini project includes:

- Network Traffic
- Data Encoding
- Authentication
- Integration with relevance

ADVANCED OPERATING SYSTEM LAB

Course Code	: 19SCL18	Credits	: 02
L:T:P	: 0:0:2	CIE Marks	: 25
Exam Hours	: 03	SEE Marks	: 25

Note: The following programs can be executed on Java/C#/ any equivalent language or tool with suitable platform.

1) Design and Develop a shell that should support at least 20 commands.
2) Design and develop a program to implement lazy buddy system algorithm.
3) Write a multi-class multithreaded program that simulates multiple sleeping barbers, all in one barbershop that has a finite number of chairs in the waiting room. Each customer is instantiated from a single customer class; each barber is instantiated from a single Barber class.
4) Use ECOS operating system to develop a program for controlling accessing to a pool of resources using mutexes and condition variables.
5) Design and develop a program to realize the virus classification, such as boot sector infector, file infector and macro virus.

SEMESTER 2

ADVANCED ALGORITHMS

Course Code	: 19SCS21	Credits	: 03
L:T:P	: 3:0:0	CIE Marks	: 50
Exam Hours	: 03	SEE Marks	: 50

Course Objectives:

- To introduce and practice advanced algorithms and programming techniques necessary for developing sophisticated computer application programs
- To get accustomed with various graph algorithms and polynomials.
- Understand and implement various string matching algorithms.
- Develop the skills to design and implement efficient programming solutions to various problems

Module 1

Review of Analysis Techniques: Growth of Functions: Asymptotic notations; Standard notations and common functions; Recurrences and Solution of Recurrence equations- The substitution method, The recurrence – tree method, The master method; Amortized Analysis: Aggregate, Accounting and Potential Methods. **9 Hrs**

Module 2

Graph Algorithms: Bellman - Ford Algorithm; Single source shortest paths in a DAG; Johnson's Algorithm for sparse graphs; Flow networks and Ford-Fulkerson method; Maximum bipartite matching.

Polynomials and the FFT: Representation of polynomials; The DFT and FFT; Efficient implementation of FFT. **9 Hrs**

Module 3

Number -Theoretic Algorithms: Elementary notions; GCD; Modular Arithmetic; Solving modular linear equations; The Chinese remainder theorem; Powers of an element; RSA cryptosystem; Primality testing; Integer factorization. **9 Hrs**

Module 4

String-Matching Algorithms: Naïve string Matching; Rabin - Karp algorithm; String matching with finite automata; Knuth-Morris-Pratt algorithm; Boyer – Moore algorithms. **9 Hrs**

Module 5

Probabilistic and Randomized Algorithms: Probabilistic algorithms; Randomizing deterministic algorithms, Monte Carlo and Las Vegas algorithms; Probabilistic numeric algorithms. **8 Hrs**

Text Books:

1. T. H Cormen, C E Leiserson, R L Rivest and C Stein: Introduction to Algorithms, 3rd Edition, Prentice-Hall of India, 2010.
2. Kenneth A. Berman, Jerome L. Paul: Algorithms, Cengage Learning, 2002.

Reference Books:

1. Ellis Horowitz, SartajSahni, S.Rajasekharan: Fundamentals of Computer Algorithms, 2nd Edition, Universities press, 2007.

Expected Course Outcome: At the end of the course graduate will be able to:

- Design and apply iterative and recursive algorithms.
- Design and implement optimization algorithms in specific applications.
- Design appropriate shared objects and concurrent objects for applications.
- Design and apply graph search algorithms.
- Design and implement string matching algorithms.
- Design modular linear equation algorithms.

CLOUD COMPUTING

Course Code	: 19SCS22	Credits	: 03
L:T:P	: 3:0:0	CIE Marks	: 50
Exam Hours	: 03	SEE Marks	: 50

Course Objectives:

1. To learn how to use Cloud Services.
2. To implement Virtualization
3. To implement Task Scheduling algorithms.
4. Apply Map-Reduce concept to applications.
5. To build Private Cloud.

Module 1

Introduction, Cloud Infrastructure

Cloud computing, Cloud computing delivery models and services, Ethical issues, Cloud vulnerabilities, Cloud computing at Amazon, Cloud computing the Google perspective, Microsoft Windows Azure and online services, Open-source software platforms for private clouds, Cloud storage diversity and vendor lock-in, Energy use and ecological impact, Service level agreements, User experience and software licensing. Exercises and problems. **9 Hrs**

Module 2

Cloud Computing: Application Paradigms.

Challenges of cloud computing, Architectural styles of cloud computing, Workflows: Coordination of multiple activities, Coordination based on a state machine model: The Zookeeper, The Map Reduce programming model, A case study: The GrepTheWeb application , Cloud for science and engineering, High-performance computing on a cloud, Cloud computing for Biology research, Social computing, digital content and cloud computing. **9 Hrs**

Module 3

Cloud Resource Virtualization.

Virtualization, Layering and virtualization, Virtual machine monitors, Virtual Machines, Performance and Security Isolation, Full virtualization and paravirtualization, Hardware support for virtualization, Case Study: Xen a VMM based paravirtualization, Optimization of network virtualization, vBlades, Performance comparison of virtual machines, The dark side of virtualization, Exercises and problems. **8 Hrs**

Module 4

Cloud Resource Management and Scheduling.

Policies and mechanisms for resource management, Application of control theory to task scheduling on a cloud, Stability of a two-level resource allocation architecture, Feedback control based on dynamic thresholds, Coordination of specialized autonomic performance managers, A utility-based model for cloud-based Web services, Resourcing bundling: Combinatorial auctions for cloud resources, Scheduling algorithms for computing clouds, Fair queuing, Start-time fair queuing, Borrowed virtual time, Cloud scheduling subject to deadlines, Scheduling Map Reduce applications subject to deadlines, Resource management and dynamic scaling, Exercises and problems.

9 Hrs

Module 5

Cloud Security, Cloud Application Development.

Cloud security risks, Security: The top concern for cloud users, Privacy and privacy impact assessment, Trust, Operating system security, Virtual machine Security, Security of virtualization, Security risks posed by shared images, Security risks posed by a management OS, A trusted virtual machine monitor, Amazon web services: EC2 instances, Connecting clients to cloud instances through firewalls, Security rules for application and transport layer protocols in EC2, How to launch an EC2 Linux instance and connect to it, How to use S3 in java, Cloud-based simulation of a distributed trust algorithm, A trust management service, A cloud service for adaptive data streaming, Cloud based optimal FPGA synthesis .Exercises and problems. **9 Hrs**

Text Book:

1. Dan C Marinescu: Cloud Computing Theory and Practice. Elsevier(MK) 2013.

REFERENCES:

1. Rajkumar Buyya , James Broberg, Andrzej Goscinski: Cloud Computing Principles and Paradigms, Willey 2014.
2. John W Rittinghouse, James F Ransome:Cloud Computing Implementation, Management and Security, CRC Press 2013.

Expected Course Outcome: At the end of the course graduate will be able to:

1.Demonstrate and experiment simple Cloud Applications
2.Apply resource allocation, scheduling algorithms.
3. Implement Map-Reduce concept.
4. Create virtual machines from available physical resources.
5. Setup a private cloud.
6. Familiarize with Open Stack.

BIG DATA ANALYTICS

Course Code	: 19SCS23	Credits	: 04
L:T:P	: 4:0:0:0	CIE Marks	: 50
Exam Hours	: 03	SEE Marks	: 50

Course Objectives:

1) To explore the fundamental concepts of big data analytics
2) To learn to analyse the big data using intelligent techniques.
3) To understand the various search methods and visualization techniques.
4) To learn to use various techniques for mining data stream.
5) To understand the applications using Map Reduce Concepts.

Module 1

INTRODUCTION TO BIG DATA: Introduction to BigData Platform – Challenges of Conventional Systems - Intelligent data analysis – Nature of Data - Analytic Processes and Tools - Analysis vs Reporting - Modern Data Analytic Tools - Statistical Concepts: Sampling Distributions - ReSampling, Statistical Inference - Prediction Error.
9 Hrs

Module 2

MINING DATA STREAMS: Introduction To Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real time Analytics , Platform(RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.
9 Hrs

Module 3

HADOOP: History of Hadoop - The Hadoop Distributed File System – Components of Hadoop - Analyzing the Data with Hadoop - Scaling Out - Hadoop Streaming - Design of HDFS - Java interfaces to HDFS Basics - Developing a Map Reduce Application - How Map Reduce Works - Anatomy of a Map Reduce Job run – Failures - Job Scheduling - Shuffle and Sort Task execution - Map Reduce Types and Formats - Map Reduce Feature.
9 Hrs

Module 4

HADOOP ENVIRONMENT: Setting up a Hadoop Cluster - Cluster specification - Cluster Setup and Installation – Hadoop Configuration - Security in Hadoop - Administering Hadoop – HDFS - Monitoring – Maintenance – Hadoop benchmarks - Hadoop in the cloud.
9 Hrs

Module 5

FRAMEWORKS: Applications on Big Data Using Pig and Hive – Data processing operators in Pig – Hive services – HiveQL – Querying Data in Hive - fundamentals of HBase and ZooKeeper - IBM InfoSphereBigInsights and Streams. Visualizations - Visual data analysis

techniques, interaction techniques; Systems and applications. **8 Hrs**

Text Books:

1. Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer, 2007.
2. Tom White “Hadoop: The Definitive Guide” Third Edition, O’reilly Media, 2012.
3. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, “Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data”, McGrawHill Publishing, 2012
4. AnandRajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2012.
5. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, JohnWiley & sons, 2012.
6. Michael Minelli (Author), Michele Chambers (Author), AmbigaDhiraj (Author) , Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses, Wiley Publications,2013
7. Zikopoulos, Paul, Chris Eaton, Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data, Tata McGraw Hill Publications, 2011

Reference Books:

1. Glenn J. Myatt, “Making Sense of Data”, John Wiley & Sons, 2007
2. PeteWarden, “Big Data Glossary”, O’Reilly, 2011.
3. Jiawei Han, MichelineKamber “Data Mining Concepts and Techniques”, Second Edition, Elsevier, Reprinted 2008.
4. Da Ruan, Guoquing Chen, Etienne E.Kerre, GeertWets, Intelligent Data Mining, Springer, 2007
5. Paul Zikopoulos, Dirk deRoos , Krishnan Parasuraman , Thomas Deutsch , James Giles , David Corrigan , Harness the Power of Big Data The IBM Big Data Platform, Tata McGraw Hill Publications, 2012

Expected Course Outcome:

At the end of the course graduate will be able to:

- Work with big data platform
- Analyze the big data analytic techniques for useful business applications.
- Design efficient algorithms for mining the data from large volumes.
- Analyze the HADOOP and Map Reduce technologies associated with big data analytics

SOFTWARE TESTING AUTOMATION

Course Code: 19SCS241	Credits : 04
L:T:P : 4:0:0	CIE Marks : 50
Exam Hours: 03	SEE Marks : 50

Course Objectives:

1) Recognize the software quality assurance and classify the software quality factors.
2) Understand the contract reviews for project development and quality plan.
3) Discuss the various types of software testing and metrics for testing.
4) Apply the formal method for the test generation
5) Use combinatorial design for test design process.

Module 1

Introduction on software quality: Software quality – definition, Software quality assurance – definition and objectives, Software quality assurance and software engineering, **Software quality factors:** Classifications of software requirements into software quality factors, Product operation, Product revision, Product transition, Alternative models of software quality factors, The components of the software quality assurance system – Overview.

9Hrs

Module 2

Contract Review: The contract review process and its stages, Contract review objectives, Implementation of a contract review, Contract review subjects, Contract reviews for internal projects, Development and quality plans, Reviews, Objectives, Formal design reviews, Peer reviews, A comparison of team review methods, Expert opinions. **9Hrs**

Module 3

Insight of Software Testing: Humans, Errors and Testing, Requirements, Behavior and correctness. Correctness versus Reliability, Testing and debugging, Test metrics, Testing and Verification, Static testing, Types of testing.

9Hrs

Module 4

Test Generation from Requirements: Introduction, The test selection problem, Equivalence partitioning, Boundary value analysis and category partition method. **Test Generation from Finite State Models:**SW design and testing, Finite state model, Conformance testing, Fault model, Characterization test, W method and WP method. **9Hrs**

Module 5

Test Generation from Combinatorial Designs: Combinatorial designs, A combinatorial test Design process, Fault model, Regression testing: What is RT? , RT process, RTS the problem, Selecting RT, Test selection using execution trace, TS using dynamic slice, Scalability of TS algorithms, Test minimization, Test prioritization, Tools for RT. **9Hrs**

Text books:

1. Elisabeth Hendrickson **,"Explore It quality Assurance",** -2015
2. Daniel Galin, Pearson**,"Software quality assurance-from theory to implementation",** 2009.(U1)
3. CemKaner, "**Lesson learned in Software Testing**", James Beach-2015

Reference books:

1. Mordechei Ben – Menachem, Garry S. Marlis ,"**Software Quality**", Thomson
2. Srinivasan D, GopalaswamyRamesh **," Software Testing- Principles and practices",** Pearson, 2006
3. Alan C Gillies, "**Software Quality Theory and Management**", 2nd Edition, Cenagage Learning, 2003

MIDDLEWARE TECHNOLOGIES IN WEB AND MOBILE DOMAIN

Course Code	: 19SCS242	Credits	: 04
L:T:P	: 4:0:0	CIE Marks	: 50
Exam Hours	: 03	SEE Marks	: 50

Course Objectives:

1) Understand Distributed systems design and implementation
2) Understand existing Distributed Technologies
3) Use Middleware to Build Distributed Applications
4) Understand Middleware Interoperability
5) Understand Web services architectures

Module-1

INTRODUCTION:

Moving to e-business, what is IT architecture? Why is this different from what we did before? Rewrite or evolve? , Who develops the architecture? Early days, Preliminaries, Remote procedure calls, Remote database access, Distributed transaction processing, Message queuing, Message queuing versus distributed transaction processing, what happened to all this technology?

OBJECTS, COMPONENTS, AND THE WEB:

Using object middleware, Transactional component middleware, COM, EJB, Final comments on TCM, Internet Applications, WEB SERVICES: Service concepts, Web services, and Using Web services: A pragmatic approach. **9 Hrs**

Module-2

A TECHNICAL SUMMARY OF MIDDLEWARE:

Middleware elements, The communications link, The middleware protocol, The programmatic interface, Data presentation, Server control, Naming and directory services, Security, System management, Comments on Web services, Vendor architectures, Vendor platform architectures, Vendor-distributed architectures, Using vendor architectures, Positioning, Strawman for user target architecture, Marketing, Implicit architectures, Middleware interoperability. **9 Hrs**

Module-3

USING MIDDLEWARE TO BUILD DISTRIBUTED APPLICATIONS:

What is middleware for? Support for business processes, Information retrieval, Collaboration, Tiers, The presentation tier, The processing tier, The data tier, Services versus tiers, Architectural choices, Middleware bus architectures, Hub architectures, Web services architectures, Loosely coupled versus tightly coupled. **9 Hrs**

Module-4

SECURITY:

What security is needed, Traditional distributed system security, Web services security, Architecture and security.

APPLICATION DESIGN AND IT ARCHITECTURE: Problems with today's design approaches, Design up front or as needed?, The role of business rules, Existing systems, Reuse, Silo and monolithic development, The role of architecture, Levels of design, Reconciling design approaches. **9 Hrs**

Module-5

IMPLEMENTING BUSINESS PROCESSES:

What is a process? Business processes, Information and processes, Architecture process patterns, Clarification and analysis, Error Handling, Timing, Migration, Flexibility. **8 Hrs**

Text Books:

- Chris Britton and Peter Eye, *"IT Architectures and Middleware: Strategies for Building Large, Integrated Systems"*, 2nd Edition, Pearson Education, 2004.

Reference Books:

- Qusay H. Mahmoud, *"Middleware for Communications"*, 1st Edition, John Wiley and Sons,2004.
- Michah Lerner, *"Middleware Networks: Concept, Design and Deployment of Internet Infrastructure"*, 1st Edition, Kluwer Academic Publishers, 2000.

Expected Course Outcome: At the end of the course graduate will be able to:

- Learn how to use Middleware to Build Distributed Applications
- Implement Business Processes
- Learn about Middle Ware Technologies
- Implement Business Processes
- Learn application design and IT architecture

SERVICE ORIENTED ARCHITECTURE

Course Code	:19SCS243	Credits	: 04
L:T:P	: 4:0:0	CIE Marks	: 50
Exam Hours	: 03	SEE Marks	: 50

Course Objectives:

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-1

Introduction To Xml 9 : XML document structure , Well formed and valid documents, Namespaces , DTD , XML Schema , X-Files. **8 Hrs**

Module-2

BUILDING XML- BASED APPLICATIONS: Parsing XML , using DOM, SAX , XML Transformation and XSL , XSL Formatting , Modelling Databases in XML. **9 Hrs**

Module-3

Characteristics of contemporary SOA, Misperception about SOA, Tangible benefits of SOA, An SOA timeline, Continuing evolution of SOA, Roots of SOA Service orientation and object orientation, SOA Standards Stack, SOA with Web Services, Key Principles of SOA . **9 Hrs**

Module-4

Web Services : Service descriptions , WSDL, Messaging with SOAP, Service discovery, UDDI , Message Exchange Patterns , Orchestration , Choreography, WS Transactions **9 Hrs**

Module-5

Building Soa-Based Applications: Service Oriented Analysis and Design, Service Modelling, Design standards and guidelines, Composition, WS-BPEL, WS, Coordination, WS-Policy , WS Security , SOA support in J2EE **9 Hrs**

Text Books:

1.Ron Schmelzer et al. “XML and Web Services”, Pearson Education.
2.Thomas Erl, “Service Oriented Architecture: Concepts, Technology, and Design”, Pearson education

3.Mark D Hansen, “SOA using Java™ Web Services”, Prentice Hall Publication.

Reference Books:

1)Muninder Singh & Michael Huhns, “Service Oriented Computing”, Wiley
2)Michael Rosen & et el., “Applied SOA”, Wiley Publication.
3)Rosheta “SOA based Enterprise Integration”, TMH Publication

Expected Course Outcome: At the end of the course graduate will be able to:

1) Understand the concepts of Service Oriented Architecture
2) Create applications based on XML
3) Analyse SOA-based applications for intra-enterprise and inter-enterprise applications.
4) Implement SOA development cycle of Web Services
5) Develop web services using technology elements

PARALLEL ALGORITHMS

Course Code	: 19SCS244	Credits	: 04
L: T: P	: 4:0:0	CIE Marks	: 50
Exam Hours	: 3	SEE Marks	: 50

Course Objectives:

CO1 Understand different parallel architectures and models of computation

CO2 Introduce the various classes of parallel algorithms

CO3 Study parallel algorithms for basic problems

CO4 Develop parallel algorithms for standard problems and applications.

CO5 Analyze efficiency of different parallel algorithms.

CO6 Understand the differences among several algorithms solving the same problem and recognize which one is better under different conditions

Module No	Module Contents	Hours
1	**INTRODUCTION :** Need for Parallel Processing – Data and Temporal Parallelism – Models of Computation – RAM and PRAM Model – Shared Memory and Message Passing Models- Processor Organisations – PRAM Algorithm – Analysis of PRAM Algorithms- Parallel Programming Languages.	9
2	**PRAM ALGORITHMS :** Parallel Algorithms for Reduction – Prefix Sum – List Ranking –Preorder Tree Traversal – Searching -Sorting – Merging Two Sorted Lists – Matrix Multiplication – Graph Coloring – Graph Searching.	9
3	**SIMD ALGORITHMS:** 2D Mesh SIMD Model – Parallel Algorithms for Reduction – Prefix Computation – Selection – Odd-Even Merge Sorting – Matrix Multiplication.	9
4	**SIMD ALGORITHMS -II :** Hypercube SIMD Model – Parallel Algorithms for Selection- Odd-Even Merge Sort- Bitonic Sort- Matrix Multiplication Shuffle Exchange SIMD Model – Parallel Algorithms for Reduction -Bitonic Merge Sort – Matrix Multiplication – Minimum Cost Spanning Tree	9

5	**MIMD ALGORITHMS :** UMA Multiprocessor Model -Parallel Summing on Multiprocessor- Matrix Multiplication on Multiprocessors and Multicomputer – Parallel Quick Sort – Mapping Data to Processors.	**8**

Text Books:

1.Michael J. Quinn, “Parallel Computing : Theory & Practice”, Tata McGraw Hill Edition, Second edition, 2017.

2.Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, “Fundamentals of Computer Algorithms”, University press, Second edition , 2011.

3.V Rajaraman, C Siva Ram Murthy, ” Parallel computers- Architecture and Programming “, PHI learning, 2016.

References Books:

- Ananth Grame, George Karpis, Vipin Kumar and Anshul Gupta, “Introduction to Parallel Computing”, 2nd Edition, Addison Wesley, 2003.
- M Sasikumar, Dinesh Shikhare and P Ravi Prakash , ” Introduction to Parallel Processing”, PHI learning , 2013.
- S.G.Akl, “The Design and Analysis of Parallel Algorithms”, PHI, 1989.

MACHINE LEARNING

Course Code	: 19SCS25	Credits	: 04
L:T:P	: 4:0:0	CIE Marks	: 50
Exam Hours	: 03	SEE Marks	: 50

Course Outcomes: At the end of the Course, the Student will be able to:

1) To understand the basic concepts of learning and decision trees
2) To understand the neural networks and genetic algorithms
3) To understand the Bayesian techniques
4) To understand the instant based learning
5) To understand the analytical learning and reinforced learning

Module 1

Introduction, Concept Learning And Decision Trees: Learning Problems – Designing Learning systems, Perspectives and Issues – Concept Learning – Find-S-finding a maximally specific hypothesis-Version Spaces and Candidate Elimination Algorithm – Inductive bias – Decision Tree learning –Representation – Algorithm – Heuristic Space Search. **9 Hrs**

Module 2

Neural Networks And Genetic Algorithms: Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evolution and Learning.
9 Hrs

Module 3

Bayesian And Computational Learning: Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum DescriptionLength Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier– Bayesian Belief Network – EM Algorithm – Probably Learning – Sample Complexity for Finite and Infinite Hypothesis Spaces – Mistake Bound Model.

9 Hrs

Module 4

Instant Based Learning And Learning Set Of Rules: K- Nearest Neighbor Learning – Locally Weighted Regression – Radial Basis Functions – Case-Based Reasoning – Sequential Covering Algorithms – Learning Rule Sets – LearningFirst Order Rules – Learning Sets of First Order Rules – Induction as Inverted Deduction – Inverting Resolution **9 Hrs**

Module 5

Analytical Learning And Reinforced Learning: Perfect Domain Theories – EBG Remarks on Explanation Based Learning – Inductive-Analytical Approaches - FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning-Relationship to Dynamic Programming **8 Hrs**

Text Books:

1. Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (INDIAN EDITION), 2013.
2. An Algorithmic Perspective, "Stephen Marsland,Taylor & Francis(CRC)

References Books:

1. Ethem Alpaydin, "Introduction to Machine Learning", 2nd Ed., PHI Learning Pvt. Ltd., 2013.
2. T. Hastie, R. Tibshirani, J. H. Friedman, "The Elements of Statistical Learning", Springer; 1st edition, 2001.

MINI PROJECT in Cloud Computing

Course Code	: 19SCS26	Credits:	02
L:T:P	: 0:0:0	CIE Marks:	25
Exam Hours	: 03	SEE Marks:	25

The student shall be capable of identifying a problem related to the stream of Cloud Computing and carry out a mini project on the problem defined. Each student is expected to do the mini project individually. The code developed towards the project will be reviewed by a panel of experts during the course of the semester. Plagiarized projects will automatically get an **"F" GRADE** and the student will be liable for further disciplinary action. At the completion of a project the student will submit a project report, which will be evaluated by duly appointed examiner(s).

Sample Mini project includes:

- Data upload to cloud and authentication
- Cryptography at cloud
- Performance analysis at cloud
- Integration with relevance

ADVANCED ALGORITHMS LAB

Course Code	: 19SCL27	Credits	: 02
L:T:P	: 0:0:2	CIE Marks	: 25
Exam Hours	: 03	SEE Marks	: 25

Note: The following programs can be executed on Java/C#/any equivalent tool/language by adapting exception handling technique wherever it is suitable.

1) Design, develop, and write a program to implement the Bellman-Ford algorithm and determine its performance. Give its applications.
2) Design, develop, and write a program to implement a Monte Carlo algorithm to test the primality of a given integer and determine its performance.
3) Design, develop, and write a program to solve string matching problem using naïve approach and the KMP algorithm. Compare their performances.
4) Design, develop, and write a program to solve String matching problem using Finite Automata and determine its performance.
5) Design, develop, and write a program to solve String matching problem using Robin Karp algorithm and determine its performance.