**MATHEMATICAL FOUNDATION OF COMPUTER SCIENCE**
**[As per Choice Based Credit System (CBCS) scheme]**
**(Effective from the academic year 2018 -2019)**
**SEMESTER – I**

| | | | |
|---|---|---|---|
| Subject Code | 18SFC11 / 18LNI11 / **18SCE11** / 18SCS11 / 18SCN11 / 18SSE11 / 18SIT11 | IA Marks | 40 |
| Number of Contact Hours/Week | 04 | Exam Marks | 60 |
| Total Number of Contact Hours | 50 | Exam Hours | 03 |

**CREDITS – 04**

**Course objectives:** This course will enable students to

- To acquaint the students with mathematical/logical fundamentals including numerical techniques,
- To understand probability, sampling and graph theory that serve as an essential tool for applications of computer and information sciences.

| **Module 1** | **Contact Hours** |
|---|---|
| **Numerical Methods:**Significant figures, Error definitions, Approximations and round off errors, accuracy and precision. Roots of Equations: Bairstow-Lin's Method, Graeffe's Root Squaring Method. Computation of eigen values of real symmetric matrices: Jacobi and Givens method.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 2** | |
| **Statistical Inference:** Introduction to multivariate statistical models: Correlation and Regression analysis, Curve fitting (Linear and Non linear)<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 3** | |
| **Probability Theory:** Probability mass function (p.m.f), density function (p.d.f), Random variable: discrete and continuous, Mathematical expectation, Sampling theory: testing of hypothesis by t-test and chi - square distribution.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 4** | |
| **Graph Theory:** Isomorphism, Planar graphs, graph coloring, Hamilton circuits and Euler cycle. Specialized techniques to solve combinatorial enumeration problems.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 5** | |
| **Vector Spaces:** Vector spaces; subspaces; Linearly independent and dependent vectors ; Bases and dimension; coordinate vectors-Illustrative examples. Linear transformations; Representation of transformations by matrices; linear functional; Non singular Linear transformations; inverse of a linear transformation- Problems.<br>**RBT: L1, L2, L3** | **10 Hours** |

**Course Outcomes**

- Understand the numerical methods to solve and find the roots of the equations.
- Utilize the statistical tools in multi variable distributions.
- Use probability formulations for new predictions with discrete and continuous RV's.
- To understand various graphs in different geometries related to edges.
- Understand vector spaces and related topics arising in magnification and rotation of images.

**Question paper pattern:**
The question paper will have ten questions.

There will be 2 questions from each module.
Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**


1. Steven C. Chapra and Raymond P Canale: " Numerical Methods for Engineers, 7th Edition, McGraw-Hill Publishers, 2015.
2. T.Veerarajan: "Probability, Statistics and Random Process",3rdEdition,Tata Mc-Graw Hill Co.,2016.
3. David C.Lay, Steven R.Lay and J.J.McDonald: Linear Algebra and its Applications, 5th Edition, Pearson Education Ltd., 2015.


**Reference Books:**


1. **B.S. Grewal**: Higher Engineering Mathematics, Khanna Publishers, 44th Ed., 2017.
2. **John Vince :** "Foundation Mathematics for Computer Science", Springer International Publishing, Switzerland, 2015
3. **M.K.Jain, S.R.K.Iyengar and R.K.Jain:** Numerical Methods for Scientific and Engineering Computation. 6thEd.,New Age Int.Publishers.2012.
4. **Norman L.Biggs**: Discrete Mathematics, 2nd Ed., Oxford University Press, 2017.


**Web links and Video Contacts:**

1. *http://nptel.ac.in/courses.php?disciplineId=111*
2. *http://www.class-central.com/subject/math(MOOCs)*
3. *http://ocw.mit.edu/courses/mathematics/*

**ADVANCED DIGITAL DESIGN**
**[As per Choice Based Credit System (CBCS) scheme]**
**(Effective from the academic year 2018 -2019)**
**SEMESTER – I**

| | | | |
|---|---|---|---|
| Subject Code | **18SCE12** | IA Marks | 40 |
| Number of Contact Hours/Week | 04 | Exam Marks | 60 |
| Total Number of Contact Hours | 50 | Exam Hours | 03 |

**CREDITS – 04**

**Course objectives:** This course will enable students to

- Explain various IC technology options
- Demonstrate Logic simulation, Design verification, Verilog.
- Illustrate behavioral modeling, Boolean-Equation, Flip-Flops and Latches; multiplexers, encoders, and decoders, synchronizers for asynchronous signals.
- Demonstrate combinational logic; three-state devices and bus interfaces; Registered logic; registers and counters; Resets; Divide and conquer: Partitioning a design.
- Define basics of PLA; PAL; Programmability of PLDs; CPLDs; FPGAs;

| **Module 1** | **Contact Hours** |
|---|---|
| Introduction: Design methodology – An introduction; IC technology options<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 2** | |
| Logic Design with Verilog: Structural models of combinational logic; Logic simulation, Design verification, and Test methodology; Propagation delay; Truth-Table models of Combinational and sequential logic with Verilog.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 3** | |
| Logic Design with Behavioral Models: Behavioral modeling; A brief look at data types for behavioral modeling; Boolean-Equation – Based behavioral models of combinational logic; Propagation delay and continuous assignments; Latches and Level – Sensitive circuits in Verilog; Cyclic behavioral models of Flip-Flops and Latches; Cyclic behavior and edge detection; A comparison of styles for behavioral modeling; Behavioral models of multiplexers, encoders, and decoders; Dataflow models of a Linear- Feedback Shift Register; Modeling digital machines with repetitive algorithms; Machines with multi-cycle operations; Design documentation with functions and tasks; Algorithmic state machine charts for behavioral modeling; ASMD charts; Behavioral models of counters, shift registers and register files; Switch debounce, meta-stability and synchronizers for asynchronous signals; Design example<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 4** | |
| Synthesis of Combinational and Sequential Logic: Introduction to synthesis; Synthesis of combinational logic; Synthesis of sequential logic with latches; Synthesis of three-state devices and bus interfaces; Synthesis of sequential logic with flip-flops; Synthesis of explicit state machines; Registered logic; State encoding; Synthesis of implicit state machines, registers and counters; Resets; Synthesis of gated clocks and clock enables; Anticipating the results of synthesis; Synthesis of loops; Design traps to avoid; Divide and conquer: Partitioning a design.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 5** | |
| Programmable Logic and Storage Devices: Programmable logic devices; storage devices; | **10 Hours** |

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|---|---|
| PLA; PAL; Programmability of PLDs; CPLDs; FPGAs; Verlog-Based design flows for FPGAs; Synthesis with FPGAs.<br>**RBT: L1, L2, L3** | |

**Course Outcomes**

The students should be able to:

- Work on various IC technology options.
- Demonstrate logic simulation, Design verification, Verilog.
- Work on Flip-Flops and Latches; multiplexers, encoders, and decoders, synchronizers for asynchronous signals.
- Design and implement circuits on combinational logic; Registered logic; registers and counters; Resets; Divide and conquer: Partitioning a design.

**Question paper pattern:**

The question paper will have ten questions.
There will be 2 questions from each module.
Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

1. Michael D. Celetti: Advanced Digital Design with the Verilog HDL, PHI, 2013

**Reference Books:**

1. PeterJ. Asheden: Degital Design –An Embedded Systems Approach Using VERILOG, ELSEVIER 2013.
2. Stephen Brown, ZvonkoVranesic: Fundamentals of Digital Logic with Verilog Design, Tata Mc-Graw Hill 2009.

**EMBEDDED COMPUTING SYSTEMS**
**[As per Choice Based Credit System (CBCS) scheme]**
**(Effective from the academic year 2018 -2019)**
**SEMESTER – I**

| | | | |
|---|---|---|---|
| Subject Code | **18SCE13** / 18SCS321 | IA Marks | 40 |
| Number of Contact Hours/Week | 04 | Exam Marks | 60 |
| Total Number of Contact Hours | 50 | Exam Hours | 03 |

**CREDITS – 04**

**Course objectives:** This course will enable students to

- Explain a general overview of Embedded Systems
- Show current statistics of Embedded Systems
- Examine a complete microprocessor-based hardware system
- Design, code, compile, and test real-time software
- Integrate a fully functional system including hardware and software
- Make intelligent choices between hardware/software tradeoffs

| **Module 1** | **Contact Hours** |
|---|---|
| Introduction to embedded systems: Embedded systems, Processor embedded into a system, Embedded hardware units and device in a system, Embedded software in a system, Examples of embedded systems, Design process in embedded system, Formalization of system design, Design process and design examples, Classification of embedded systems, skills required for an embedded system designer.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 2** | |
| Devices and communication buses for devices network: IO types and example, Serial communication devices, Parallel device ports, Sophisticated interfacing features in device ports, Wireless devices, Timer and counting devices, Watchdog timer, Real time clock, Networked embedded systems, Serial bus communication protocols, Parallel bus device protocols-parallel communication internet using ISA, PCI, PCI-X and advanced buses, Internet enabled systems-network protocols, Wireless and mobile system protocols.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 3** | |
| Device drivers and interrupts and service mechanism: Programming-I/O busy-wait approach without interrupt service mechanism, ISR concept, Interrupt sources, Interrupt servicing (Handling) Mechanism, Multiple interrupts, Context and the periods for context switching, interrupt latency and deadline, Classification of processors interrupt service mechanism from Context-saving angle, Direct memory access, Device driver programming.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 4** | |
| Inter process communication and synchronization of processes, Threads and tasks: Multiple process in an application, Multiple threads in an application, Tasks, Task states, Task and Data, Clear-cut distinction between functions. ISRS and tasks by their characteristics, concept and semaphores, Shared data, Inter-process communication, Signal function, Semaphore functions, Message Queue functions, Mailbox functions, Pipe functions, Socket functions, RPC functions.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 5** | |
| Real-time operating systems: OS Services, Process management, Timer functions, Event | **10 Hours** |

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|---|---|
| functions, Memory management, Device, file and IO subsystems management, Interrupt routines in RTOS environment and handling of interrupt source calls, Real-time operating systems, Basic design using an RTOS, RTOS task scheduling models, interrupt latency and response of the tasks as performance metrics, OS security issues. Introduction to embedded software development process and tools, Host and target machines, Linking and location software.<br>**RBT: L1, L2, L3** | |

**Course Outcomes**

The students should be able to:

- Distinguish the characteristics of embedded computer systems.
- Examine the various vulnerabilities of embedded computer systems.
- Design an embedded system.
- Design and develop modules using RTOS.
- Implement RPC, threads and tasks

**Question paper pattern:**

The question paper will have ten questions.
There will be 2 questions from each module.
Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

1. Raj Kamal, "Embedded Systems: Architecture, Programming, and Design" 2nd edition , Tata McGraw hill-2013.

**Reference Books:**

1. Marilyn Wolf, "Computer as Components, Principles of Embedded Computing System Design" 3rd edition, Elsevier-2014.

**CLOUD COMPUTING**
**[As per Choice Based Credit System (CBCS) scheme]**
**(Effective from the academic year 2018 -2019)**
**SEMESTER – I**

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|---|---|---|---|
| Subject Code | 18LNI151 / **18SCE14** / 18SCN31 / 18SCS23 / 18SIT22 / 18SSE251 | IA Marks | 40 |
| Number of Contact Hours/Week | 04 | Exam Marks | 60 |
| Total Number of Contact Hours | 50 | Exam Hours | 03 |

**CREDITS – 04**

**Course objectives:** This course will enable students to

- Define and Cloud, models and Services.
- Compare and contrast programming for cloud and their applications
- Explain virtuaization, Task Scheduling algorithms.
- Apply ZooKeeper, Map-Reduce concept to applications.

| **Module 1** | **Contact Hours** |
|---|---|
| **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.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **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 Gre The Web application, Cloud for science and engineering, High-performance computing on a cloud, Cloud computing for Biology research, Social computing, digital content and cloud computing.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **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<br>**RBT: L1, L2, L3** | **10 Hours** |
| **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 MapReduce applications subject to deadlines, Resource management and dynamic scaling, Exercises and problems. | **10 Hours** |

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| **RBT: L1, L2, L3** | |
| **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.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Course Outcomes** | |
| The students should be able to:<br>• Compare the strengths and limitations of cloud computing<br>• Identify the architecture, infrastructure and delivery models of cloud computing<br>• Apply suitable virtualization concept.<br>• Choose the appropriate cloud player<br>• Address the core issues of cloud computing such as security, privacy and interoperability<br>• Design Cloud Services<br>• Set a private cloud | |
| **Question paper pattern:**<br>The question paper will have ten questions.<br>There will be 2 questions from each module.<br>Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module. | |
| **Text Books:**<br>1. Dan C Marinescu: Cloud Computing Theory and Practice. Elsevier(MK) 2013. | |
| **Reference Books:**<br>1. RajkumarBuyya , James Broberg, Andrzej Goscinski: Cloud Computing Principles and Paradigms, Willey 2014.<br>2. John W Rittinghouse, James F Ransome:Cloud Computing Implementation, Management and Security, CRC Press 2013. | |

**COMPUTER SYSTEMS PERFORMANCE ANALYSIS**
**[As per Choice Based Credit System (CBCS) scheme]**
**(Effective from the academic year 2018 -2019)**
**SEMESTER – I**

| | | | |
|---|---|---|---|
| Subject Code | **18SCE151** / 18SCN321 / 18SCS154 | IA Marks | 40 |
| Number of Contact Hours/Week | 04 | Exam Marks | 60 |
| Total Number of Contact Hours | 50 | Exam Hours | 03 |

**CREDITS – 04**

**Course objectives:** This course will enable students to

- Discuss mathematical foundations needed for performance evaluation of computer systems
- Illustrate metrics used for performance evaluation
- Develop the analytical modeling of computer systems
- Develop new queuing analysis for both simple and complex systems
- Analyze techniques for evaluating scheduling policies

| **Module 1** | **Contact Hours** |
|---|---|
| Introduction: The art of Performance Evaluation; Common Mistakes in Performance Evaluation, A Systematic Approach to Performance Evaluation, Selecting an Evaluation Technique, Selecting Performance Metrics, Commonly used Performance Metrics, Utility Classification of Performance Metrics, Setting Performance Requirements.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 2** | |
| Workloads, Workload Selection and Characterization: Types of Workloads, addition instructions, Instruction mixes, Kernels; Synthetic programs, Application benchmarks, popular benchmarks. Work load Selection: Services exercised, level of detail; Representativeness; Timeliness, Other considerations in workload selection. Work load characterization Techniques: Terminology; Averaging, Specifying dispersion, Single Parameter Histograms, Multi Parameter Histograms, Principle Component Analysis, Markov Models, Clustering.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 3** | |
| Monitors, Program Execution Monitors and Accounting Logs: Monitors: Terminology and classification; Software and hardware monitors, Software versus hardware monitors, Firmware and hybrid monitors, Distributed System Monitors, Program Execution Monitors and Accounting Logs, Program Execution Monitors, Techniques for Improving Program Performance, Accounting Logs, Analysis and Interpretation of Accounting log data, Using accounting logs to answer commonly asked questions.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 4** | |
| Capacity Planning and Benchmarking: Steps in capacity planning and management; Problems in Capacity Planning; Common Mistakes in Benchmarking; Benchmarking Games; Load Drivers; Remote- Terminal Emulation; Components of an RTE; Limitations of RTEs. Experimental Design and Analysis: Introduction: Terminology, Common mistakes in experiments, Types of experimental designs, 2k Factorial Designs, Concepts, Computation of effects, Sign table method for computing effects; Allocation of variance; | **10 Hours** |

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| General 2k Factorial Designs, General full factorial designs with k factors: Model, Analysis of a General Design, Informal Methods.<br>**RBT: L1, L2, L3** | |
| **Module 5** | |
| Queuing Models: Introduction: Queuing Notation; Rules for all Queues; Little's Law, Types of Stochastic Process. Analysis of Single Queue: Birth-Death Processes; M/M/1 Queue; M/M/m Queue; M/M/m/B Queue with finite buffers; Results for other M/M/1 Queuing Systems. Queuing Networks: Open and Closed Queuing Networks; Product form networks, queuing Network models of Computer Systems. Operational Laws: Utilization Law; Forced Flow Law; Little's Law; General Response Time Law; Interactive Response Time Law; Bottleneck Analysis; Mean Value Analysis and Related Techniques; Analysis of Open Queuing Networks; Mean Value Analysis; Approximate MVA; Balanced Job Bounds; Convolution Algorithm, Distribution of Jobs in a System, Convolution Algorithm for Computing G(N), Computing Performance using G(N), Timesharing Systems, Hierarchical Decomposition of Large Queuing Networks: Load Dependent Service Centers, Hierarchical Decomposition, Limitations of Queuing Theory.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Course Outcomes** | |
| The students should be able to:<br>• Identify the need for performance evaluation and the metrics used for it<br>• Implement Little's law and other operational laws<br>• Apply the operational laws to open and closed systems<br>• Use discrete-time and continuous-time Markov chains to model real world systems<br>• Develop analytical techniques for evaluating scheduling policies | |
| **Question paper pattern:**<br>The question paper will have ten questions.<br>There will be 2 questions from each module.<br>Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module. | |
| **Text Books:**<br>1. Raj Jain: The Art of Computer Systems Performance Analysis, John Wiley and Sons, 2013. | |
| **Reference Books:**<br>1. Paul J Fortier, Howard E Michel: computer Systems Performance Evaluation and prediction, Elsevier, 2003.<br>2. Trivedi K S: Probability and Statistics with Reliability, Queuing and Computer Science Applications, 2nd Edition, Wiley India, 2001. | |

**DISTRIBUTED OPERATING SYSTEM**
**[As per Choice Based Credit System (CBCS) scheme]**
**(Effective from the academic year 2018 -2019)**
**SEMESTER – I**

| | | | |
|---|---|---|---|
| Subject Code | **18SCE152** / 18SIT154 / 18SSE152 | IA Marks | 40 |
| Number of Contact Hours/Week | 04 | Exam Marks | 60 |
| Total Number of Contact Hours | 50 | Exam Hours | 03 |

**CREDITS – 04**

**Course objectives:** This course will enable students to

- Explain distributed systems principles associated with communication, naming, synchronization, distributed file systems, system design, distributed scheduling, and several case studies
- Extend foundational concepts and as well as practical deployments.
- Recall distributed operating system concepts that includes architecture, Mutual exclusion algorithms, Deadlock detection algorithms and agreement protocols
- Explain the distributed resource management components viz. the algorithms for implementation of distributed shared memory, recovery and commit protocols

| **Module 1** | **Contact Hours** |
|---|---|
| **Fundamentals:** What is Distributed Computing Systems? Evolution of Distributed Computing System; Distributed Computing System Models; What is Distributed Operating System? Issues in Designing a Distributed Operating System; Introduction to Distributed Computing Environment (DCE). **Message Passing:** Introduction, Desirable features of a Good Message Passing System, Issues in PC by Message Passing, Synchronization, Buffering, Multi-datagram Messages, Encoding and Decoding of Message Data, Process Addressing, Failure Handling, Group Communication, Case Study: 4.3 BSD UNIX IPC Mechanism.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 2** | |
| **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, Optimization for Better Performance, Case Studies: Sun RPC.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 3** | |
| **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. **Synchronization:** Introduction, Clock Synchronization, Event Ordering, Mutual Exclusion, Dead Lock, Election Algorithms.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 4** | |
| **Resource Management:** Introduction, Desirable Features of a Good Global Scheduling Algorithm, Task Assignment Approach, Load – Balancing Approach, Load – Sharing Approach **Process Management:** Introductjion, Process Migration, Threads.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 5** | |

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|---|---|
| **Distributed File Systems:** Introduction, Desirable Features of a Good Distributed File System, File models, File–Accessing Models, File – Sharing Semantics, File – Caching Schemes, File Replication, Fault Tolerance, Atomic Transactions and Design Principles.<br>**RBT: L1, L2, L3** | **10 Hours** |

**Course Outcomes**

The students should be able to:

- The concepts underlying distributed systems
- Demonstrate an ability to apply theory and techniques to unseen problems.
- Demonstrate the Mutual exclusion, Deadlock detection and agreement protocols of Distributed operating system
- Explore the various resource management techniques for distributed systems.

**Question paper pattern:**

The question paper will have ten questions.
There will be 2 questions from each module.
Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

1. Pradeep. K. Sinha: Distributed Operating Systems: Concepts and Design, PHI, 2007.

**Reference Books:**

1. Andrew S. Tanenbaum: Distributed Operating Systems, Pearson Education, 2013.

**ADVANCES IN COMPUTER ARCHITECTURE**
**[As per Choice Based Credit System (CBCS) scheme]**
**(Effective from the academic year 2018 -2019)**
**SEMESTER – I**

| | | | |
|---|---|---|---|
| Subject Code | **18SCE153** | IA Marks | 40 |
| Number of Contact Hours/Week | 04 | Exam Marks | 60 |
| Total Number of Contact Hours | 50 | Exam Hours | 03 |

**CREDITS – 04**

**Course objectives:** This course will enable students to

- Discover recent trends in the field of Computer Architecture and identify performance related parameters
- Explain pipelining., thread –level parallelism and Memory hierarchy design

| **Module 1** | **Contact Hours** |
|---|---|
| Data-Level Parallelism in vector, SIMD, and GPU Architectures: Introduction, Vector Architecture, SIMD Instructions Set Extensions for Multimedia, Graphics Processing Units, Detecting and Enhancing Loop-level Parallelism, Crosscutting Issues, Putting it All Together: Mobile versus Server GPUs and Tesla versus Core i7, Fallacies and Pitfalls, Concluding Remarks, Historical Perspective and References Case Study and Exercises by Jason D. Bakos. **RBT: L1, L2, L3** | **10 Hours** |
| **Module 2** | |
| Thread-Level Parallelism: Introduction, Centralized Shared-Memory Architectures, Performance of Symmetric Shared-Memory Multiprocessors, Distributed Shared-Memory and Directory-Based Coherence, Synchronization: The Basics, Models of Memory Consistency: An Introduction, Crosscutting Issues, Putting it All Together: Multicore Processors and Their Performance, Fallacies and Pitfalls, Concluding Remarks, Historical Perspective and References Case Studies and Exercises by Amr Zaky and David A. Wood. **RBT: L1, L2, L3** | **10 Hours** |
| **Module 3** | |
| Warehouse-Scale Computers to Exploit Request-Level and Data-Level Parallelism: Introduction, Programming Models and Workloads for Warehouse-Scale Computers, Computer Architecture of Warehouse-Scale Computers, Physical Infrastructure and Costs of Warehouse-Scale Computers, Cloud Computing: the Return of Utility Computing, Crosscutting Issues, Putting it All Together: A Google Warehouse-Scale Computer, Fallacies and Pitfalls, Concluding Remarks, Historical Perspective and References Case Studies and Exercises by ParthasarathyRanganathan. **RBT: L1, L2, L3** | **10 Hours** |
| **Module 4** | |
| Vector Processors in More Depth : Why Vector Processors?, Basic Vector Architecture, Two Real-World Issues: Vector Length and Stride, Enhancing Vector Performance, Effectiveness of Compiler Vectorization, Putting it All Together: Performance of Vector Processors, a Modern Vector Supercomputer: The Cray X1 Fallacies and Pitfalls, Concluding Remarks, Historical Perspective and References Exercises **RBT: L1, L2, L3** | **10 Hours** |
| **Module 5** | |
| Hardware and Software for VLIW and EPIC: Introduction: Exploiting Instruction-Level Parallelism Statically, Detecting and Enhancing Loop-Level Parallelism, Scheduling and Structuring Code for Parallelism, Hardware Support for Exposing Parallelism: Predicated | **10 Hours** |

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|---|---|
| Instructions, Hardware Support for Compiler Speculation, The Intel IA-64 Architecture and Itanium Processor, Concluding Remarks.<br>**RBT: L1, L2, L3** | |

**Course Outcomes**

The students should be able to:

- Implement Pipelining concepts
- Identify the limitations of ILP
- Demonstrate an ability to apply theory and techniques to unseen problems.
- Interpret the thread –level parallelism concepts.
- Explain concepts of vector process super computers and Cray X1.

**Question paper pattern:**

The question paper will have ten questions.
There will be 2 questions from each module.
Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

1. Hennessey and Patterson: "Computer Architecture A Quantitative Approach", 5th Edition, Elsevier, 2013.

**Reference Books:**

1. Kai Hwang: Advanced Computer Architecture - Parallelism, Scalability, Programmability, 2nd Edition, Tata McGraw Hill, 2013.

**DATA MINING & DATA WAREHOUSING**
**[As per Choice Based Credit System (CBCS) scheme]**
**(Effective from the academic year 2018 -2019)**
**SEMESTER – I**

| | | | |
|---|---|---|---|
| Subject Code | **18SCE154** / 18SCS244 / 18SFC251 / 18SIT23 / 18SSE241 | IA Marks | 40 |
| Number of Contact Hours/Week | 04 | Exam Marks | 60 |
| Total Number of Contact Hours | 50 | Exam Hours | 03 |

**CREDITS – 04**

**Course objectives:** This course will enable students to

- Define Data warehousing Architecture and Implementation
- Explain Data mining principles and techniques and Introduce DM as a cutting edge business intelligence
- Interpret association rule mining for handling large data
- Classification for the retrieval purposes
- Explain clustering techniques in details for better organization and retrieval of data

| **Module -1** | **Contact Hours** |
|---|---|
| Introduction and Data Preprocessing :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 Preprocessing: An overview, Data cleaning, Data integration, Data reduction, Data transformation and data discretization. **RBT: L1, L2, L3** | **10 Hours** |
| **Module -2** | |
| Data warehousing and online analytical processing: Data warehousing: Basic concepts, Data warehouse modeling: Data cube and OLAP, Data warehouse design and usage, Data warehouse implementation, Data generalization by attribute-oriented induction, **RBT: L1, L2, L3** | **10 Hours** |
| **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 **RBT: L1, L2, L3** | **10 Hours** |
| **Module-4** | |
| Cluster Analysis: Basic concepts and methods: Cluster Analysis, Partitioning methods, Hierarchical Methods, Density-based methods, Grid-Based Methods, Evaluation of clustering. **RBT: L1, L2, L3** | **10 Hours** |
| **Module-5** | |
| Data mining trends and research frontiers: Mining complex data types, other methodologies of data mining, Data mining applications, Data Mining and society. **RBT: L1, L2, L3** | **10 Hours** |

**Course outcomes:**

The students shall able to:

- Demonstrate Storing voluminous data for online processing, Preprocess 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

**Question paper pattern:**
The question paper will have ten questions.
There will be 2 questions from each module.
Each question will have questions covering all the topics under a module.
The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

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

**Reference Books:** NIL

**EMBEDDED COMPUTINGLABORATORY**
**[As per Choice Based Credit System (CBCS) scheme]**
**(Effective from the academic year 2018 -2019)**
**SEMESTER – I**

| | | | |
|---|---|---|---|
| Subject Code | **18SCEL16** | IA Marks | 40 |
| Number of Contact Hours/Week | 04 | Exam Marks | 60 |
| Total Number of Contact Hours | 50 | Exam Hours | 03 |

**CREDITS – 02**

**Course objectives:** This course will enable students to

- Distinguish the characteristics of embedded computer systems.
- Examine the various vulnerabilities of embedded computer systems.
- Design an embedded system.
- Design and develop modules using RTOS.
- Implement RPC, threads and tasks.

1. To get in touch with development tool/environment for ATMEL microcontroller program and architecture. To know the overview of Kiel software and an introduction to ATMEL 8051 architecture.
2. Write an embedded C program to add subtract multiply divide 16 bit data by ATMEL microcontroller. Write a separate module for each of the arithmetic module and bind it under a single module.
3. Write embedded c program to generate 10 KHz frequency using interrupts on P1.2 ant to view it on the CRO.
4. Write a program to interface 16X2 LCD to ATMEL microcontroller and use port P0 for interfacing it and use port P1 to interface key board.
5. Write a program to control DC motor using PWM method. To monitor the PWM status and control the speed of DC motor in 100% and 25% duty cycle pulse.
6. Write a program to control Position of servo motor. Using any of the ports to be input and output ports and provide an option for a switch to control the position of the motor.
7. Transmission and reception of data. The module has to be designed to have a clear understanding of how serial and parallel interface devices are controlled and interfaced with microcontroller.
8. To program and implement the temperature and pressure measurement units. Using appropriate sensor modules interfaced to the microcontroller indicate the changes in real world through the LEDs.

NOTE; Use AT89C52 microcontroller as main kit with peripherals and KeilµVision 4/ Equivalent tool.

**Course Outcomes**

The students should be able to:

- Distinguish the characteristics of embedded computer systems.
- Examine the various vulnerabilities of embedded computer systems.
- Design an embedded system.
- Design and develop modules using RTOS.
- Implement RPC, threads and tasks.

**Conduction of Practical Examination:**

All laboratory experiments (nos) aretobeincludedforpracticalexamination.
Studentsare allowed to pick one experimentfrom **each part and execute both**
Strictlyfollow theinstructions as printed on the cover page of answer script for breakup of marks
**Change of experiment is allowed only once and marks allotted to the procedure part to be made zero.**

**MANAGING BIG DATA**
**[As per Choice Based Credit System (CBCS) scheme]**
**(Effective from the academic year 2018 -2019)**
**SEMESTER – II**

| | | | |
|---|---|---|---|
| Subject Code | 18LNI251 / **18SCE21** / 18SCN252 / 18SCS21 / 18SFC331 / 18SIT31 / 18SSE322 | IA Marks | 40 |
| Number of Lecture Hours/Week | 03 | Exam Marks | 60 |
| Total Number of Lecture Hours | 40 | Exam Hours | 03 |

**CREDITS – 04**

**Course objectives:** This course will enable students to

- Deal with Big data using Hadoop and SPARK technologies
- Explain basic concepts of Map and Reduce
- Explain basic concepts of Hadoop Distributed File System
- Develop map-reduce analytics using Hadoop and related tools

| **Module -1** | **Teaching Hours** |
|---|---|
| **Meet Hadoop:** Data!, Data Storage and Analysis, Querying All Your Data, Beyond Batch, Comparison with Other Systems: Relational Database Management Systems, Grid Computing, Volunteer Computing Hadoop Fundamentals MapReduce A Weather Dataset: Data Format, Analyzing the Data with Unix Tools, Analyzing the Data with Hadoop: Map and Reduce, Java MapReduce, Scaling Out: Data Flow, Combiner Functions, Running a Distributed MapReduce Job, Hadoop Streaming<br>**The Hadoop Distributed Filesystem** The Design of HDFS, HDFS Concepts: Blocks, Namenodes and Datanodes, HDFS Federation, HDFS High-Availability, The Command-Line Interface, Basic Filesystem Operations, Hadoop Filesystems Interfaces, The Java Interface, Reading Data from a Hadoop URL, Reading Data Using the FileSystem API, Writing Data, Directories, Querying the Filesystem, Deleting Data, Data Flow: Anatomy of a File Read, Anatomy of a File Write.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module -2** | |
| **YARN** Anatomy of a YARN Application Run: Resource Requests, Application Lifespan, Building YARN Applications, YARN Compared to MapReduce, Scheduling in YARN: The FIFO Scheduler, The Capacity Scheduler, The Fair Scheduler, Delay Scheduling, Dominant Resource Fairness<br>**Hadoop I/O** Data Integrity, Data Integrity in HDFS, LocalFileSystem, ChecksumFileSystem, Compression, Codecs, Compression and Input Splits, Using Compression in MapReduce, Serialization, The Writable Interface, Writable Classes, Implementing a Custom Writable, Serialization Frameworks, File-Based Data Structures: SequenceFile<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module – 3** | |
| **Developing a MapReduce Application** The Configuration API, Combining Resources, Variable Expansion, Setting Up the Development Environment, Managing Configuration, GenericOptionsParser, Tool, and ToolRunner, Writing a Unit Test with MRUnit: Mapper, Reducer, Running Locally on Test Data, Running a Job in a Local Job Runner, Testing the Driver, Running on a Cluster, Packaging a Job, Launching a Job, The MapReduce Web UI, Retrieving the Results, Debugging a Job, Hadoop Logs, Tuning a Job, Profiling Tasks, | **10 Hours** |

| | |
|---|---|
| MapReduce Workflows: Decomposing a Problem into MapReduce Jobs, JobControl, Apache Oozie<br>**How MapReduce Works** Anatomy of a MapReduce Job Run, Job Submission, Job Initialization, Task Assignment, Task Execution, Progress and Status Updates, Job Completion, Failures: Task Failure, Application Master Failure, Node Manager Failure, Resource Manager Failure, Shuffle and Sort: The Map Side, The Reduce Side, Configuration Tuning, Task Execution: The Task Execution Environment, Speculative Execution, Output Committers<br>**RBT: L1, L2, L3** | |
| **Module-4** | |
| **MapReduce Types and Formats:**MapReduce Types, Input Formats: Input Splits and Record,s Text Input, Binary Input, Multiple Inputs, Database Input (and Output) Output Formats: Text Output, Binary Output, Multiple Outputs, Lazy Output, Database Output,<br>**Flume** Installing Flume, An Example,Transactions and Reliability, Batching, The HDFS Sink, Partitioning and Interceptors, File Formats, Fan Out, Delivery Guarantees, Replicating and Multiplexing Selectors, Distribution: Agent Tiers, Delivery Guarantees, Sink Groups, Integrating Flume with Applications, Component Catalog<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module-5** | |
| **Pig** Installing and Running Pig, Execution Types, Running Pig Programs, Grunt, Pig Latin Editors, An Example: Generating Examples, Comparison with Databases, Pig Latin: Structure, Statements, Expressions, Types, Schemas, Functions, Data Processing Operators: Loading and Storing Data, Filtering Data, Grouping and Joining Data, Sorting Data, Combining and Splitting Data.<br>**Spark** An Example: Spark Applications, Jobs, Stages and Tasks, A Java Example, A Python Example, Resilient Distributed Datasets: Creation, Transformations and Actions, Persistence, Serialization, Shared Variables, Broadcast Variables, Accumulators, Anatomy of a Spark Job Run, Job Submission, DAG Construction, Task Scheduling, Task Execution, Executors and Cluster Managers: Spark on YARN<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Course outcomes:** | |
| The students shall able to:<br>• Understand managing big data using Hadoop and SPARK technologies<br>• Explain HDFS and MapReduce concepts<br>• Install, configure, and run Hadoop and HDFS.<br>• Perform map-reduce analytics using Hadoop and related tools<br>• Explain SPARK concepts | |
| **Question paper pattern:**<br>The question paper will have ten questions.<br>There will be 2 questions from each module.<br>Each question will have questions covering all the topics under a module.<br>The students will have to answer 5 full questions, selecting one full question from each module. | |
| **Text Books:**<br>1. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012. | |
| **Reference Books:**<br>1. MateiZaharia and Bill Chambers, SPARK: The Definitive Guide, Oreilly, 2018<br>2. S. D'Souza and Steve Hoffman, Apache Flume: Distributed Log Collection for Hadoop, Oreilly. 2014 | |

**MULTI-CORE ARCHITECTURE AND PROGRAMMING**
**[As per Choice Based Credit System (CBCS) scheme]**
**(Effective from the academic year 2018 -2019)**
**SEMESTER - II**

| | | | |
|---|---|---|---|
| Subject Code | **18SCE22** / 18SCN152 / 18SCS152 | IA Marks | 40 |
| Number of Contact Hours/Week | 04 | Exam Marks | 60 |
| Total Number of Contact Hours | 50 | Exam Hours | 03 |

**CREDITS - 04**

**Course objectives:** This course will enable students to

- Define technologies of multicore architecture and performance measures
- Demonstrate problems related to multiprocessing
- Illustrate windows threading, posix threads, openmp programming
- Analyze the common problems in parallel programming

| **Module -1** | **Contact Hours** |
|---|---|
| Introduction to Multi-core Architecture Motivation for Concurrency in software, Parallel Computing Platforms, Parallel Computing in Microprocessors, Differentiating Multi-core Architectures from Hyper- Threading Technology, Multi-threading on Single-Core versus Multi-Core Platforms Understanding Performance, Amdahl's Law, Growing Returns: Gustafson's Law. System Overview of Threading : Defining Threads, System View of Threads, Threading above the Operating System, Threads inside the OS, Threads inside the Hardware, What Happens When a Thread Is Created, Application Programming Models and Threading, Virtual Environment: VMs and Platforms, Runtime Virtualization, System Virtualization.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module -2** | |
| Fundamental Concepts of Parallel Programming :Designing for Threads, Task Decomposition, Data Decomposition, Data Flow Decomposition, Implications of Different Decompositions, Challenges You'll Face, Parallel Programming Patterns, A Motivating Problem: Error Diffusion, Analysis of the Error Diffusion Algorithm, An Alternate Approach: Parallel Error Diffusion, Other Alternatives. Threading and Parallel Programming Constructs: Synchronization, Critical Sections, Deadlock, Synchronization Primitives, Semaphores, Locks, Condition Variables, Messages, Flow Control- based Concepts, Fence, Barrier, Implementation-dependent Threading Features<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module – 3** | |
| Threading APIs :ThreadingAPIs for Microsoft Windows, Win32/MFC Thread APIs, Threading APIs for Microsoft. NET Framework, Creating Threads, Managing Threads, Thread Pools, Thread Synchronization, POSIX Threads, Creating Threads, Managing Threads, Thread Synchronization, Signaling, Compilation and Linking.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module-4** | |
| OpenMP: A Portable Solution for Threading : Challenges in Threading a Loop, Loop-carried Dependence, Data-race Conditions, Managing Shared and Private Data, Loop Scheduling and Portioning, Effective Use of Reductions, Minimizing Threading Overhead, Work-sharing Sections, Performance-oriented Programming, Using Barrier and No wait, Interleaving Single-thread and Multi-thread Execution, Data Copy-in and Copy-out, Protecting Updates of Shared Variables, Intel Task queuing Extension to OpenMP, OpenMP Library Functions, | **10 Hours** |

| | |
|---|---|
| OpenMP Environment Variables, Compilation, Debugging, performance<br>**RBT: L1, L2, L3** | |
| **Module-5** | |
| Solutions to Common Parallel Programming Problems : Too Many Threads, Data Races, Deadlocks, and Live Locks, Deadlock, Heavily Contended Locks, Priority Inversion, Solutions for Heavily Contended Locks, Non-blocking Algorithms, ABA Problem, Cache Line Ping-ponging, Memory Reclamation Problem, Recommendations, Thread-safe Functions and Libraries, Memory Issues, Bandwidth, Working in the Cache, Memory Contention, Cache-related Issues, False Sharing, Memory Consistency, Current IA-32 Architecture, Itanium Architecture, High-level Languages, Avoiding Pipeline Stalls on IA-32,Data Organization for High Performance.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Course outcomes:** | |
| The students shall able to:<br>• Identify the limitations of ILP and the need for multicore architectures<br>• Define fundamental concepts of parallel programming and its design issues<br>• Solve the issues related to multiprocessing and suggest solutions<br>• Make out the salient features of different multicore architectures and how they exploit parallelism<br>• Demonstrate the role of OpenMP and programming concept | |
| **Question paper pattern:**<br>The question paper will have ten questions.<br>There will be 2 questions from each module.<br>Each question will have questions covering all the topics under a module.<br>The students will have to answer 5 full questions, selecting one full question from each module. | |
| **Text Books:**<br>1. Multicore Programming , Increased Performance through Software Multi-threading by Shameem Akhter and Jason Roberts , Intel Press , 2006 | |
| **Reference Books:** NIL | |

**INTERNET OF THINGS**
**[As per Choice Based Credit System (CBCS) scheme]**
**(Effective from the academic year 2018 -2019)**
**SEMESTER – II**

| | | | |
|---|---|---|---|
| Subject Code | 18LNI22 / **18SCE23** / 18SCN14 / 18SCS14 / 18SSE321 | IA Marks | 40 |
| Number of Contact Hours/Week | 04 | Exam Marks | 60 |
| Total Number of Contact Hours | 50 | Exam Hours | 03 |

**CREDITS – 04**

**Course objectives:** This course will enable students to

- Define and explain basic issues, policy and challenges in the IoT
- Illustrate Mechanism and Key Technologies in IoT
- Explain the Standard of the IoT
- Explain resources in the IoT and deploy of resources into business
- Demonstrate data analytics for IoT

| **Module -1** | **Contact Hours** |
|---|---|
| What is The Internet of Things? Overview and Motivations, Examples of Apllications, IPV6 Role, Areas of Development and Standardization, Scope of the Present Investigation.Internet of Things Definitions and frameworks-IoT Definitions, IoT Frameworks, Basic Nodal Capabilities. Internet of Things Apjplication Examples-Overview, Smart Metering/Advanced Metering Infrastructure-Health/Body Area Networks, City Automation, Automotive Applications, Home Automation, Smart Cards, Tracking, Over-The-Air-Passive Surveillance/Ring of Steel, Control Application Examples, Myriad Other Applications. **RBT: L1, L2, L3** | **10 Hours** |
| **Module -2** | |
| Fundamental IoT Mechanism and Key Technologies-Identification of IoT Object and Services, Structural Aspects of the IoT, Key IoT Technologies. Evolving IoT Standards-Overview and Approaches, IETF IPV6 Routing Protocol for RPL Roll, Constrained Application Protocol, Representational State Transfer, ETSI M2M,Third Generation Partnership Project Service Requirements for Machine-Type Communications, CENELEC, IETF IPv6 Over Low power WPAN, Zigbee IP(ZIP),IPSO **RBT: L1, L2, L3** | **10 Hours** |
| **Module – 3** | |
| Layer ½ Connectivity: Wireless Technologies for the IoT-WPAN Technologies for IoT/M2M, Cellular and Mobile Network Technologies for IoT/M2M,Layer 3 Connectivity :IPv6 Technologies for the IoT: Overview and Motivations. Address Capabilities,IPv6 Protocol Overview, IPv6 Tunneling, IPsec in IPv6,Header Compression Schemes, Quality of Service in IPv6, Migration Strategies to IPv6. **RBT: L1, L2, L3** | **10 Hours** |
| **Module-4** | |
| Case Studies illustrating IoT Design-Introduction, Home Automation, Cities, Environment, Agriculture, Productivity Applications. **RBT: L1, L2, L3** | **10 Hours** |
| **Module-5** | |
| Data Analytics for IoT – Introduction, Apache Hadoop, Using Hadoop MapReduce for Batch Data Analysis, Apache Oozie, Apache Spark, Apache Storm, Using Apache Storm for Real-time Data Analysis, Structural Health Monitoring Case Study. **RBT: L1, L2, L3** | **10 Hours** |

**Course outcomes:**

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

- Develop schemes for the applications of IOT in real time scenarios
- Manage the Internet resources
- Model the Internet of things to business
- Understand the practical knowledge through different case studies
- Understand data sets received through IoT devices and tools used for analysis

**Question paper pattern:**

The question paper will have ten questions.
There will be 2 questions from each module.
Each question will have questions covering all the topics under a module.
The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**


1. Daniel Minoli, ”Building the Internet of Things with IPv6 and MIPv6:The Evolving World of M2M Communications”, Wiley, 2013.
2. ArshdeepBahga, Vijay Madisetti, ”Internet of Things: A Hands on Approach” Universities Press., 2015


**Reference Books:**


1. Michael Miller,” The Internet of Things”, First Edition, Pearson, 2015.
2. Claire Rowland,Elizabeth Goodman et.al.,” Designing Connected Products”, First Edition,O’Reilly, 2015.

**WIRELESS NETWORKS AND MOBILE COMPUTING**
**[As per Choice Based Credit System (CBCS) scheme]**
**(Effective from the academic year 2018 -2019)**
**SEMESTER – II**

| | | | |
|---|---|---|---|
| Subject Code | 18LNI331 / **18SCE241** / 18SCN151 / 18SCS323 | IA Marks | 40 |
| Number of Lecture Hours/ | **04** | Exam Marks | 60 |
| Total Number of Lecture Hours | **50** | Exam Hours | 03 |

**CREDITS – 04**

**Course objectives:** This course will enable students to

- Define concepts of wireless communication.
- Compare and contrast propagation methods, Channel models, capacity calculations multiple antennas and multiple user techniques used in the mobile communication.
- Explain CDMA, GSM. Mobile IP, WImax and Different Mobile OS
- Illustrate various Markup Languages CDC, CLDC, MIDP; Programming for CLDC, MIDlet model and security concerns

| **Module -1** | **Contact Hours** |
|---|---|
| Mobile Computing Architecture: Architecture for Mobile Computing, 3-tier Architecture, Design Considerations for Mobile Computing. Emerging Technologies: Wireless broadband (WiMAX), Mobile IP: Introduction, discovery, Registration, Tunneling, Cellular IP, Mobile IP with IPv6. Wireless Networks : Global Systems for Mobile Communication (GSM): GSM Architecture, Entities, Call routing in GSM, PLMN Interface, GSM Addresses and Identities, Network Aspects in GSM, Mobility Management, GSM Frequency allocation. Short Service Messages (SMS): Introduction to SMS, SMS Architecture, SMMT, SMMO, SMS as Information bearer, applications, GPRS and Packet Data Network, GPRS Network Architecture, GPRS Network Operations, Data Services in GPRS, Applications for GPRS, Billing and Charging in GPRS.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module -2** | |
| Spread Spectrum technology, IS-95, CDMA versus GSM, Wireless Data, Third Generation Networks, Applications on 3G, Mobile Client: Moving beyond desktop, Mobile handset overview, Mobile phones and their features, PDA, Design Constraints in applications for handheld devices.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module – 3** | |
| Mobile OS and Computing Environment: Smart Client Architecture, The Client: User Interface, Data Storage, Performance, Data Synchronization, Messaging. The Server: Data Synchronization, Enterprise Data Source, Messaging. Mobile Operating Systems: WinCE, Palm OS, Symbian OS, Linux, Proprietary OS Client Development: The development process, Need analysis phase, Design phase, Implementation and Testing phase, Deployment phase, Development Tools, Device Emulators<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module-4** | |
| Building Wireless Internet Applications: Thin client overview: Architecture, the client, Middleware, messaging Servers, Processing a Wireless request, Wireless Applications Protocol (WAP) Overview, Wireless Languages: Markup Languages, HDML, WML, | **10 Hours** |

| | |
|---|---|
| HTML, cHTML, XHTML, VoiceXML.<br>**RBT: L1, L2, L3** | |
| **Module-5** | |
| J2ME: Introduction, CDC, CLDC, MIDP; Programming for CLDC, MIDlet model, Provisioning, MIDlet life-cycle, Creating new application, MIDlet event handling, GUI in MIDP, Low level GUI Components, Multimedia APIs; Communication in MIDP, Security Considerations in MIDP.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Course outcomes:** | |
| The students shall able to:<br>• Explain state of art techniques in wireless communication.<br>• Discover CDMA, GSM. Mobile IP, WImax<br>• Demonstrate program for CLDC, MIDP let model and security concerns | |
| Question paper pattern:<br>The question paper will have ten questions. There will be 2 questions from each module. Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module. | |
| **Text Books:**<br>1. Ashok Talukder, RoopaYavagal, Hasan Ahmed: Mobile Computing,Technology, Applications and Service Creation, 2nd Edition, Tata McGraw Hill, 2010.<br>2. Martyn Mallik: Mobile and Wireless Design Essentials, Wiley India, 2003 | |
| **Reference Books:**<br>1. Raj kamal: Mobile Computing, Oxford University Press, 2007.<br>2. ItiSahaMisra: Wireless Communications and Networks, 3G and Beyond, Tata McGraw Hill, 2009. | |

**PATTERN RECOGNITION**
**[As per Choice Based Credit System (CBCS) scheme]**
**(Effective from the academic year 2018 -2019)**
**SEMESTER - II**

| | | | |
|---|---|---|---|
| Subject Code | **18SCE242** | IA Marks | 40 |
| Number of Contact Hours/Week | 04 | Exam Marks | 60 |
| Total Number of Contact Hours | 50 | Exam Hours | 03 |

**CREDITS – 04**

**Course objectives:** This course will enable students to

- Explain various Image processing and Pattern recognition techniques.
- Illustrate mathematical morphology necessary for Pattern recognition.
- Demonstrate Image Representation and description and feature extraction.
- Explain principles of decision trees and clustering in pattern recognition.

| **Module -1** | **Contact Hours** |
|---|---|
| Introduction: Definition of PR, Applications, Datasets for PR, Different paradigms for PR, Introduction to probability, events, random variables, Joint distributions and densities, moments. Estimation minimum risk estimators, problems<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module -2** | |
| Representation: Data structures for PR, Representation of clusters, proximity measures, size of patterns, Abstraction of Data set, Feature extraction, Feature selection, Evaluation<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module – 3** | |
| Nearest Neighbor based classifiers & Bayes classifier: Nearest neighbor algorithm, variants of NN algorithms, use of NN for transaction databases, efficient algorithms, Data reduction, prototype selection, Bayes theorem, minimum error rate classifier, estimation of probabilities, estimation of probabilities, comparison with NNC, Naive Bayes classifier, Bayessian belief network<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module-4** | |
| Naive Bayes classifier, Bayessian belief network, Decision Trees: Introduction, DT for PR, Construction of DT, Splitting at the nodes, Over fitting & Pruning, Examples , Hidden Markov models: Markov models for classification, Hidden Markov models and classification using HMM<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module-5** | |
| Clustering: Hierarchical (Agglomerative, single/complete/average linkage, wards, Partitional (Forgy's, k-means, Isodata), clustering large data sets, examples, An application: Handwritten Digit recognition<br>**RBT: L1, L2, L3** | **10 Hours** |

**Course outcomes:**

The students shall able to:

- Explain pattern recognition principals
- Develop algorithms for Pattern Recognition.
- Develop and analyze decision tress.
- Design the nearest neighbor classifier.
- Apply Decision tree and clustering techniques to various applications

**Question paper pattern:**
The question paper will have ten questions.
There will be 2 questions from each module.
Each question will have questions covering all the topics under a module.
The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**


1. Pattern Recognition ( An Introduction) , V Susheela Devi, M Narsimha Murthy, 2011 Universities Press, ISBN 978-81-7371-725-3
2. Pattern Recognition & Image Analysis, Earl Gose, Richard Johnsonbaugh, Steve Jost. PH ISBN-81-203-1484-0, 1996.


**Reference Books:**


1. Duda R. O., P.E. Hart, D.G. Stork., Pattern Classification, John Wiley and sons, 2000.

**NATURAL LANGUAGE PROCESSING AND TEXT MINING**
**[As per Choice Based Credit System (CBCS) scheme]**
**(Effective from the academic year 2018 -2019)**
**SEMESTER – II**

| | | | |
|---|---|---|---|
| Subject Code | **18SCE243** | IA Marks | 40 |
| Number of Contact Hours/Week | 04 | Exam Marks | 60 |
| Total Number of Contact Hours | 50 | Exam Hours | 03 |

**CREDITS – 04**

**Course objectives:** This course will enable students to
The student should be able to:

- Learn the techniques in natural language processing.
- Be familiar with the natural language generation.
- Be exposed to Text Mining.
- Analyze the information retrieval techniques

| **Module -1** | **Contact Hours** |
|---|---|
| OVERVIEW AND LANGUAGE MODELING: Overview: Origins and challenges of NLP-Language and Grammar-Processing Indian Languages- NLP Applications-Information Retrieval. Language Modeling: Various Grammar- based Language Models-Statistical Language Model.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module -2** | |
| WORD LEVEL AND SYNTACTIC ANALYSIS: Word Level Analysis: Regular Expressions-Finite-State Automata-Morphological Parsing-Spelling Error Detection and correction-Words and Word classes-Part-of Speech Tagging. Syntactic Analysis: Context-free Grammar-Constituency- Parsing-Probabilistic Parsing.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module - 3** | |
| Extracting Relations from Text: From Word Sequences to Dependency Paths: Introduction, Subsequence Kernels for Relation Extraction, A Dependency-Path Kernel for Relation Extraction and Experimental Evaluation. Mining Diagnostic Text Reports by Learning to Annotate Knowledge Roles: Introduction, Domain Knowledge and Knowledge Roles, Frame Semantics and Semantic Role Labeling, Learning to Annotate Cases with Knowledge Roles and Evaluations. A Case Study in Natural Language Based Web Search: InFact System Overview, The GlobalSecurity.org Experience.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module-4** | |
| Evaluating Self-Explanations in iSTART: Word Matching, Latent Semantic Analysis, and Topic Models: Introduction, iSTART: Feedback Systems, iSTART: Evaluation of Feedback Systems, Textual Signatures: Identifying Text-Types Using Latent Semantic Analysis to Measure the Cohesion of Text Structures: Introduction, Cohesion, Coh-Metrix, Approaches to Analyzing Texts, Latent Semantic Analysis, Predictions, Results of Experiments. Automatic Document Separation: A Combination of Probabilistic Classification and Finite-State Sequence Modeling: Introduction, Related Work, Data Preparation, Document Separation as a Sequence Mapping Problem, Results. Evolving Explanatory Novel Patterns for Semantically-Based Text Mining: Related Work, A Semantically Guided Model for Effective TextMining.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module-5** | |

| | |
|---|---|
| INFORMATION RETRIEVAL AND LEXICAL RESOURCES: Information Retrieval: Design features of Information Retrieval Systems-Classical, Non classical, Alternative Models of Information Retrieval – valuation Lexical Resources: World Net-Frame Net-Stemmers-POS Tagger- Research Corpora.<br>**RBT: L1, L2, L3** | **10 Hours** |

**Course outcomes:**

Upon completion of the course, the student should be able to:

- Analyze the natural language text.
- Generate the natural language.
- Demonstrate Text mining.
- Apply information retrieval techniques.

**Question paper pattern:**

The question paper will have ten questions.
There will be 2 questions from each module.
Each question will have questions covering all the topics under a module.
The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**


1. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.
2. Anne Kao and Stephen R. Poteet (Eds), "Natural LanguageProcessingandText Mining",Springer-Verlag London Limited 2007.


**Reference Books:**


1. Daniel Jurafsky and James H Martin, "Speech and Language Processing: Anintroduction to Natural Language Processing, Computational Linguistics and SpeechRecognition", 2nd Edition, Prentice Hall, 2008.
2. James Allen, "Natural Language Understanding", 2nd edition, Benjamin/Cummingspublishingcompany, 1995.
3. Gerald J. Kowalski and Mark.T. Maybury, "Information Storage and Retrieval systems", Kluwer academic Publishers, 2000.
4. Steven Bird, Ewan Klein, Edward Loper, "Natural Language Processing with Python," Publisher: O'Reilly Media, June 2009
5. Christopher D.Manning and HinrichSchutze, "Foundations of Statistical Natural Language Processing", MIT Press, 1999.

**CYBER SECURITY AND CYBER LAW**
**[As per Choice Based Credit System (CBCS) scheme]**
**(Effective from the academic year 2018 -2019)**
**SEMESTER –II**

| | | | |
|---|---|---|---|
| Subject Code | 18LNI244 / **18SCE244** / 18SIT244 | IA Marks | 40 |
| Number of Contact Hours/Week | 04 | Exam Marks | 60 |
| Total Number of Contact Hours | 50 | Exam Hours | 03 |

**CREDITS – 04**

**Course objectives:** This course will enable students to

- Define the area of cybercrime and forensics.
- Explain the motive and causes for cybercrime , detection and handling.
- Investigate Areas affected by cybercrime.
- Illustrate tools used in cyber forensic
- Infer legal Perspectives in cyber security

| **Module -1** | **Contact Hours** |
|---|---|
| Introduction to Cybercrime: Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals?, Classifications of Cybercrimes, Cybercrime: The Legal Perspectives, Cybercrimes: An Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes, Cybercrime Era: Survival Mantra for the Netizens. Cyberoffenses: How Criminals Plan Them: How Criminals Plan the Attacks, Social Engineering, Cyberstalking, Cybercafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module -2** | |
| Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module – 3** | |
| Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks. Phishing and Identity Theft: Introduction, Phishing, Identity Theft (ID Theft).<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module-4** | |
| Understanding Computer Forensics: Introduction, Historical Background of Cyberforensics, Digital Forensics Science, The Need for Computer Forensics, Cyberforensics and Digital Evidence, Forensics Analysis of E-Mail, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Setting up a Computer Forensics Laboratory: Understanding the Requirements, Computer Forensics and Steganography, Relevance of the OSI 7 Layer Model to Computer Forensics, Forensics and | **10 Hours** |

| | |
|---|---|
| Social Networking Sites: The Security/Privacy Threats, Computer Forensics from Compliance Perspective, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing, Antiforensics.<br>**RBT: L1, L2, L3** | |
| **Module-5** | |
| Introduction to Security Policies and Cyber Laws: Need for An Information Security Policy, Information Security Standards – Iso, Introducing Various Security Policies and Their Review Process, Introduction to Indian Cyber Law, Objective and Scope of the it Act, 2000, Intellectual Property Issues, Overview of Intellectual - Property - Related Legislation in India, Patent, Copyright, Law Related to Semiconductor Layout and Design, Software License.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Course outcomes:** | |
| By the end of this course the student acquire<br>• Define cyber security, cyber law and their roles<br>• Demonstrate cyber security cybercrime and forensics.<br>• Infer legal issues in cybercrime,<br>• Demonstrate tools and methods used in cybercrime and security.<br>• Illustrate evidence collection and legal challenges | |
| Question paper pattern:<br>The question paper will have ten questions.<br>There will be 2 questions from each module.<br>Each question will have questions covering all the topics under a module.<br>The students will have to answer 5 full questions, selecting one full question from each module. | |
| **Text Books:**<br>1. SunitBelapure and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives", Wiley India Pvt Ltd, ISBN: 978-81-265-21791, Publish Date 2013<br>2. Dr. Surya Prakash Tripathi, RitendraGoyal, Praveen Kumar Shukla, KLSI. "Introduction to information security and cyber laws". Dreamtech Press. ISBN: 9789351194736, 2015 | |
| **Reference Books:**<br>1. Thomas J. Mowbray, "Cybersecurity: Managing Systems, Conducting Testing, and Investigating Intrusions", Copyright © 2014 by John Wiley & Sons, Inc, ISBN: 978 -1-118 -84965 -1<br>2. James Graham, Ryan Olson, Rick Howard, "Cyber Security Essentials", CRC Press, 15-Dec-2010 | |

**WIRELESS SENSOR NETWORKS**
**[As per Choice Based Credit System (CBCS) scheme]**
**(Effective from the academic year 2018 -2019)**
**SEMESTER – II**

| | | | |
|---|---|---|---|
| Subject Code | 18LNI324 /**18SCE251** / 18SCN251 | IA Marks | 40 |
| Number of Contact Hours/Week | 04 | Exam Marks | 60 |
| Total Number of Contact Hours | 50 | Exam Hours | 03 |

**CREDITS – 04**

**Course objectives:** This course will enable students to

- Explain sensor networks for various application setups.
- Demonstrate the design space and conduct trade-off analysis between performance and resources.
- Assess coverage and conduct node deployment planning.
- Devise appropriate data dissemination protocols and model links cost.
- Determine suitable medium access protocols and radio hardware.
- Illustrate sensor networks using commercial components.
- Discuss quality of service, fault-tolerance, security and other dependability requirements while coping with resource constraints.

| **Module -1** | **Contact Hours** |
|---|---|
| Introduction, Overview and Applications of Wireless Sensor Networks Introduction, Basic overview of the Technology, Applications of Wireless Sensor Networks: Introduction, Background, Range of Applications, Examples of Category 2 WSN Applications, Examples of Category 1 WSN Applications, Another Taxonomy of WSN Technology. (Chapter 1: 1.1, 1.2, Chapter2: 2.1-2.6)<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module -2** | |
| Basic Wireless Sensor Technology and Systems: Introduction, Sensor Node Technology, Sensor Taxonomy, WN Operating Environment, WN Trends, Wireless Transmission Technology and Systems: Introduction, Radio Technology Primer, Available Wireless Technologies (Chapter3: 3.1-3.5, Chapter 4: 4.1-4.3)<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module – 3** | |
| MAC and Routing Protocols for Wireless Sensor Networks: Introduction, Background, Fundamentals of MAC Protocols, MAC Protocols for WSNs, Sensor-MAC case Study, IEEE 802.15.4 LR-WPANs Standard Case Study. Routing Protocols for Wireless Sensor Networks: Introduction, Background, Data Dissemination and Gathering, Routing Challenges and Design Issues in WSNs, Routing Strategies in WSNs. (Chapter 5: 5.1-5.6, Chapter 6: 6.1-6.5)<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module-4** | |
| Transport Control and Middleware for Wireless Sensor Networks: Traditional Transport Control Protocols, Transport Protocol Design Issues, Examples of Existing Transport Control Protocols, Performance of Transport Control Protocols. Middleware for Wireless Sensor Networks: Introduction, WSN Middleware Principles, Middleware Architecture, Existing Middleware. (Chapter 7: 7.1-7.4, Chap. 8: 8.1-8.4)<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module-5** | |

| | |
|---|---|
| Network Management and Operating System for Wireless Sensor Networks: Introduction, Network Management Requirements, Traditional Network Management Models, Network Management Design Issues. Operating Systems for Wireless Sensor Networks: Introduction, Operating System Design Issues, Examples of Operating Systems. (Chapter 9: 9.1-9.5, Chapter 10: 10.1-10.3)<br>**RBT: L1, L2, L3** | **10 Hours** |

**Course outcomes:**

The students shall able to:

- Explain existing applications of wireless sensor actuator networks
- Apply in the context of wireless sensor networks and explain elements of distributed computing and network protocol design
- Contrast Various hardware, software platforms that exist for sensor networks
- Summarize various network level protocols for MAC, routing, time synchronization, aggregation, consensus and distributed tracking

**Question paper pattern:**

The question paper will have ten questions.
There will be 2 questions from each module.
Each question will have questions covering all the topics under a module.
The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

1. KAZEM SOHRABY, DANIEL MINOLI, TAIEB ZNATI, "Wireless Sensor Networks: Technology, Protocols and Applications:, WILEY , Second Edition (Indian) , 2014

**Reference Books:**

1. Ian F. Akyildiz, Mehmet Can Vuran "Wireless Sensor Networks", Wiley 2010
2. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.

**ADVANCES IN DATA BASE MANAGEMENT SYSTEMS**
**[As per Choice Based Credit System (CBCS) scheme]**
**(Effective from the academic year 2018 -2019)**
**SEMESTER – II**

| | | | |
|---|---|---|---|
| Subject Code | **18SCE252** / 18SCS13 / 18SIT14 / 18SSE151 | IA Marks | 40 |
| Number of Lecture Hours/Week | 04 | Exam Marks | 60 |
| Total Number of Lecture Hours | 50 | Exam Hours | 03 |

**CREDITS – 04**

**Course objectives:** This course will enable students to

- Define parallel and distributed databases and its applications.
- Show applications of Object Oriented database
- Explain basic concepts, principles of intelligent databases.
- Utilize the advanced topics of data warehousing and mining .
- Infer emerging and advanced data models
- Extend knowledge in research topics of databases.

| **Module 1** | **Teaching Hours** |
|---|---|
| **Review of Relational Data Model and Relational Database Constraints:**<br>Relational model concepts; Relational model constraints and relational database schemas; Update operations, anomalies, dealing with constraint violations, Types and violations.<br>**Object and Object-Relational Databases:**<br>Overview of Object Database Concepts, Object Database Extensions to SQL, The ODMG Object Model and the Object Definition Language ODL, Object Database Conceptual Design, The Object Query Language OQL, Overview of the C++ Language Binding in the ODMG Standard.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 2** | |
| **Disk Storage, Basic File Structures, Hashing, and Modern Storage Architectures:**<br>Introduction, Secondary Storage Devices, Buffering of Blocks, Placing File Records on Disk Operations on Files, Files of Unordered Records (Heap Files) , Files of Ordered Records (Sorted Files), Hashing Techniques, Other Primary File Organizations, Parallelizing Disk Access Using RAID Technology, Modern Storage Architectures.<br>**Distributed Database Concepts:**<br>Distributed Database Concepts, Data Fragmentation, Replication, and Allocation Techniques forDistributed Database Design, Overview of Concurrency Control and Recovery in Distributed Databases, Overview of Transaction Management in Distributed Databases,Query Processing and Optimization in Distributed Databases, Types of Distributed Database Systems , Distributed Database Architectures, Distributed Catalog Management.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 3** | |
| **NOSQL Databases and Big Data Storage Systems:**<br>Introduction to NOSQL Systems, The CAP Theorem, Document-Based NOSQL Systems and MongoDB, NOSQL Key-Value Stores, Column-Based or Wide Column NOSQL Systems, NOSQL Graph Databases and Neo4j.<br>**Big Data Technologies Based on MapReduce and Hadoop:**<br>What Is Big Data? Introduction to MapReduce and Hadoop, Hadoop Distributed File System (HDFS), MapReduce: Additional Details Hadoop v2 alias YARN, General | **10 Hours** |

| | |
|---|---|
| Discussion<br><br>**RBT: L1, L2, L3** | |
| **Module 4** | |
| **Enhanced Data Models: Introduction to Active, Temporal, Spatial, Multimedia, and Deductive Databases:**<br>Active Database Concepts and Triggers, Temporal Database Concepts, Spatial Database Concepts, Multimedia Database Concepts, Introduction to Deductive Databases.<br>**Introduction to Information Retrieval and Web Search:**<br>Information Retrieval (IR) Concepts, Retrieval Models, Types of Queries in IR Systems, Text Preprocessing, Inverted Indexing, Evaluation Measures of Search Relevance, Web Search and Analysis. Trends in Information Retrieval<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 5** | |
| **Data Mining Concepts:**<br>Overview of Data Mining Technology, Association Rules, Classification, Clustering, Approaches to Other Data Mining Problems, Applications of Data Mining, Commercial Data Mining Tools<br>**Overview of Data Warehousing and OLAP:**<br>Introduction, Definitions, and Terminology, Characteristics of Data Warehouses, Data Modeling for Data Warehouses, Building a Data Warehouse, Typical Functionality of a Data Warehouse, Data Warehouse versus Views, Difficulties of Implementing Data Warehouses.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Course Outcomes** | |
| The students should be able to:<br>• Select the appropriate high performance database like parallel and distributed database<br>• Infer and represent the real world data using object oriented database<br>• Interpret rule set in the database to implement data warehousing of mining<br>• Discover and design database for recent applications database for better interoperability | |
| **Question paper pattern:**<br>The question paper will have ten questions.<br>There will be 2 questions from each module.<br>Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module. | |
| **Text Books:**<br>1. Elmasri and Navathe: Fundamentals of Database Systems, Pearson Education, 2013.<br>2. Raghu Ramakrishnan and Johannes Gehrke: Database Management Systems, 3rd Edition, McGraw-Hill, 2013. | |
| **Reference Books:**<br>1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan: Database System Concepts, 6th Edition, McGraw Hill, 2010. | |

**DECISION SUPPORT SYSTEMS**
**[As per Choice Based Credit System (CBCS) scheme]**
**(Effective from the academic year 2018 -2019)**
**SEMESTER - II**

| | | | |
|---|---|---|---|
| Subject Code | **18SCE253** | IA Marks | 40 |
| Number of Contact Hours/Week | 04 | Exam Marks | 60 |
| Total Number of Contact Hours | 50 | Exam Hours | 03 |

**CREDITS – 04**

**Course objectives:** This course will enable students to

- Explain the fundamentals of decision making and problem solving, mathematical modeling.
- Utilize an electronic spreadsheet as a mathematical model.
- How artificial intelligence emerged as a computer application, and its main areas.
- Define four basic parts of an expert system.
- what a group decision support system (GDSS) is and the different environmental settings that can be used

| **Module -1** | **Contact Hours** |
|---|---|
| Introduction to decision support systems: DSS Defined, History of decision support systems, Ingredients of a DSS, Data and model management, DSS Knowledge base, User interfaces, User interfaces, The DSS user, Categories and classes of DSSs, Chapter Summary. Decisions and decision makers Decision makers: who are they, Decision styles, Decision effectiveness, How can a DSS help?, A Typology of decisions, Decision theory and simon's model of problem solving, Bounded decision making, The process of choice, Cognitive processes, Biases and heuristics in decision making, Chapter summary.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module -2** | |
| Decisions in the organization: Understanding the organization, Organizational culture. Modeling decision processes: Defining the problem and its structures, Decision models, Types of probability, Techniques for forecasting probabilities, Calibration and sensitivity, Chapter summary<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module – 3** | |
| Group decision support and groupware technologies: Group Decision making, the problem with groups, MDM support technologies, Managing MDM activities, the virtual workspace, chapter summary. Executive information systems: What exactly is an EIS, Some EIS history, Why area top executives so different?, EIS components, Making the EIS work, The future of executive decision making and the EIS, chapter summary<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module-4** | |
| Designing and building decision support systems: Strategies for DSS analysis and design, The DSS developer, DSS user interface issues, chapter summary. Implementing and integrating decision support systems: DSS implementation, System evaluation, The importance of integration, chapter summary.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module-5** | |
| Creative decision making and problem solving What is creativity?, Creativity defined, The occurrence of creativity, Creative problem solving techniques, Creativity and the role of technology, chapter summary.<br>**RBT: L1, L2, L3** | **10 Hours** |

| **Course outcomes:** |
| --- |
| The students shall able to:<br>• Recognize the relationship between business information needs and decision making<br>• Appraise the general nature and range of decision support systems<br>• Appraise issues related to the development of DSS<br>• Select appropriate modeling techniques<br>• Analyze, design and implement a DSS |
| **Question paper pattern:**<br>The question paper will have ten questions.<br>There will be 2 questions from each module.<br>Each question will have questions covering all the topics under a module.<br>The students will have to answer 5 full questions, selecting one full question from each module. |
| **Text Books:**<br>1. George M.Marakas: DECISION SUPPORT SYSTEM, PHI.2011. |
| **Reference Books:** NIL |

**COMPUTER VISION**
**[As per Choice Based Credit System (CBCS) scheme]**
**(Effective from the academic year 2018 -2019)**
**SEMESTER - II**

| | | | |
|---|---|---|---|
| Subject Code | **18SCE254** | IA Marks | 40 |
| Number of Contact Hours/Week | 04 | Exam Marks | 60 |
| Total Number of Contact Hours | 50 | Exam Hours | 03 |

**CREDITS – 04**

**Course objectives:** This course will enable students to

- Review image processing techniques for computer vision
- Discuss shape and region analysis
- Analyze Hough Transform and its applications to detect lines, circles, ellipses
- Analyze three-dimensional image analysis techniques
- Illustrate motion analysis
- Discuss some applications of computer vision algorithms

| **Module -1** | **Contact Hours** |
|---|---|
| CAMERAS: Pinhole Cameras, Radiometry – Measuring Light: Light in Space, Light Surfaces, Important Special Cases, Sources, Shadows, And Shading: Qualitative Radiometry, Sources and Their Effects, Local Shading Models, Application: Photometric Stereo, Interreflections: Global Shading Models, Color: The Physics of Color, Human Color Perception, Representing Color, A Model for Image Color, Surface Color from Image Color.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module -2** | |
| Linear Filters: Linear Filters and Convolution, Shift Invariant Linear Systems, Spatial Frequency and Fourier Transforms, Sampling and Aliasing, Filters as Templates, Edge Detection: Noise, Estimating Derivatives, Detecting Edges, Texture: Representing Texture, Analysis (and Synthesis) Using Oriented Pyramids, Application: Synthesis by Sampling Local Models, Shape from Texture.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module – 3** | |
| The Geometry of Multiple Views: Two Views, Stereopsis: Reconstruction, Human Stereposis, Binocular Fusion, Using More Cameras, Segmentation by Clustering: What Is Segmentation?, Human Vision: Grouping and Getstalt, Applications: Shot Boundary Detection and Background Subtraction, Image Segmentation by Clustering Pixels, Segmentation by Graph-Theoretic Clustering,<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module-4** | |
| Segmentation by Fitting a Model: The Hough Transform, Fitting Lines, Fitting Curves, Fitting as a Probabilistic Inference Problem, Robustness, Segmentation and Fitting Using Probabilistic Methods: Missing Data Problems, Fitting, and Segmentation, The EM Algorithm in Practice, Tracking With Linear Dynamic Models: Tracking as an Abstract Inference Problem, Linear Dynamic Models, Kalman Filtering, Data Association, Applications and Examples.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module-5** | |
| Geometric Camera Models: Elements of Analytical Euclidean Geometry, Camera Parameters and the Perspective Projection, Affine Cameras and Affine Projection Equations, Geometric Camera Calibration: Least-Squares Parameter Estimation, A Linear Approach to Camera | **10 Hours** |

| | |
|---|---|
| Calibration, Taking Radial Distortion into Account, Analytical Photogrammetry, An Application: Mobile Robot Localization, Model- Based Vision: Initial Assumptions, Obtaining Hypotheses by Pose Consistency, Obtaining Hypotheses by pose Clustering, Obtaining Hypotheses Using Invariants, Verification, Application: Registration In Medical Imaging Systems, Curved Surfaces and Alignment.<br>**RBT: L1, L2, L3** | |

**Course outcomes:**

Upon completion of the course, the students will be able to

- Implement fundamental image processing techniques required for computer vision
- Perform shape analysis
- Implement boundary tracking techniques
- Apply chain codes and other region descriptors
- Apply Hough Transform for line, circle, and ellipse detections.
- Apply 3D vision techniques.
- Implement motion related techniques.
- Develop applications using computer vision techniques.

**Question paper pattern:**

The question paper will have ten questions.
There will be 2 questions from each module.
Each question will have questions covering all the topics under a module.
The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

1. David A. Forsyth and Jean Ponce: Computer Vision – A Modern Approach, PHI Learning (Indian Edition), 2009.

**Reference Books:**

1. E. R. Davies: Computer and Machine Vision – Theory, Algorithms and Practicalities, Elsevier (Academic Press), 4th edition, 2013.

**ARM PROCESSORS**
**[As per Choice Based Credit System (CBCS) scheme]**
**(Effective from the academic year 2018 -2019)**
**SEMESTER - III**

| | | | |
|---|---|---|---|
| Subject Code | **18SCE31** | IA Marks | 40 |
| Number of Contact Hours/Week | 04 | Exam Marks | 60 |
| Total Number of Contact Hours | 50 | Exam Hours | 03 |

**CREDITS - 04**

**Course objectives:** This course will enable students to

- Describe the programmer's model of ARM processor and create and test assembly level programming.
- Analyze various types of coprocessors and design suitable co-processor interface to ARM processor.
- Analyze floating point processor architecture and its architectural support for higher level language.
- Become aware of the Thumb mode of operation of ARM.
- Identify the architectural support of ARM for operating system and analyze the function of memory Management unit of ARM.

| **Module -1** | **Contact Hours** |
|---|---|
| An Introduction to Processor Design: Processor architecture and organization. Abstraction in hardware design. A simple processor. Instruction set design. Processor design trade-offs. The Reduced Instruction Set Computer. Design for low power consumption. The ARM Architecture: The Acorn RISC Machine. Architectural inheritance. The ARM programmer's model. ARM development tools.<br>**RBT: L1, L2, L3** | **10Hours** |
| **Module -2** | |
| ARM Assembly Language Programming: Data processing instructions. Data transfer instructions. Control flow instructions. Writing simple assembly language programs. ARM Organization and Implementation: 3-stage pipeline ARM organization. 5-stage pipeline ARM organization. ARM instruction execution. ARM implementation. The ARM coprocessor interface.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module – 3** | |
| The ARM Instruction Set: Introduction. Exceptions. Conditional execution. Branch and Branch with Link (B, BL) Branch, Branch with Link and exchange instructions (BX, BLX). Software Interrupt (SWI). Data processing instructions. Multiply instructions. Count leading zeros (CLZ - architecture v5T only). Single word and unsigned byte data transfer instructions. Half-word and signed byte data transfer instructions. Multiple register transfer instructions. Swap memory and register instructions (SWP). Status register to general register transfer instructions . General register to status register transfer instructions. Coprocessor instructions. Coprocessor data operations . Coprocessor data transfers. Coprocessor register transfers. Breakpoint instruction (BRK - architecture v5T only). Unused instruction space. Memory faults. ARM architecture variants. Architectural Support for High-Level Languages: Abstraction in software design. Data types. Floating-point data types. The ARM floating-point architecture. Expressions . Conditional statements. Loops. Functions and procedures. Use of memory. Run-time environment.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module-4** | |

| | |
|---|---|
| The Thumb Instruction Set: The Thumb bit in the CPSR .The Thumb programmer's model. Thumb branch instructions. Thumb software interrupts instruction. Thumb data processing instructions. Thumb single register data transfer instructions. Thumb multiple register data transfer instructions. Thumb breakpoint instruction. Thumb implementation. Thumb applications. Architectural Support for System Development: The ARM memory interface. The Advanced Microcontroller Bus Architecture (AMBA). The ARM reference peripheral specification. Hardware system prototyping tools. The JTAG boundary scan test architecture. The ARM debug architecture. Embedded Trace. Signal processing support.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module-5** | |
| ARM Processor Cores: ARM7TDMI. ARM8. ARM9TDMI.ARM10TDMI Memory Hierarchy: Memory size and speed. On-chip memory. Memory management. Architectural Support for Operating Systems. An introduction to operating systems. The ARM system control coprocessor. CP15 protection unit registers. ARM protection unit. CP15 MMU registers. ARM MMU architecture. Synchronization. Context switching. Input / Output.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Course outcomes:** | |
| The students shall able to:<br>• Categorize the hardware and software issues related to the design of a Microcontroller based system catering to the needs of medium and higher end applications.<br>• Explain the architecture and programming of the 32-bit ARM Cortex Processors<br>• Demonstrate thumb instruction sets<br>• Design and develop ARM specific applications | |
| **Question paper pattern:**<br>The question paper will have ten questions.<br>There will be 2 questions from each module.<br>Each question will have questions covering all the topics under a module.<br>The students will have to answer 5 full questions, selecting one full question from each module. | |
| **Text Books:**<br>1. Steve Furber:*ARM System on Chip Architecture* by S.B Fuber 2nd Edition, Pearson 2013. | |
| **Reference Books:**<br>1. Joseph Yiu: The definitive guide to ARM Cortex M3 M4 processors, Elsevier Newnes 3rd edition 2014 | |

**MACHINE LEARNING TECHNIQUES**
**[As per Choice Based Credit System (CBCS) scheme]**
**(Effective from the academic year 2018 -2019)**
**SEMESTER - III**

| | | | |
|---|---|---|---|
| Subject Code | 18LNI322 / **18SCE321** / 18SCN324 / 18SCS31 / 18SFC254 / 18SIT322 / 18SSE334 | IA Marks | 40 |
| Number of Contact Hours/Week | 04 | Exam Marks | 60 |
| Total Number of Contact Hours | 50 | Exam Hours | 03 |

**CREDITS – 04**

**Course objectives:** This course will enable students to

- Explain basic concepts of learning and decision trees.
- Compare and contrast neural networks and genetic algorithms
- Apply the Bayesian techniques and instant based learning
- Examine analytical learning and reinforced learning

| **Module -1** | **Contact Hours** |
|---|---|
| INTRODUCTION, CONCEPT LEARNING AND DECISION TREES<br>Learning Problems – Designing Learning systems, Perspectives and Issues – Concept Learning – Version Spaces and Candidate Elimination Algorithm – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search<br>**RBT: L1, L2, L3** | **10Hours** |
| **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.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module – 3** | |
| BAYESIAN AND COMPUTATIONAL LEARNINGL Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length 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.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **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 – Learning First Order Rules – Learning Sets of First Order Rules – Induction as Inverted Deduction – Inverting Resolution<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module-5** | |
| ANALYTICAL LEARNING AND REINFORCED LEARNING: Perfect Domain Theories – Explanation Based Learning – Inductive-Analytical Approaches - FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Course outcomes:** | |
| On Completion of the course, the students will be able to | |

- Choose the learning techniques with this basic knowledge.
- Apply effectively neural networks and genetic algorithms for appropriate applications.
- Apply bayesian techniques and derive effectively learning rules.
- Choose and differentiate reinforcement and analytical learning techniques

**Question paper pattern:**

The question paper will have ten questions.
There will be 2 questions from each module.
Each question will have questions covering all the topics under a module.
The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

1. Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (INDIAN EDITION), 2013.

**Reference Books:**

1. EthemAlpaydin, "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.

**MULTIMEDIA COMMUNICATIONS**
**[As per Choice Based Credit System (CBCS) scheme]**
**(Effective from the academic year 2018 -2019)**
**SEMESTER – III**

| | | | |
|---|---|---|---|
| Subject Code | 18LNI152 / **18SCE322** / 18SCN21 | IA Marks | 40 |
| Number of Contact Hours/Week | 04 | Exam Marks | 60 |
| Total Number of Contact Hours | 50 | Exam Hours | 03 |

**CREDITS – 04**

**Course objectives:** This course will enable students to

- Define the Multimedia Communication Models
- Explain Multimedia Transport in Wireless Networks
- Solve the Security issues in multimedia networks
- Illustrate real-time multimedia network applications.
- Explain different network layer based application.

| **Module 1** | **Contact Hours** |
|---|---|
| Introduction, multimedia information representation, multimedia networks, multimedia applications, Application and networking terminology, network QoS and application QoS, Digitization principles,.Text, images, audio and video.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 2** | |
| Text and image compression,, compression principles, text compression- Runlength, Huffman, LZW, Document Image compression using T2 and T3 coding, image compression- GIF, TIFF and JPEG<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 3** | |
| Audio and video compression, audio compression – principles, DPCM, ADPCM, Adaptive and Linear predictive coding, Code-Excited LPC, Perceptual coding, MPEG and Dolby coders video compression, video compression principles.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 4** | |
| **V**ideo compression standards: H.261, H.263, MPEG, MPEG 1, MPEG 2, MPEG-4 and Reversible VLCs, MPEG 7 standardization process of multimedia content description, MPEG 21 multimedia framework.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 5** | |
| Notion of synchronization, presentation requirements, reference model for synchronization, Introduction to SMIL, Multimedia operating systems, Resource management, process management techniques.<br>**RBT: L1, L2, L3** | **10 Hours** |

**Course Outcomes**

The students should be able to:

- Deploy the right multimedia communication models.
- Apply QoS to multimedia network applications with efficient routing techniques.
- Solve the security threats in the multimedia networks.
- Develop the real-time multimedia network applications

**Question paper pattern:**

The question paper will have ten questions.
There will be 2 questions from each module.
Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**


1. Fred Halsall, "Multimedia Communications", Pearson education, 2001.
2. Raif Steinmetz, KlaraNahrstedt, "Multimedia: Computing, Communications and Applications", Pearson education, 2002.


**Reference Books:**


2. K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, "Multimedia Communication Systems", Pearson education, 2004.
3. John Billamil, Louis Molina, "Multimedia : An Introduction", PHI, 2002.

**ADVANCES IN STORAGE AREA NETWORKS**
**[As per Choice Based Credit System (CBCS) scheme]**
**(Effective from the academic year 2018 -2019)**
**SEMESTER – III**

| | | | |
|---|---|---|---|
| Subject Code | 18LNI243 / **18SCE323** / 18SCN241 / 18SCS241 / 18SIT253 / 18SSE153 | IA Marks | 40 |
| Number of Contact Hours/Week | 04 | Exam Marks | 60 |
| Total Number of Contact Hours | 50 | Exam Hours | 03 |

**CREDITS – 04**

**Course objectives:** This course will enable students to

- Define and contrast storage centric and server centric systems
- Define metrics used for Designing storage area networks
- Illustrate RAID concepts
- Demonstrate, how data centers maintain the data with the concepts of backup mainly remote mirroring concepts for both simple and complex systems.

| **Module 1** | **Contact Hours** |
|---|---|
| **Introduction**: Server Centric IT Architecture and its Limitations; Storage – Centric IT Architecture and its advantages. Case study: Replacing a server with Storage Networks The Data Storage and Data Access problem; The Battle for size and access. Intelligent Disk Subsystems: Architecture of Intelligent Disk Subsystems; Hard disks and Internal I/O Channels; JBOD, Storage virtualization using RAID and different RAID levels; Caching: Acceleration of Hard Disk Access; Intelligent disk subsystems, Availability of disk subsystems.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 2** | |
| **I/O Techniques**: The Physical I/O path from the CPU to the Storage System; SCSI; Fibre Channel Protocol Stack; Fibre Channel SAN; IP Storage. Network Attached Storage: The NAS Architecture, The NAS hardware Architecture, The NAS Software Architecture, Network connectivity, NAS as a storage system. File System and NAS: Local File Systems; Network file Systems and file servers; Shared Disk file systems; Comparison of fibre Channel and NAS.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 3** | |
| **Storage Virtualization**: Definition of Storage virtualization; Implementation Considerations; Storage virtualization on Block or file level; Storage virtualization on various levels of the storage Network; Symmetric and Asymmetric storage virtualization in the Network.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 4** | |
| **SAN Architecture and Hardware devices**: Overview, Creating a Network for storage; SAN Hardware devices; The fibre channel switch; Host Bus Adaptors; Putting the storage in SAN; Fabric operation from a Hardware perspective. Software Components of SAN: The switch's Operating system; Device Drivers; Supporting the switch's components; Configuration options for SANs.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 5** | |
| **Management of Storage Network**: System Management, Requirement of management System, Support by Management System, Management Interface, Standardized | **10 Hours** |

| | |
|---|---|
| Mechanisms, Property Mechanisms, In-band Management, Use of SNMP, CIM and WBEM, Storage Management Initiative Specification (SMI-S), CMIP and DMI, Optional Aspects of the Management of Storage Networks, Summary<br>**RBT: L1, L2, L3** | |

**Course Outcomes**

The students should be able to:

- Identify the need for performance evaluation and the metrics used for it
- Apply the techniques used for data maintenance.
- Realize strong virtualization concepts
- Develop techniques for evaluating policies for LUN masking, file systems

**Question paper pattern:**

The question paper will have ten questions.
There will be 2 questions from each module.
Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

1. Ulf Troppens, Rainer Erkens and Wolfgang Muller: Storage Networks Explained, Wiley India,2013.

**Reference Books:**

1. Robert Spalding: “Storage Networks The Complete Reference”, Tata McGraw-Hill, 2011.
2. Marc Farley: Storage Networking Fundamentals – An Introduction to Storage Devices, Subsystems, Applications, Management, and File Systems, Cisco Press, 2005.
3. Richard Barker and Paul Massiglia: “Storage Area Network Essentials A Complete Guide to understanding and Implementing SANs”, Wiley India, 2006.

**AGILE TECHNOLOGIES**
**[As per Choice Based Credit System (CBCS) scheme]**
**(Effective from the academic year 2018 -2019)**
**SEMESTER – III**

| | | | |
|---|---|---|---|
| Subject Code | **18SCE324** / 18SCS242 / 18SIT331 / 18SSE323 | IA Marks | 40 |
| Number of Contact Hours/Week | 04 | Exam Marks | 60 |
| Total Number of Contact Hours | 50 | Exam Hours | 03 |

**CREDITS – 04**

**Course objectives:** This course will enable students to

- Explain iterative, incremental development process leads to faster delivery of more useful software
- Evaluate essence of agile development methods
- Illustrate the principles and practices of extreme programming
- Show the roles of prototyping in the software process
- Explain the Mastering Agility

| **Module -1** | **Contact Hours** |
|---|---|
| **Why Agile?:** Understanding Success, Beyond Deadlines, The Importance of Organizational Success, Enter Agility, **How to Be Agile?:** Agile Methods, Don't Make Your Own Method, The Road to Mastery, Find a Mentor<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module -2** | |
| **Understanding XP:** The XP Lifecycle, The XP Team, XP Concepts, **Adopting XP:** Is XP Right for Us?, Go!, Assess Your Agility<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module – 3** | |
| **Practicing XP: Thinking:** Pair Programming, Energized Work, Informative Workspace, Root-Cause Analysis, Retrospectives, **Collaborating:** Trust, Sit Together, Real Customer Involvement, Ubiquitous Language, Stand-Up Meetings, Coding Standards, Iteration Demo, Reporting, **Releasing:**"Done Done", No Bugs, Version Control, Ten-Minute Build, Continuous Integration, Collective Code Ownership, Documentation. **Planning:** Vision, Release Planning, The Planning Game, Risk Management, Iteration Planning, Slack, Stories, Estimating. **Developing:** Incremental requirements, Customer Tests, Test-Driven Development, Refactoring, Simple Design ,Incremental Design and Architecture, Spike Solutions, Performance Optimization, Exploratory Testing<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module-4** | |
| **Mastering Agility: Values and Principles:** Commonalities, About Values, Principles, and Practices, Further Reading, **Improve the Process:** Understand Your Project, Tune and Adapt, Break the Rules, **Rely on People :**Build Effective Relationships, Let the Right People Do the Right Things, Build the Process for the People, **Eliminate Waste :**Work in Small, Reversible Steps, Fail Fast, Maximize Work Not Done, Pursue Throughput<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module-5** | |
| **Deliver Value:** Exploit Your Agility, Only Releasable Code Has Value, Deliver Business Results, Deliver Frequently, **Seek Technical Excellence :**Software Doesn't Exist, Design Is | **10 Hours** |

| | |
|---|---|
| for Understanding, Design Trade-offs, Quality with a Name, Great Design, Universal Design Principles, Principles in Practice, Pursue Mastery<br>**RBT: L1, L2, L3** | |

**Course outcomes:**

Students should be able to

- Define XP Lifecycle, XP Concepts, Adopting XP
- Evaluate on Pair Programming, Root-Cause Analysis, Retrospectives, Planning, Incremental Requirements, Customer Tests
- Demonstrate concepts to Eliminate Waste

**Question paper pattern:**

The question paper will have ten questions.
There will be 2 questions from each module.
Each question will have questions covering all the topics under a module.
The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

1. **The Art of Agile Development** (Pragmatic guide to agile software development), James shore, Chromatic, O'Reilly Media, Shroff Publishers & Distributors, 2007.

**Reference Books:**

1. Agile Software Development, Principles, Patterns, and Practices,Robert C. Martin, Prentice Hall; 1st edition, 2002.
2. Agile and Iterative Development A Manger's Guide", Craig Larman Pearson Education, First Edition, India, 2004.

**CLOUD SECURITY**
**[As per Choice Based Credit System (CBCS) scheme]**
**(Effective from the academic year 2018 -2019)**
**SEMESTER – III**

| | | | |
|---|---|---|---|
| Subject Code | 18LNI333 / **18SCE331** / 18SCN154 / 18SFC152 | IA Marks | 40 |
| Number of Contact Hours/Week | 04 | Exam Marks | 60 |
| Total Number of Contact Hours | 50 | Exam Hours | 03 |

**CREDITS – 04**

**Course objectives:** This course will enable students to

- Describe the fundamentals of Cloud Computing.
- Summarize the need of cloud compliance and existing cloud solutions.
- Explain the cloud security concepts.
- Demonstrate the operations of Data Centre.
- Distinguish the concepts of Identity management and virtualization.

| **Module 1** | **Contact Hours** |
|---|---|
| Cloud Computing Architectural Framework: Cloud Benefits, Business scenarios, Cloud Computing Evolution, cloud vocabulary, Essential Characteristics of Cloud Computing, Cloud deployment models, Cloud Service Models, Multi- Tenancy, Approaches to create a barrier between the Tenants, cloud computing vendors, Cloud Computing threats, Cloud Reference Model, The Cloud Cube Model, Security for Cloud Computing, How Security Gets Integrated.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 2** | |
| Compliance and Audit: Cloud customer responsibilities, Compliance and Audit Security Recommendations. Portability and Interoperability: Changing providers reasons, Changing providers expectations, Recommendations all cloud solutions, IaaS Cloud Solutions, PaaS Cloud Solutions, SaaS Cloud Solutions.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 3** | |
| Traditional Security, Business Continuity, Disaster Recovery, Risk of insider abuse, Security baseline, Customers actions, Contract, Documentation, Recovery Time Objectives (RTOs), Customers responsibility, Vendor Security Process (VSP).<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 4** | |
| Data Center Operations: Data Center Operations, Security challenge, Implement Five Principal Characteristics of Cloud Computing, Data center Security Recommendations. Encryption and Key Management: Encryption for Confidentiality and Integrity, Encrypting data at rest, Key Management Lifecycle, Cloud Encryption Standards, Recommendations.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 5** | |
| Identity and Access Management: Identity and Access Management in the cloud, Identity and Access Management functions, Identity and Access Management (IAM) Model, Identity Federation, Identity Provisioning Recommendations, Authentication for SaaS and Paas customers, Authentication for IaaS customers, Introducing Identity Services, Enterprise Architecture with IDaaS , IDaaS Security Recommendations. Virtualization: Hardware Virtualization, Software Virtualization, Memory Virtualization, Storage | **10 Hours** |

| | |
|---|---|
| Virtualization, Data Virtualization, Network Virtualization, Virtualization Security Recommendations.<br>**RBT: L1, L2, L3** | |

**Course Outcomes**

The students should be able to:

- Demonstrate the growth of Cloud computing, architecture and different modules of implementation.
- Evaluate the different types of cloud solutions among IaaS, PaaS, SaaS.
- Access the security implementation flow, actions and responsibilities of stake holders.
- Generalize the Data Centre operations, encryption methods and deployment details.
- Provide recommendations for using and managing the customer's identity and choose the type of virtualization to be used.

**Question paper pattern:**

The question paper will have ten questions.
There will be 2 questions from each module.
Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

2. Tim Mather, SubraKumaraswamy, ShahedLatif, "Cloud Security and Privacy, An Enterprise Perspective on Risks and Compliance", Oreilly Media 2009.

**Reference Books:**

2. Vic (J.R.) Winkler, "Securing the Cloud, Cloud Computer Security Techniques and Tactics", Syngress, April 2011.

**DATABASE SECURITY**
**[As per Choice Based Credit System (CBCS) scheme]**
**(Effective from the academic year 2018 -2019)**
**SEMESTER – III**

| | | | |
|---|---|---|---|
| **Subject Code** | **18SCE332** / 18SFC252 | **IA Marks** | 40 |
| **Number of Contact Hours/Week** | 04 | **Exam Marks** | 60 |
| **Total Number of Contact Hours** | 50 | **Exam Hours** | 03 |

**CREDITS – 04**

**Course objectives:** This course will enable students to

- Fundamental security concepts and architectures that serve as building blocks to database security
- Concepts of user account management and administration, including security risks
- To use current database management system to design and configure the user and data permissions
- Operational components necessary to maximize database security using various security models

| **Module 1** | **Contact Hours** |
|---|---|
| Introduction: Introduction to Databases, Security Problems in Databases Security Controls Conclusions. Security Models 1: Introduction, Access Matrix Model, Take-Grant Model, Acten Model, PN Model, Hartson and Hsiao's Model, Fernandez's Model, Bussolati and Martella's Model for Distributed databases. **RBT: L1, L2, L3** | **10 Hours** |
| **Module 2** | |
| Security Models 2: Bell and LaPadula's Model, Biba's Model, Dion's Model, Sea View Model, Jajodia and Sandhu's Model, The Lattice Model for the Flow Control conclusion. Security Mechanisms: Introduction, User Identification/Authentication, Memory Protection, Resource Protection, Control Flow Mechanisms, Isolation, Security Functionalities in Some Operating Systems, Trusted Computer System, Evaluation Criteria. **RBT: L1, L2, L3** | **10 Hours** |
| **Module 3** | |
| Security Software Design: Introduction, A Methodological Approach to Security, Software Design, Secure Operating System Design, Secure DBMS Design, Security Packages, Database Security Design. **RBT: L1, L2, L3** | **10 Hours** |
| **Module 4** | |
| Statistical Database Protection & Intrusion Detection Systems: Introduction, Statistics, Concepts and Definitions, Types of Attacks, Inference Controls, evaluation Criteria for Control Comparison, Introduction IDES System, RETISS System, ASES System Discovery. **RBT: L1, L2, L3** | **10 Hours** |
| **Module 5** | |
| Models For The Protection Of New Generation Database Systems 1: Introduction, A Model for the Protection of Frame Based Systems, A Model for the Protection of Object-Oriented Systems, SORION Model for the Protection of Object-Oriented Databases. Models For The Protection Of New Generation Database Systems 2: A Model for the Protection of New Generation Database Systems, the Orion Model, Jajodia and Kogan's Model, A Model for the Protection of Active Databases Conclusions. | **10 Hours** |

| | |
|---|---|
| **RBT: L1, L2, L3** | |
| **Course Outcomes** | |
| The students should be able to:<br>• Carry out a risk analysis for a large database<br>• Implement identification and authentication procedures, fine-grained access control and data encryption techniques<br>• Set up accounts with privileges and roles<br>• Audit accounts and the database system | |
| **Question paper pattern:**<br>The question paper will have ten questions.<br>There will be 2 questions from each module.<br>Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module. | |
| **Text Books**<br>1. Database Security and Auditing, Hassan A. Afyouni, India Edition, CENGAGE Learning, 2009.<br>2. Database Security, Castano, Second edition, Pearson Education. | |
| **Reference Books:**<br>1. Database security by Alfred Basta, Melissa Zgola , CENGAGE learning.. | |

**SOFTWARE DEFINED NETWORKS**
**[As per Choice Based Credit System (CBCS) scheme]**
**(Effective from the academic year 2018 -2019)**
**SEMESTER - III**

| | | | |
|---|---|---|---|
| Subject Code | **18SCE333** | IA Marks | 40 |
| Number of Lecture Hours/Week | 04 | Exam Marks | 60 |
| Total Number of Lecture Hours | 50 | Exam Hours | 03 |

**CREDITS – 04**

**Course objectives:** This course will enable students to

- Explore the emerging definitions, protocols, and standards for SDN
- Building SDN frame framework using different components
- Extending the SDN concepts for service virtualization
- Designing different applications using SDN

| **Module -1** | **Teaching Hours** |
|---|---|
| **Introduction. Centralized and Distributed Control and Data Planes**. Introduction - Evolution versus Revolution. What Do They Do? - The Control Plane, Data Plane, Moving Information Between Planes, Why Can Separation Be Important? Distributed Control Planes - IP and MPLS, Creating the IP Underlay, Convergence Time, Load Balancing, High Availability, Creating the MPLS Overlay, Replication. Centralized Control Planes - Logical Versus<br>**RBT: L1, L2, L3** | **10Hours** |
| **Module -2** | |
| **OpenFlow**. Introduction - Wire Protocol, Replication, FAWG (Forwarding Abstraction Workgroup), Config and Extensibility, Architecture. Hybrid Approaches - Ships in the Night, Dual Function Switches.<br>**SDN Controllers**. Introduction. General Concepts – Vmware, Nicira, Vmware/Nicira, OpenFlow-Related, Mininet, NOX/POX. Trema, Ryu, Big Switch Networks/Floodlight. Layer 3 Centric - L3VPN, Path Computation Element Server. OF-CONFIG.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module – 3** | |
| **Network Programmability.** Introduction. The Management Interface. The Application-Network Divide - The Command-Line Interface, NETCONF and NETMOD, SNMP. Modern Programmatic Interfaces - Publish and Subscribe Interfaces, XMPP. Google's Protocol Buffers - Thrift. JSON, I2RS. Modern Orchestration - OpenStack. CloudStack, Puppet.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module-4** | |
| **Network Function Virtualization.** Introduction. Virtualization and Data Plane I/O - Data Plane I/O, I/O Summary. Services Engineered Path. Service Locations and Chaining – Metadata, An Application Level Approach, Scale, NFV at ETSI. Non-ETSI NFV Work - Middlebox Studies, Embrane/LineRate, Platform Virtualization. Add OVS, OVN, OPNFV, Openstack<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module-5** | |
| **Building an SDN Framework.** Introduction. Build Code First; Ask Questions Later. The Juniper SDN Framework. IETF SDN Framework(s) – SDN (P), ABNO. Open Daylight Controller/Framework – API, High Availability and State Storage, Analytics. Policy, MD-SAL, VTN, OVSDB. ONOS **Use Cases for Bandwidth Scheduling, Manipulation, and Calendaring. Introduction.** Bandwidth Calendaring - Base Topology | **10 Hours** |

| | |
|---|---|
| andFundamentalConcepts, OpenFlow and PCE Topologies, Example Configuration, OpenFlow Provisioned Example, Enhancing the Controller. Overlay Example Using PCE Provisioning, **Expanding your reach:** Barbarians at the gate. Big Data and Application Hyper-virtualization for Instant CSPF expanding topology.<br>**RBT: L1, L2, L3** | |

**Course outcomes:**

On Completion of the course, the students will be able to

- Differentiate between traditional networks and Software defined networks
- Analyze the characteristics of OpenFlow and SDN Controller
- Explore and apply SDN concepts for network programmability and service virtualization.
- Design application in SDN eco-system.

**Question paper pattern:**

The question paper will have ten questions.
There will be 2 questions from each module.
Each question will have questions covering all the topics under a module.
The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**


3. Software Defined Networks: A Comprehensive Approach, by Paul Goransson and Chuck Black, Morgan Kaufmann, June 2014, Print Book ISBN: 9780124166752, eBook ISBN : 9780124166844
4. Software defined networks: Design and Deployment, Particia A. Morreale and James M. Anderson. CRC Press, December 2014, ISBN: 9781482238631
5. Network Innovation through OpenFlow and SDN: Principles and Design, Edited by Fei Hu, CRC Press, ISBN-10: 1466572094, 2014.


**Reference Books:**


1. Paul Goransson, Chuck Black: Software Defined Networks A Comprehensive Approach , Elsevier, 2014. Paperback ISBN: 9780128045558, eBook ISBN: 9780128045794
2. SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies, By Thomas D. Nadeau, Ken Gray Publisher: O'Reilly Media, August 2013, ISBN: 978-1-4493-4230-2, ISBN 10:1-4493-4230-2.
3. When SDN Meets Hadoop big data analysis, things get dynamic – Conrad Menezes – TechTarget.
4. Programming your network at run-time for big data applications – Guohui Wang et..al –ACM SIGCOMM HotSDN 2012.

**OBJECT ORIENTED SOFTWARE ENGINEERING**
**[As per Choice Based Credit System (CBCS) scheme]**
**(Effective from the academic year 2018 -2019)**
**SEMESTER – III**

| | | | |
|---|---|---|---|
| Subject Code | **18SCE334** / 18 SCS253 / 18SIT333 / 18SSE13 | IA Marks | 40 |
| Number of Contact Hours/Week | 04 | Exam Marks | 60 |
| Total Number of Contact Hours | 50 | Exam Hours | 03 |

**CREDITS – 04**

**Course objectives:** This course will enable students to

- Discuss the fundamental principles underlying Object-Oriented software design
- Illustrate the requirements of various domain applications
- Interpret object-oriented analysis and to familiarize UML concepts
- Design, implement and test the software in object oriented approach
- Explore the factors related to software maintenance and software configuration management

| **Module 1** | **Contact Hours** |
|---|---|
| **INTRODUCTION:** What is software engineering? Software Engineering Concepts, Development Activities, Managing Software Development, Modeling with UML, Project Organization and Communication.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 2** | |
| **REQUIREMENT ELICITATION AND ANALYSIS: Requirements Elicitation:** Requirements Elicitation Concepts, Requirements Elicitation Activities, Managing Requirements Elicitation, **Analysis:** Analysis Concepts, Analysis Activities, Managing Analysis.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 3** | |
| **SYSTEM DESIGN :System design-Decomposing the system**: Overview of System Design, System Design Concepts, System Design Activities: Objects to Subsystems, **System Design –Addressing design goals**: Activities: An overview of system design actives, UML deployment diagrams, Addressing Design Goals, Managing System Design.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 4** | |
| **OBJECT DESIGN, IMPLEMENTATION AND TESTING : Object design-Reusing pattern solutions:** An Overview of Object Design, Reuse Concepts: Design Patterns, Reuse Activities, Managing Reuse, **Object design-Specifying interface:** An overview of interface specification, Interfaces Specification Concepts, Interfaces Specification Activities, Managing Object Design, **Mapping model to code**: Mapping Models to Code Overview, Mapping Concepts, Mapping Activities, Managing Implementation, Testing: An overview of testing, Testing concepts, Managing testing.<br>**RBT: L1, L2, L3** | **10 Hours** |
| **Module 5** | |
| **SOFTWARE MAINTENANCE AND SOFTWARE CONFIGURATION MANAGEMENT: Software maintenance:** What is Software Maintenance?, Factors that Mandate Change, Lehman's Laws of system evolution, Types of software maintenance, Software maintenance process and actives, Reverse Engineering, Software Re-engineering, Patterns for Software Maintenance, Tool support for Software Maintenance**. Software** | **10 Hours** |

| | |
|---|---|
| **Configuration Management:** The baseline of Software Life Cycle, What is Software Configuration Management, Why Software Configuration Management, Software Configuration Management Functions, Software Configuration Management Tools.<br>**RBT: L1, L2, L3** | |

**Course Outcomes**

The students should be able to:

- Apply Object Oriented Software Engineering approach in every aspect of software project
- Analyze the requirements from various domains
- Adapt appropriate object oriented design aspects in the development process
- Implement and test the software projects using object oriented approach
- Learn the issues and concepts relating to maintenance of software projects
- Adapt the concepts and tools related to software configuration management

**Question paper pattern:**

The question paper will have ten questions.
There will be 2 questions from each module.
Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**


1. Bernd Bruegge, Alan H Dutoit, Object-Oriented Software Engineering, Pearson Education, 3rd edition, 2014.
2. David C. Kung, "Object oriented software engineering", Tata McGraw Hill,2015


**Reference Books:**


1. Stephan R. Schach, "Object oriented software engineering", Tata McGraw Hill,2008
2. Craig Larman, Applying UML and Patterns, 3rd ed, Pearson Education, 2005.