# M. Tech. (CSE) – Curriculum (NITTPGCSE19)

## Semester-wise Curriculum
### M.Tech (CSE)

#### Semester 1

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Type</th>
<th>Course name</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS601</td>
<td>PC</td>
<td>Mathematical Concepts of Computer Science</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CS603</td>
<td>PC</td>
<td>Advanced Data Structures and Algorithms</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CS605</td>
<td>PC</td>
<td>High Performance Computer Architecture</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>E1</td>
<td>PE</td>
<td>Elective 1</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>E2</td>
<td>PE</td>
<td>Elective 2</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>E3</td>
<td>PE</td>
<td>Elective 3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CS607</td>
<td>ELR</td>
<td>Advanced Programming lab</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CS609</td>
<td>ELR</td>
<td>Computer System Design lab</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td>22</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Semester 2

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Type</th>
<th>Course name</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS602</td>
<td>PC</td>
<td>Service Oriented Architecture &amp; Web Security</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CS604</td>
<td>PC</td>
<td>Advanced Databases</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CS606</td>
<td>PC</td>
<td>Advances in Operating Systems</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>E4</td>
<td>PE</td>
<td>Elective 4</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>E5</td>
<td>PE</td>
<td>Elective 5</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>E6</td>
<td>PE</td>
<td>Elective 6</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>CS608</td>
<td>ELR</td>
<td>DBMS lab</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Semester 3

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Type</th>
<th>Course name</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS639</td>
<td>PE</td>
<td>Project Work- Phase I</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Semester 4

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Type</th>
<th>Course name</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS640</td>
<td>PE</td>
<td>Project Work- Phase II</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Course Code</td>
<td>Course name</td>
<td>L</td>
<td>T</td>
<td>P</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>-------------------------------------------------</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>CS610</td>
<td>Advanced Network Principles and Protocols</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CS611</td>
<td>Advanced Cryptography</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CS612</td>
<td>Network Security</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CS613</td>
<td>Wireless sensor networks</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CS614</td>
<td>Software Design Architectures</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CS615</td>
<td>Mobile Network systems</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CS616</td>
<td>Cloud computing principles</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CS617</td>
<td>Cloud Security</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CS618</td>
<td>Design and Analysis of Parallel Algorithms</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CS619</td>
<td>Statistical Natural language processing</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CS620</td>
<td>Social network mining and analysis</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CS621</td>
<td>Computational geometry</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CS622</td>
<td>Database Tuning and administration</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CS623</td>
<td>Big Data analytics and mining</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CS624</td>
<td>Models of Computation</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CS625</td>
<td>Cognitive Science</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CS626</td>
<td>Internet of Things</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CS627</td>
<td>Image and Video Analytics</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CS628</td>
<td>Information Visualization</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CS629</td>
<td>Knowledge management</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CS630</td>
<td>Text Mining</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CS631</td>
<td>Digital &amp; Cyber Forensics</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CS632</td>
<td>Principles of Machine Learning &amp; Deep Learning</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CS633</td>
<td>Multimedia Presentation And Coding Techniques</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CS634</td>
<td>Principles of Datawarehousing and Datamining</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CS635</td>
<td>Hardware Security</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CS636</td>
<td>Advanced Digital Design</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CS637</td>
<td>Real Time systems</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CS638</td>
<td>Smart phone Computing</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
First Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CS601</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>Mathematical Foundations for Computer Science</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3-0-0-3</td>
</tr>
<tr>
<td>Prerequisites (Course code)</td>
<td></td>
</tr>
<tr>
<td>Course Type</td>
<td>PC</td>
</tr>
</tbody>
</table>

### Course Objectives
- Study the fundamental concepts of logic, abstract algebra, linear algebra, probability and statistics, graph theory etc.

### Course Content

**Unit I**  Introduction
Functional Logic: Proposition Logic, Resolution Proof system, Predicate logic. Congruences, Fermat's theorem, Euler function, Chinese remainder theorem.

**Unit II**  Linear Algebra
Groups, homomorphism theorems, cosets and normal subgroups, Lagrange’s theorem, Ring. Field. Linear algebra: Vector Space, Basis, Matrices and Linear Transformations, Eigen values, Orthogonality.

**Unit III**  Probability
Counting, Probability, Discrete random variable, Continuous random variable, Moment generating function, Markov’s inequality, Chebyshev’s inequality, The geometric and binomial distributions, The tail of the binomial distribution.

**Unit IV**  Graph Theory
Graphs, Euler tours, planar graphs, Hamiltonian graphs, Euler's formula, applications of Kuratowski's theorem.

**Unit V**  Graph Applications
Graph colouring, chromatic polynomials, trees, weighted trees, the max-flow min-cut theorem. Matching, halls marriage problem. Independent set, Dominating set, Vertex cover, clique.

### Course Outcomes

Upon completion of this course, the students will be able to:
- Be able to comprehend the fundamental methods of logic, number theory and algebra.
- Be able to comprehend the fundamental methods of combinatorics, probability and graph theory. Use basic combinatorics in graph theory and to obtain probabilities.
- Be conversant with the Mathematical Rigor that is necessary for computer science and be able to come up with rigorous arguments.

### Text Books


### Reference Books

2. G. Chartrand and P. Zhang, Introduction to Graph Theory, McGraw-Hill Companies.
Course Code : CS603
Course Title : Advanced Data Structures and Algorithms
Number of Credits : 3-0-0-3
Prerequisites (Course code) :
Course Type : PC

Course Objectives
- To introduce and practice advanced algorithms and programming techniques necessary for developing sophisticated computer application programs
- To get accustomed with various programming constructs such as divide-and-conquer, backtracking, and dynamic programming.
- To understand and use various data structures in applications
- To learn new techniques for solving specific problems more efficiently and for analyzing space and time requirements.

Course Content

Unit I  Analysis Of Algorithms
Review of order of growth of functions, recurrences, probability distributions, Average case analysis of algorithms, Randomized Algorithms – Analysis - NP – Complete and NP – Hard Problems – Amortized Analysis

Unit II  Heaps

Unit III  Trees

Unit IV  Advanced Tree Structures
Point – trees – Quad trees - K-d trees – TV- trees – Segment trees – Static and Dynamic

Unit V  Geometric Algorithms
Geometric algorithms – line segment intersection – Map overlay detection – Voronoi diagram

Course Outcomes
Upon completion of this course, the students will be able to:

- Familiarize with algorithmic techniques such as brute force, greedy, and divide and conquer.
- Apply advanced abstract data type (ADT) and data structures in solving real world problems.
- Analyze and apply graph data structure to real-life problems
- Effectively combine fundamental data structures and algorithmic techniques in building a complete algorithmic solution to a given problem

Text Books
Course Code : CS605
Course Title : High Performance Computer Architecture
Number of Credits : 3-0-0-3
Prerequisites (Course code) :
Course Type : PC

Course Objectives
- To understand the basics of high performance computer architecture.
- To understand the concept of parallel execution within computer systems through modern parallel architectures.
- To assess the communication and computing possibilities of high performance computing architecture and to predict the performance of parallel applications.
- To understand the concept memory allocation and management in high performance computer.
- To gain knowledge about the real world high performance processors.

Course Content

Unit – I Fundamentals of Computer Design Defining

Unit – II Instruction-Level Parallelism and Its Exploitation Instruction-Level Parallelism:

Unit – III Data-Level and Thread-Level Parallelism

Unit – IV Memory Hierarchy Design Cache
Performance – Six Basic Cache Optimizations – Virtual Memory – Protection and Examples of Virtual Memory – Ten Advanced Optimizations of Cache Performance – Memory Technology and Optimizations – Protection: Virtual Memory and Virtual Machines – The Design of Memory Hierarchies

Unit – V Storage Systems & Case Studies
Advanced Topics in Disk Storage – Definition and Examples of Real Faults and Failures – I/O Performance, Reliability Measures and Benchmarks – Designing and Evaluating an I/O System – The Internet Archive Cluster Case Studies / Lab Exercises: INTEL i3, i5, i7 processor cores, NVIDIA GPUs, AMD, ARM processor cores – Simulators – GEM5, CACTI, SIMICS, Multi2sim and INTEL Software development tools.

Course Outcomes
Upon completion of this course, the students will be able to:
- Accustom with the representation of data, addressing modes, and instructions sets.
- Understand parallelism both in terms of a single processor and multiple processors.
• Gain technical knowledge of parallel hardware constructs to include instruction-level parallelism for multi-core processor design
• Analyze the way data are stored in memory.
• Understand new architectures of various new generation processors.

**Text Books**


**Reference Books**

Course Code : CS607
Course Title : Advanced Programming Laboratory
Number of Credits : 0-0-3-2
Prerequisites (Course code) :
Course Type : ELR

Course Objectives

● To explore the features of object oriented programming.
● To focus programming rather on programming language.
● To understand the OS internals.

Exercises

1. Exercises using Linux tools – Grep, awk, tr
2. Exercises using system calls
3. Exercises in Python
4. Exercises in C++/ Java

Course Outcomes

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

● develop shell scripts for various applications.
● Gain knowledge about OS internals.
● Understand Object oriented concepts and developing software modules.

Text Books

Course Code | CS609
---|---
Course Title | Computer Systems Design Laboratory
Number of Credits | 0 – 0 – 3 – 2
Prequisites(Course code) | 0
Course Type | ELR

Course Objective
- To understand the functionality of the various modules of a computer system.
- To build computer systems from components.

Exercises
1. Comparative study of motherboards from INTEL, AMD and ARM with focus on performance.
2. Study of GPUs using NVIDIA boards.
3. Study of memory sub systems with focus on performance.
4. Study of Reconfigurable hardware using FPGA boards.
5. Study of display cards, RAM, Sound cards, disk and I/o interfaces
6. Understanding BIOS and CMOS settings.

MBED
1. Blinking of Onboard LEDS alternatively
2. Blinking of Onboard LED sin specified order
3. Switching between Hexa and Decade counters
4. Hexadecimal counter using Ticker and Time Out
5. Display 0 to 9 in7-Segment Display infinitely
6. Display 0 to 99 in7-Segment Display infinitely
7. Generate a given waveform
8. Generate a given waveform

RASPBERRYPI
1. Install RaspberryPi Osin pen drive and boot successfully.
2. Install apache and PHP packages in RaspberryPi and host a web page using PHP
3. Change the brightness of external LED using GPIO pins of RaspberryPi Board

Zybo
1. Controlling onboard LEDs using DIP switches
2. Implementing hexadecimal counter.

IoT KIT
1. Read and display temperature and humidity using Scientech IoT Kit
2. Controlling on bard LEDs of Scientech IoT depending on room temperature and humidity

Course Outcome
Upon completion of the course, the students will be able to:
- Build computer systems from components for various specifications.
- Gain knowledge on the architecture of the computer systems.

Text Books
Second Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CS602</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>Service Oriented Architecture And Web Security</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3-0-0-3</td>
</tr>
<tr>
<td>Prerequisites (Course code)</td>
<td></td>
</tr>
<tr>
<td>Course Type</td>
<td>PC</td>
</tr>
</tbody>
</table>

Course Objectives
- To understand the basic concepts and the foundations of the Web.
- To apply the concept of web services in application development.
- To relate to the cryptography concepts on the web.
- To illustrate various web security concepts.

Course Content

Unit 1: Web Service Architecture
Web Service Architecture, XML Technologies, Service Description: WSDL, Service Discovery: UDDI, Service Transport, Security Considerations

Unit 2: Web Services Technologies
Web Services Technologies - JAX-RPC, JAX-WS, Service Orchestration and Choreography – Composition Standards - Service Oriented Analysis and Design, BPEL

Unit 3: Basics Of Cryptography
Basics of Cryptography, Symmetric key Encipherment, Asymmetric key Encipherment

Unit 4: Integrity And Authentication
Message Integrity and authentication, Cryptographic hash functions, Digital signature, Entity authentication, Key management

Unit 5: Security
Security at the application layer, Transport layer, Network layer, Principles in Practice and System Security

Course Outcomes
Upon completion of this course, the students will be able to:
- Apply Security Concepts for Web applications.
- Develop web applications using web services.
- Interpret Web Security Infrastructure.
- Differentiate between Network and Web Security

TEXTBOOKS

REFERENCES
3. Web Services Essentials, By: Ethan Cerami, Publisher: O'Reilly Media, Inc., 2002
4. Web Security and Commerce, By: Simson Garfinkel; Gene Spafford, Publisher: O'Reilly Media, Inc., 2001
Course Code : CS604
Course Title : Advanced Databases
Number of Credits : 3-0-0-3
Prerequisites (Course code) :
Course Type : PC

Course Objectives

- To understand the basic concepts and terminology related to DBMS and Relational Database Design
- To design and implement Distributed Databases.
- To understand advanced DBMS techniques like parallel and Main-memory databases
- To understand the concept of transaction management in the database

Course Content

Unit I   Introduction
Evaluation of relational algebra expressions, query equivalence, join strategies, query optimization algorithms, Formal review of relational database and FDs Implication, Closure, its correctness

Unit II  Locking And Concurrency Control
Correctness of interleaved execution, Locking and management of locks, Two Phase Locking, deadlocks, multiple level granularity, Concurrency Control on B+ trees, Optimistic Concurrency Control

Unit III   Timestamp Based Techniques
Timestamp based techniques, Multiversion approaches, Comparison of Concurrency Control methods, dynamic databases, Failure classification, recovery algorithm, XML and relational databases

Unit IV   Query Optimization
Query Optimization, Rule-Based Query Optimization using the Volcano Framework, Adaptive Query processing

Unit V    Databases
Main-Memory Databases, Parallel and Distributed Databases, Massively Parallel Data Management Systems, Streaming Data and Reactive Applications

Course Outcomes

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

- Write complex queries including full outer joins, self-join, sub queries, and set theoretic queries.
- Know about the file organization, Query Optimization,
- Know about the Transaction management, and database administration techniques
- Work with Main-memory Databases and Data Streams

Text Books


Reference Books

1. K. V. Iyer, Lecture notes available as PDF file for classroom use
Course Code : CS606  
Course Title : Advances in Operating Systems  
Number of Credits : 3-0-0-3  
Prerequisites (Course code) :  
Course Type :  

Course Objectives  
- To study the characteristics of OS for Multiprocessor and Multicomputer.  
- To learn the issues related to designing OS for a distributed system.  
- To learn the latest trends in building Mobile OS.  
- To explore the various issues related to the networks  
- To discuss the role of OS in embedded systems  

Course Content  

UNIT-I  Multiprocessor Operating Systems  

UNIT-II  Distributed Operating Systems  

UNIT-III  Distributed Scheduling  
Distributed scheduling - Distributed shared memory - Distributed File system – Multimedia file systems - File placement - Caching  

UNIT-IV  Mobile Operating Systems  
Mobile Operating Systems: ARM and Intel architectures - Power Management - Mobile OS Architectures - Underlying OS - Kernel structure and native level programming - Runtime issues- Approaches to power management  

UNIT-V  Os Issues  
OS issues related to the Internet, intranets, Data centers, pervasive computing, embedded systems, Cloud and IoT .  

Course Outcomes  
Upon completion of this course, the students will be able to:  

- Acquire knowledge about advanced concepts in OS  
- Develop OS for distributed systems  
- Develop modules for mobile devices  
- Design and develop OS for networking  

Text Books  

Reference Books  
Course Code : CS608
Course Title : DBMS Laboratory
Number of Credits : 0-0-3-2
Co-requisites (Course code) : CS604
Course Type : ELR

Course Objectives
- To explore the features of a Database Management Systems
- To interface a database with front end tools
- To understand the database design and normalization techniques
- To understand the internals of a database system
- To implement supervised and unsupervised learning techniques on relational data using Python/R programming language

Exercises
1. Working with Basic SQL
2. Working with Intermediate SQL.
3. Advanced SQL using procedures, functions and Triggers.
5. Working with XML
6. Accessing Databases from Programs using JDBC
7. Working with PHP and MySQL
8. Indexing and Query Processing
9. Query Evaluation Plans
10. Working with classification algorithms using Python / R programming
11. Working with clustering techniques using Python / R programming
12. Database Design and implementation (Mini Project)

Course Outcomes
Upon completion of this course, the students will be able to:
- Comprehend the internal working of a database system
- Design database and apply normalization techniques
- Design and develop a database using SQL and the mechanism in connecting with a Web based GUI
- Apply Machine learning algorithms to the real time datasets using Python/R programming languages

Text Book
Course Objectives
- To understand the architecture of the Internet protocols as a layered model
- To understand the fundamentals of data transmission, encoding and multiplexing
- To understand how the various components of wide area networks and local area networks work together
- To understand the concept of application layer

Course Content

UNIT-1 Introduction
Introduction to Networks - Application of Networks - Architecture Topology Switching - SLIP, PPP -ALOHA protocols, CSMA/CD, IEEE 802.3, 802.4, 802.5

UNIT-2 Network Layer

UNIT-3 Network Protocol
Network Protocol- IP datagram - hop by hop routing, ARP, RARP, DHCP -Sub net Addressing, Address Masking, ICMP, RIP, RIPV2, OSPF, DNS, LAN and WAN Multicast.

UNIT-4 Transport Layer

UNIT-5 Application Layer
Application Layer Protocol- Telnet - TFTP - FTP - SMTP - Ping Finger, Bootstrap Network Time Protocol-SNMP.

Course Outcomes
Upon completion of the course, the students will be able to:
- Familiarize the different layers of TCP/IP protocol stack
- Understand the working principle of different protocols at different layers
- Apply networking concepts to real life problems

Text Books

Reference Books
Course Code: CS611
Course Title: Advanced Cryptography
Number of Credits: 3-0-0-3
Prerequisites(Course code): 
Course Type: PE

Course Objectives
- To study the concepts of applied cryptography
- To understand the application of cryptographic techniques in real world applications
- To comprehend the notion of provable security and its implication with improved security guarantees

Course Content

UNIT-I Number Theory
Review of number theory, group, ring and finite fields, quadratic residues, Legendre symbol, Jacobi symbol, Probability, Probability, Discrete random variable, Continuous random variable, Markov’s inequality, Chebyshev’s inequality, normal distribution, the geometric and binomial distributions.

UNIT-II Formal Notions Of Attacks

UNIT-III Public Key Cryptography
Public key cryptography, probabilistic encryption, homomorphic encryption, Elliptic curve cryptosystems, Cryptographic hash functions.

UNIT-IV Digital Signatures
Digital signatures and the notion of existential unforgability under chosen message attacks. Schnorr signature scheme. Zero Knowledge Proofs and Protocols,

UNIT-V Blockchain Technology
Blockchain technology, Consensus algorithm, Incentives and proof of work, Smart contract, Bitcoin.

Course Outcomes
Upon completion of this course, the students will be able to:
- Break cryptosystems that are not provably secure
- Derive simple provable security proofs for cryptographic schemes
- Design and implement cryptographic protocols

Text Books

Reference Books
Course Code : CS612  
Course Title : Network Security  
Number of Credits : 3-0-0-3  
Prerequisites (Course code) :  
Course Type : PE

Course Objective

- To understand the network security, services, attacks, mechanisms, types of attacks on TCP/IP protocol suite.
- To comprehend and apply authentication services, authentication algorithms
- To comprehend and apply network layer security protocols, Transport layer security protocols, Web security protocols.
- To understand the wireless network security threats.

Course Content

UNIT –I  Overview of Network Security

UNIT-II  Authentication Protocol

UNIT-III  Security

UNIT-IV  Viruses
Intruders, Viruses, Worms, Trojan horses, Distributed Denial-Of-Service (DDoS), Firewalls, IDS, Honey nets, Honey pots.

UNIT-V  Introduction to wireless Network Security

Course Outcomes

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

- Be able to determine appropriate mechanisms for protecting the network.
- Design a security solution for a given application, system with respect to security of the system.
- Find solution to Security Threats
- Understand authentication algorithms

Text Books:

Reference Books:
Course Code : CS613
Course Title : Wireless Sensor Networks
Number of Credits : 3-0-0-3
Prerequisites(Course code) :
Course Type : PE

Course Objective
- To understand the fundamentals of wireless sensor networks and its application to critical real time scenarios.
- To study the various protocols at various layers and its differences with traditional protocols.
- To understand the issues pertaining to sensor networks and the challenges involved in managing a sensor network.

Unit 1 Introduction
Introduction: Fundamentals of wireless communication technology, the electromagnetic spectrum radio propagation, characteristics of wireless channels, modulation techniques, multiple access techniques, wireless LANs, PANs, WANs, and MANs, Wireless Internet.

Unit 2 Introduction to Adhoc/sensor networks
Introduction to adhoc/sensor networks: Key definitions of adhoc/sensor networks, unique constraints and challenges, advantages of ad-hoc/sensor network, driving applications, issues in adhoc wireless networks, issues in design of sensor network, sensor network architecture, data dissemination and gathering.

Unit 3 MAC Protocols

Unit 4 Routing Protocols
Routing Protocols: Issues in designing a routing protocol, classification of routing protocols, table-driven, on-demand, hybrid, flooding, hierarchical, and power aware routing protocols

Unit 5 QoS and Energy Management
QoS and Energy Management: Issues and Challenges in providing QoS, classifications, MAC, network layer solutions, QoS frameworks, need for energy management, classification, battery, transmission power, and system power management schemes.

Course Outcomes
Upon completion of the course, the students will be able to:
- Technical know how in building a WSN network.
- Analysis of various critical parameters in deploying a WSN

TEXTBOOKS

REFERENCES
Course Objectives

- Define basics of software architecture and its design
- know the necessity of documentation of the architecture
- Design a UML for software Architecture
- Design a case studies
- Explore modeling tools

Course Content

UNIT-I  Software Architecture

UNIT-II  Architectural Design

UNIT-III  Design Space for Architecture and models

UNIT-IV  Software Architecture Process and Documentation

UNIT-V Modeling Tools and Case studies
UML, SysML, AADL, Case studies-FCAPS systems, Big data systems, Banking system(Text1)

Course Outcomes

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

- analyze the abstraction of various architectural styles of a software
- analyze the software architectural design models to make design decisions
- analyze the design, validate and document the software architecture
- Design a algorithms for case studies
- Enforce tools to implement algorithm for case studies
Text Books

Reference Books
Course Objectives
- To understand the fundamentals of Mobile communication systems.
- To understand the different multiplexing scheme.
- To understand the significance of different layers in mobile system.
- To understand how to perform wireless communication

Course Content

Unit 1  Introduction
Introduction to wireless, mobile and cellular mobile systems- cellular mobile telephone systems, analog and digital cellular systems- frequency reuse, co-channel interference.

Unit 2  MAC
MAC - Medium access control - MAC, SDMA, FDMA, TDMA, CDMA, Hand offs and dropped calls- initiation of handoff, power difference, mobile assisted cell-site and Intersystem handoff.

Unit 3  Wireless Network

Unit 4  Mobile Network Layer
Mobile Network Layer - Network support for mobile systems – Mobile IP- IP packet delivery- Agent discovery- tunneling and encapsulation, reverse tunneling, IPV6, DHCP.

Unit 5  Mobile Transport Layer
Mobile Transport Layer - Mobile transport and application layer protocol - Review of traditional TCP, fast retransmit/fast recovery, transmission/timeout freezing, file systems, WWW, WAP.

Course Outcomes
Upon completion of the course, the students will be able to:
- Understand the concepts of mobile communication.
- Gain knowledge about wireless communications.
- Implement Mobile Applications.
- Apply the knowledge gained in exploring, application and protocol development.

Text Books

Reference Books
### Course Objectives
- To provide an in-depth and comprehensive knowledge of the Cloud Computing fundamental issues, technologies, applications and implementations.
- To expose the students to the frontier areas of Cloud Computing
- To motivate students to do programming and experiment with the various cloud computing environments
- To shed light on the Security issues in Cloud Computing
- To introduce about the Cloud Standards.

### Course Content

#### UNIT - I
History of Centralized and Distributed Computing - Overview of Distributed Computing, Cluster computing, Grid computing. Technologies for Network based systems- SOA – Hardware- MultiCore Systems – GPGPU- Data Storage

#### UNIT - II

#### UNIT - III
Service models - Infrastructure as a Service (IaaS) - Platform as a Service (PaaS) - Software as a Service (SaaS) - Anything as a service (XaaS) – Service Management

#### UNIT - IV

#### UNIT - V

### Course Outcomes
Upon completion of this course, the students will be able to:
- Articulate the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing
- Identify the architecture and infrastructure of cloud computing, including saas, paas, iaas, public cloud, private cloud, hybrid cloud
- Design a cloud with security, privacy, and interoperability.
- Provide the appropriate cloud computing solutions and recommendations according to the applications used.

### Text Book

### Reference Books
Course Code : CS617
Course Title : Cloud Security
Number of Credits : 3-0-0-3
Prerequisites (Course code) :
Course Type : PE

Course Objectives
- Compare modern security concepts as they are applied to cloud computing
- Assess the security of virtual systems in terms of infrastructure and data security
- Evaluate the security issues related to multi-tenancy
- Appraise compliance in security issues that arise from cloud computing

Course Content

Unit I: Introduction to cryptography
Secret Key Cryptography, Public Key Cryptography, Secret Key Cryptography, Advanced Encryption Standard (AES), Hashes and Message Digests: MD2;MD4;MD5, Public Key Algorithms: RSA

Unit II: Introduction to Cloud Security and Securing Cloud Architecture

Unit III: Infrastructure Security and Data Security
The network level: ensuring data confidentiality and integrity, ensuring proper access control, ensuring the availability of internet facing resources replacing the established model of network zones and tiers with domains, network level mitigation. The host level: SaaS and PaaS host security; IaaS host security, virtualization software security, virtual server security. The application level: DoS and EDoS, end user security, SaaS application security, PaaS application security, customer deployed application security, IaaS application security, aspects of data security, Data security mitigation and provider data and its security, data encryption, cloud data security, cloud data storage, cloud lock-in.

Unit IV: Security criteria, Evaluating Cloud Security and security management
Security control, best practices, security Monitoring, building an internal cloud security, selecting an external cloud provider, evaluating cloud security and checklists for evaluating cloud security, metrics for the checklists. Standards, availability management, SaaS availability management, PaaS availability management, IaaS availability management, security vulnerability, patch and configuration management.

Unit V: Operating Cloud Security

Course Outcomes
1. Understanding network security and cloud security.
2. Design the cloud security architecture that assures secure isolation of computer network and storage infrastructure comprehensive data protection.
3. Gaining knowledge about monitoring and auditing processes.
4. Evaluate cloud security and cloud security management

References

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CS618</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>Design and Analysis Parallel Algorithms</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3-0-0-3</td>
</tr>
<tr>
<td>Prerequisites (Course code)</td>
<td></td>
</tr>
<tr>
<td>Course Type</td>
<td>PE</td>
</tr>
</tbody>
</table>

**Course Objectives**
- To understand different array processors and parallel algorithms for multiprocessor.
- To perform the various operations on PRAM model.
- To perform merging and sorting operations on different models.
- To solve linear equations using parallel algorithms for basic problems.
- To study graph Algorithms

**Course Content**

**UNIT I**

**UNIT II**
Selection – broadcast- all sums- parallel selection. Searching a random sequence, sorted sequence on PRAM models, Tree and Mesh.

**UNIT III**

**UNIT IV**
Matrix operations- Transposition, Matrix by matrix multiplication, matrix by vector multiplication. Numerical problems- solving systems of linear equations, finding roots of non linear equations on PRAM models.

**UNIT V**

**Course Outcomes**
Upon completion of the course, the students will be able to:
- Describe the algorithms for array processors
- Develop searching algorithms for various kinds of models.
- Perform efficient sorting operation on different models.
- Solve linear and nonlinear equations using PRAM models.
- Construct graph and find solutions to real world problems.

**Text book:**
Course Code : CS619  
Course Title : Statistical Natural Language Processing  
Number of Credits : 3-0-0-3  
Prerequisites(Course code) :  
Course Type : PE

COURSE OBJECTIVES  
- To understand the need for morphological processing and their representation  
- To know about the various techniques used for speech synthesis and recognition  
- To appreciate the syntax analysis and parsing that is essential for natural language processing  
- To learn about the various representations of semantics and discourse  
- To have knowledge about the applications of natural language processing

UNIT I  Morphology And Part-Of-Speech Processing  

UNIT II  Speech Processing  

UNIT III  Syntax Analysis  

UNIT IV  Semantic and Pragmatic Interpretation  

UNIT V  Applications  

COURSE OUTCOMES  
Upon completion of this course, the student should be able to:  
- Identify the different linguistic components of natural language  
- Design a morphological analyser for a given natural language  
- Decide on the appropriate parsing techniques necessary for a given language and application  
- Design new tagset and a tagger for a given natural language  
- Design applications involving natural language
TEXT BOOKS

REFERENCE BOOKS
Course Code : CS620  
Course Title : Social Network Mining and Analysis  
Number of Credits : 3-0-0-3  
Prerequisites (Course code) :  
Course Type : PE

Course Objectives
- Describe about the current web development and emergence of social web
- Design modeling, aggregating and knowledge representation of semantic web
- Summarize knowledge on extraction and analyzing of social web
- Describe Association rule mining algorithms
- Recognize the evolution of social networks

Course Content

UNIT-I Introduction:

UNIT-II Modelling, Aggregating And Knowledge Representation:

UNIT-III Algorithms And Techniques:
Association Rule Mining, Supervised Learning, Unsupervised Learning, Semi-supervised Learning, Markov models, K-Nearest Neighbouring, Content-based Recommendation, Collaborative Filtering Recommendation, Social Network Analysis, Detecting Community Structure in Networks, the Evolution of Social Networks

UNIT-IV Extracting And Analyzing Web Social Networks:
Extracting Evolution of Web Community from a Series of Web Archive, Temporal Analysis on Semantic Graph using Three-Way Tensor, Decomposition, Analysis of Communities and Their Evolutions in Dynamic Networks.

UNIT-V Web Mining And Recommendation Systems:
User-based and Item-based Collaborative Filtering Recommender Systems, Hybrid User-based and Item-based Web Recommendation System, User Profiling for Web Recommendation Based on PLSA and LDA Model, Combining Long-Term Web Achieves and Logs for Web Query Recommendation

Course Outcomes
Upon completion of this course, the students will be able to:
- Design a model for social network data
- Apply general mining algorithms for social media data
- Design algorithms for handling social media data
- Interpret the semantic content of social media data
- Analyze the patterns involved in social media data

Text Books
Reference Books

## Course Code
CS621

## Course Title
Computational Geometry

## Number of Credits
3-0-0-3

## Prerequisites (Course code)

## Course Type
PE

### Course Objectives
- To introduction to geometric algorithms and related research issues.
- To exposure algorithms and data structures for geometric problems.
- To exposure to techniques for addressing degenerate cases.
- To exposure to randomization as a tool for developing geometric algorithms.

### Course Content

#### UNIT - I Convex hulls
Convex hulls: construction in 2d and 3d, lower bounds; Triangulations: polygon triangulations, representations, point-set triangulations, planar graphs; Voronoi diagrams: construction and applications, variants;

#### UNIT - II Delaunay triangulations
Delaunay triangulations: divide-and-conquer, flip and incremental algorithms, duality of Voronoi diagrams, min-max angle properties;

#### UNIT - III Geometric searching
Geometric searching: point location, fractional cascading, linear programming with prune and search, finger trees, concatenable queues, segment trees, interval trees; Visibility: algorithms for weak and strong visibility, visibility with reflections, art-gallery problems; Arrangements of lines: arrangements of hyperplanes, zone theorems, many-faces complexity and algorithms;

#### UNIT - IV Combinatorial geometry
Combinatorial geometry: Ham-sandwich cuts, Helly's theorems, k-sets, polytopes and hierarchies, polytopes and linear programming in d-dimensions, complexity of the union of convex sets, simply connected sets and visible regions;

#### UNIT - V Sweep techniques
Sweep techniques: plane sweep for segment intersections, Fortune's sweep for Voronoi diagrams, topological sweep for line arrangements; Randomization in computational geometry: algorithms, techniques for counting; Robust geometric computing; Applications of computational geometry.

### Course Outcomes
Upon completion of the course, the students will be able to:
- Introduce a variety of algorithmic techniques that apply to geometric problems
- Aim for diversity at the expense of getting the fastest known algorithms, which are typically obtained with amortized analysis
- Use Geometric algorithms in Computer Graphics, Databases, Wireless Networks (and the combined GIS systems), and Natural Sciences.

### Text Books

### Reference Books
2. Lecture Notes by David Mount.
Course Objectives
- To learn various types of File Systems and Database Architectures
- To understand the internal storage structures in a physical DB design.
- To know the fundamental concepts of transaction processing techniques.
- To understand the concept of ASM Instance.
- To know the manipulation of SQL Queries for transaction and concurrency control.
- To learn about Database Security and Database Maintenance.

Course Content

UNIT – I  File systems and databases
Data, information, databases, database management systems, data redundancy, database systems, DBMS functions, and connecting a client to the Oracle DBMS, Data models: entities, attributes, relationships, business rules. Data abstraction, conceptual, internal, and external models. Hands on: Installing and connecting to a database management system; introduction to SQL. Advanced Database Programming, Modeling and Normalization Performance Tuning, Security, Administration, and Ethical Issues, Transactions, Distributed, Clustered, Tiered and Mobile Databases Object-Oriented and Object-Relational Databases, The Web, XML, and Database Administration Business Intelligence: Data warehousing and Data Mining

UNIT - II  Exploring the Oracle Database Architecture
Introduction Exploring the Oracle Database Architecture, Connecting to a server, Oracle Database Server Architecture Instance: Database Configurations, Memory structures- Shared Pool, MS – Buffer Cache, MS- Redo Log Buffer, MS- Large Pool MS- Java Pool/Streams Pool, MS-PGA, Transactions, Properties (ACID Rules), Life Cycle.
Concurrency control- Types of concurrency control mechanisms, Crash Recovery Components, Undo and Redo operations, Examples for different component behaviors,
Managing the Database instance - Database initialization parameters modification, Stages of database startup, Database shutdown modes and options, Alert log, Using Trace Files, Dynamic performance views, Data Dictionary views, Data dictionary from SQL Expert.

UNIT – III  Managing the ASM instance
Benefits of using ASM, ASM instance processes and parameters, Interaction between database instances and ASM, ASM instance dynamic performance views, ASM system privileges, ASM disk groups, ASM disks, Allocation units, ASM files, Extent Maps, Striping granularity, Fine-Grained Striping, ASM Failure groups, Stripe and mirror example, Failure example, Managing disk groups, Adding disk to disk groups, Alter commands, ASM disk group compatibility, Disk Group Attributes, ASM Fast Mirror Resync Overview.
Configuring the Oracle Network environment: Creating additional listeners, Creating Oracle Net Service aliases, Configuring connect-time failover, Controlling the Oracle Net Listener, Using TNSPING to test Oracle Net connectivity, Shared servers versus dedicated servers, Managing Database Storage Structures: Storage of table row data in blocks, Oracle-Managed Files (OMF), Enlarging the database, Managing Data Concurrency: Locking mechanism, Oracle data concurrency management, Enqueue mechanism, Monitoring and resolving locking conflict
UNIT – IV  
**Administering User security**

Create and manage database user accounts: Authenticate users, Assign default storage areas (table spaces), Administer authentication, Grant and revoke privileges (system & object privileges) Create and manage roles, Predefined roles, Create and manage profiles, Supplied password verification Function, Assigning quotas to users, Principle of least privilege, Protect privileged Accounts Managing Undo Data: DML and undo data generation, Monitor and administer undo data, Difference between undo data and redo data, Configuring undo retention, Undo retention guarantee, Undo Advisor, Implementing Oracle Database Auditing: DBA responsibilities for security and auditing, Standard database auditing, DBA responsibilities for security and auditing, Standard database auditing, Specifying audit options, Audit information, Value-based auditing, Fine-Grained Auditing, FGA Guidelines, SYSDBA Auditing, Maintaining the audit trail, Oracle Audit Vault.

UNIT - V  
**Database Maintenance**

Database Maintenance: Managing optimizer statistics, Preferences for Gathering Statistics, Managing the Automatic workload Repository (AWR), Statistic Levels, Automatic Database Diagnostic Monitor (ADDM), Advisory framework, Automated Maintenance Tasks, Server-generated alerts, Setting alert thresholds, Reacting to alerts, Alert types and clearing Alerts, Performance Management: Use Enterprise Manager to monitor performance, Use Automatic Memory Management (AMM), Use the Memory Advisor to size memory buffers, View performance-related dynamic views, Troubleshoot invalid and unusable objects, Backup and Recovery Concepts: Types of failure that can occur in an Oracle database (statement/user process/network/Instance failures), Flashback Technology, Ways to tune instance recovery (Redo Log files/Log Writer), Using MTTR Advisor, Media failure, Configuring recoverability, Configuring the fast recovery area, Checkpoints, redo log files, and archive log files, Achiever process, Configuring ARCHIVELOG mode, Performing Database Backups: Consistent database backups, Oracle Secure Backup, User Managed Backup, Recovery Manager (RMAN), Backing Up the Control File to a Trace File, Performing Database Recovery: Opening a Database, Keeping a Database Open, Data Recovery Advisor, Loss of Control file/Redo Log file/data file/noncritical data file/system_critical data file, Data failure examples, Data recovery advisor, Recovery.

**Course Outcomes**

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

- design and develop an effective Database Architecture.
- maintain and manage user accounts in the Database
- administering the user Security.
- manage ASM instance.

**Text book**

1. *Oracle Database 11g: Administration Workshop1 (Volume 1 and 2).*

**Reference Books**

Course Code : CS623
Course Title : Big Data Analytics and Mining
Number of Credits : 3-0-0-3
Prerequisites (Course code) :
Course Type : PE

Course Objectives

- To understand big data and data analytics lifecycle
- To learn Basic Data analytic methods using R
- To Get a knowledge on advanced analytical methods, technology and tools

Course Content

UNIT-I  Big data overview
State of the practice in Analytics-Key roles for new big data ecosystem Data Analytics Lifecycle-Data analytics lifecycle overview- Discovery- Data Preparation-Model Planning-Model Building-Communicate Results-operationalize

UNIT-II  Introduction to R
Exploratory Data Analytics-Statistical methods for evaluation Hadoop & Map Reduce framework for R, R with Relational Database Management Systems, R with Non-Relational (NoSQL) DBs

UNIT-III  Clustering

UNIT-IV  Classification
Decision Trees-Naïve Bayes-Diagnostics of Classifiers-Additional classification methods, Time series Analysis-Overview of Time series analysis-ARIMA Model-Additional methods, Text Analysis-Text analysis steps-A text analysis Example-Collecting raw Text-Representing Text-Term Frequency—Inverse document frequency(TFIDF)-Categorizing documents by Topics-Determining Sentiments-Gaining insights

UNIT-V  Analytics for Unstructured data
The Hadoop Ecosystem-NoSQL, In-Database Analytics-SQL Essentials-In-Database Text Analysis-Advanced SQL

Course Outcomes

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

- Understand the big data concepts
- Utilize and apply the Analytical methods, Technology and tools in the industry.
- Understand hadoop ecosystem and apply to solve real-life problems

Text Books


Reference Books

Course Objectives

- To understand computation and computability concepts.
- To study different approaches to facilitate computing
- To learn the abstractions of computation and their implementations

UNIT I  Turing Machine Model
Turing Machine Logic, Proof, Computability.

UNIT II  Quantum Computation
Quantum Computing History, Postulates of Quantum Theory, Dirac Notation, the Quantum Circuit Model, Teleportation, Superdense Coding, Foundation Algorithms

UNIT III  Nature Inspired Computing
Nature-Inspired Computing Optimization and Decision Support Techniques, Evolutionary Algo
Benchmarks and Testing

UNIT IV  Social Computing
Social Computing Online communities, Online discussions, Twitter, Social Networking Systems. Crowdsourcing, Facebook, blogs, wikis, social recommendations, Collective intelligence

UNIT V  Evolutionary Computing

OUTCOMES:
Upon completion of this course, the student should be able to
- Identify the terminology of the theory of computing
- Predict the major results in computability and complexity theory.
- Prepare the major models of computations

Text books

References books:
Course Code : CS625
Course Title : Cognitive Science
Number of Credits : 3-0-0-3
Prerequisites (Course code) :
Course Type : PE

Course Objectives
- To know concepts, approaches and issues in the field of cognitive science
- to increase the awareness of the students to the questions raised in the disciplines of computer science, linguistics, philosophy and psychology
- to focus on the interaction of these disciplines in approaching the study of the mind
- To make specialization on topics central to cognitive science such as the nature of mental representation, reasoning, perception, language use
- To learn other cognitive processes of humans and other intelligent systems.

Course Content

UNIT - I Introduction
Introduction to the study of cognitive sciences. A brief history of cognitive science. Methodological concerns in philosophy, artificial intelligence and psychology. Structure and constituents of the brain; Brief history of neuroscience; Mathematical models; Looking at brain signals; Processing of sensory information in the brain.

UNIT - II Neural Network Models
Neural Network Models; Processing of sensory information in the brain; motor and sensory areas; Brain Imaging, fMRI, MEG, PET, EEG; Multisensory integration in cortex; information fusion; from sensation to cognition, cybernetics; From physics to meaning; Analog vs. Digital: Code duality.

UNIT - III Linguistic Knowledge
What is language?; Linguistic knowledge: Syntax, semantics, (and pragmatics); Generative linguistics; Brain and language; Language disorders; Lateralization; The great past tense debate; Cognitivist and emergent standpoints ; A robotic perspective.

UNIT - IV Robotics
Affordances, direct perception, Ecological Psychology, affordance learning in robotics; Development, child and robotic development; Attention and related concepts; Human visual attention; Computational models of attention; Applications of computational models of attentional.

UNIT - V Machine Learning
Categories and concepts; Concept learning; Logic ; Machine learning; Constructing memories; Explicit vs. implicit memory; Information processing (three-boxes) model of memory; Sensory memory; Short term memory; Long term memory; Rationality; Bounded rationality; Prospect theory ; Heuristics and biases; Reasoning in computers; Key points in social cognition; Context and social judgment; Schemas; Social signals.

Course Outcomes
Upon completion of the course, the students will be able to:
- Know Introduction to Cognitive Science, Psychology, Nervous system and brain
- Understand Brain and sensory motor information, Representation of sensory information
- Analyse From Sensation to Cognition; Roots of Cognitive Science
- Develop Language and Embodiment
- Implement Affordances in biological and artificial systems, Cognitive Development
- Make Attention, Learning, Memory, Reasoning, Social Cognition.
**Text Books**

**Reference Books**
Course Objectives

- To understand Smart Objects and IoT Architectures
- To learn about various IOT-related protocols
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications

Course Content

UNIT-I   Fundamentals Of Iot

UNIT-II   Iot Protocols
IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition – Application Layer Protocols: CoAP and MQTT

UNIT-III  Design And Development

UNIT-IV   Data Analytics And Supporting Services

UNIT-V   Case Studies/Industrial Applications

Course Outcomes

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

- Explain the concept of IoT.
- Analyze various protocols for IoT.
- Design a PoC of an IoT system using Rasperry Pi/Arduino
- Apply data analytics and use cloud offerings related to IoT.
- Analyze applications of IoT in real time scenario

Text Books

2. Arshdeep Bahga, Vijay Madisetti, —Internet of Things – A hands-on approach, Universities Press, 2015
Reference Books
Course Objectives
- To understand the fundamentals of digital image processing
- To have an knowledge on image and video analysis.
- To understand the real time use of image and video analytics.
- To understand the processing of images and videos
- To demonstrate real time image and video analytics applications.

Course Content

Unit 1 Introduction

Unit 2 Basic Techniques of image processing

Unit 3 Transformations and Segmentations

Unit 4 Detection and Classification
Object detection and recognition in image and video-Texture models Image and Video classification models- Object tracking in Video.

Unit 5 Applications and Case studies
Industrial- Transportation & Travel- Remote Sensing-Video Analytics in WSN: IoT Video Analytics Architectures.

Course Outcomes
Upon completion of this course, the students will be able to:
- Describe the fundamental principles of image analysis
- Have an idea of various image processing techniques.
- Apply pattern recognition techniques.
- Apply image analysis in real world problem
- Extend the technologies for analyzing and processing of videos.

Text Books

Reference Books
Course Code : CS628
Course Title : Information Visualization
Number of Credits : 3-0-0-3
Prerequisites (Course code) :
Course Type : PE

Course Objectives
- To introduce visual perception and core skills for visual analysis
- To understand visualization for time-series analysis
- To understand visualization for ranking analysis AND deviation analysis
- To understand visualization for distribution analysis and correlation analysis
- To understand visualization for multivariate analysis
- To understand issues and best practices in information dashboard design

Course Content

UNIT I   Introduction

UNIT II  Time Analysis And Ranking Pattern

UNIT III  Distribution And Correlation Analysis

UNIT IV  Introduction To Dashboard

UNIT V  Analysis And Designing Of Dashboard

Course Outcomes
Upon completion of this course, the students will be able to:
- Explain principles of visual perception
- Apply core skills for visual analysis
- Apply visualization techniques for various data analysis tasks
- Design information dashboard

Text Books
Reference Books

Course Code: CS629
Course Title: Knowledge Management
Number of Credits: 3-0-0-3
Prerequisites (Course code): PE

Course Objectives
- To give an overview of Knowledge management, its evolution and the challenges it faces.
- To acquire the knowledge about building the learning organization and how knowledge markets are managed.
- To know the use of Knowledge management tools.
- To learn in-depth details about various knowledge management applications.
- To expose the future trends and challenges in knowledge management.

Course Content

Unit 1 Introduction
An Introduction to Knowledge Management - The foundations of knowledge management - including cultural issues - technology applications organizational concepts and processes - management aspects - and decision support systems. The Evolution of Knowledge management: From Information Management to Knowledge Management - Key Challenges Facing the Evolution of Knowledge Management - Ethics for Knowledge Management

Unit 2 Organization And Knowledge Management

Unit 3 Telecommunications And Networks In Knowledge Management
Telecommunications and Networks in Knowledge Management - Internet Search Engines and Knowledge Management - Information Technology in Support of Knowledge Management - Knowledge Management and Vocabulary Control - Information Mapping in Information Retrieval - Information Coding in the Internet Environment - Repackaging Information.

Unit 4 Components Of A Knowledge Strategy
Components of a Knowledge Strategy - Case Studies (From Library to Knowledge Center, Knowledge Management in the Health Sciences, Knowledge Management in Developing Countries).

Unit 5 Advanced Topics And Case Studies In Knowledge Management
Advanced topics and case studies in knowledge management - Development of a knowledge management map/plan that is integrated with an organization's strategic and business plan - A case study on Corporate Memories for supporting various aspects in the process life-cycles of an organization.

Course Outcomes
Upon completion of this course, the students will be able to:
- Ability to understand the fundamental concepts in knowledge management.
- Ability to understand the importance of knowledge sharing.
- Ability to know usage of knowledge management tools for various applications.
- Ability to develop knowledge management applications.
- Ability to design and develop enterprise knowledge management applications.

Text Books
**Reference Books**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>CS630</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Title</td>
<td>Text Mining</td>
</tr>
<tr>
<td>Number of Credits</td>
<td>3-0-0-3</td>
</tr>
<tr>
<td>Prerequisites (Course code)</td>
<td></td>
</tr>
<tr>
<td>Course Type</td>
<td>PE</td>
</tr>
</tbody>
</table>

**Course Objectives**
- Describe text extraction techniques.
- Differentiate clustering and classification techniques on text.
- Analyze visualization methodologies.
- Illustrate about event detection methods and embedding semantics in models.
- Compare feature extraction methods

**Course Content**

**Unit-I: Text Extraction**

**Unit-II: Clustering**
Clustering: Multilingual document clustering: Multilingual LSA, Tucker1 method, PARAFAC2 method, LSA with term alignments, LMSA, LMSA with term alignments.

**Unit-III: Classification**
Classification: Content-based spam email classification using machine-learning algorithms, Utilizing nonnegative matrix factorization for email classification problems, Constrained clustering with k-means type algorithms.

**Unit-IV: Anomaly and trend detection**
Anomaly and trend detection: Text Visualization techniques such as tag clouds, authorship and change tracking, Data Exploration and the search for novel patterns, sentiment tracking, visual analytics and FutureLens, scenario discovery, adaptive threshold setting for novelty mining.

**Unit-V: Text streams**

**Course Outcomes**
Upon completion of this course, the students will be able to:
- Design text extraction techniques.
- Design clustering techniques for text.
- Design classification techniques for text.
- Practice visualization methodologies using tools.
- Practice feature extraction using tools

**Text Books**
1. Michael W. Berry & Jacob Kogan, "Text Mining Applications and Theory", Wiley publications.
Reference Books

Course Objectives
• To understand the basic digital forensics and techniques for conducting the forensic examination on different digital devices.
• To understand how to examine digital evidences such as the data acquisition, identification analysis.
• To understand the basics of mobile phone forensics.
• To understand the network based cyber security intrusion detection.
• To know the various forensics tool.

Course Content

UNIT-I Introduction
Computer forensics fundamentals, computer crimes, Understanding Computing Investigations – Procedure for corporate High-Tech investigations, understanding data recovery work station and software, conducting and investigations.

UNIT-II Data Acquisition
Data acquisition- understanding storage formats and digital evidence, determining the best acquisition method, acquisition tools, validating data acquisitions, performing RAID data acquisitions, remote network acquisition tools, other forensics acquisitions tools.

UNIT-III Network Forensic
Collecting and analyzing network-based evidence, reconstructing web browsing, email activity, and windows registry changes, intrusion detection, tracking offenders. E-Mail investigations- investigating email crime and violations, understanding E-Mail servers, specialized E-Mail forensics tool.

UNIT-IV Mobile Network Forensic

UNIT-V Processing Crime
Processing crimes and incident scenes, securing a computer incident or crime, seizing and storing digital evidence at scene, obtaining digital hash, reviewing case, current computer forensics tools - software, hardware tools, validating and testing forensic software, addressing data-hiding techniques.

Course Outcomes
Upon completion of this course, the students will be able to:
• Know how to apply forensic analysis tools to recover important evidence for identifying computer crime.
• train as next-generation computer crime investigators.
• identify the background of various forensic techniques.
• use correct tool for the particular case.
• classify the different kind of data.

Text Books
Reference Books
Course Code : CS632
Course Title : Principles of Machine Learning And Deep Learning
Number of Credits : 3-0-0-3
Prerequisites (Course code) :
Course Type : PE

Course Objectives
- To understand the basic building blocks and general principles that allow one to design machine learning algorithms
- To become familiar with specific, widely used machine learning algorithms
- To introduce building blocks of deep neural network architecture
- To understand representation and transfer of knowledge using deep learning
- To learn to use deep learning tools and framework for solving real-life problems

Course Content
UNIT-I  Introduction

UNIT-II  Supervised and Unsupervised Learning
Decision Tree - Representation, hypothesis, issues in Decision Tree Learning, Pruning, Rule extraction from Tree, Learning rules from Data, Probabilistic classifier: Bayes rule, Nearest Neighbor, Clustering: Unsupervised learning technique, Similarity and Distance Measures, k-means and k-medoids algorithm.

UNIT-III  Deep Networks

UNIT-IV  Convolutional Networks
Convolution operation, Motivation, Pooling, Convolution and Pooling as strong prior, Efficient convolution algorithms, Unsupervised features, Sequence Modeling: Recurrent and Recursive Nets, LSTM Networks, Applications - Computer Vision, Speech Recognition, Natural Language Processing.

UNIT-V  Deep Learning Frameworks

Course Outcomes
Upon completion of this course, the students will be able to:
- Ability to implement and apply machine learning algorithms to real-world applications.
- Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains
- Incorporate transfer of knowledge in machine learning algorithms
- Implement deep learning algorithms and solve real-world problems

Text Books
1. Ethem Alpaydin, Introduction to Machine Learning, PHI, 2005
Reference Books

Course Objectives

- To Understand how Text, Audio, Image and Video information can be represented digitally in a Computer
- To Learn the basic audio coding techniques
- To Understand the bi-level Image lossless coding techniques, grayscale and colour image coding techniques.
- To Understand lossy Image, video Coding techniques

Course Content

UNIT -I  Multimedia Representation

UNIT- II  Coding Techniques
Basic Coding Techniques-Introduction to Data Compression - Information Theory -Statistical Coding - Dictionary Based Coding – Audio Coding.

UNIT-III  Lossless Image Coding
Lossless Image Coding-Bi-Level -Reflected Gray Codes - Predictive Coding –GIF-Lossless JPEG

UNIT-IV  Lossy Image Coding

UNIT-V  Video Coding
Video Coding (Lossy)-Video Coding Concepts - The Hybrid DPCM/DCT Algorithm-Motion Compensated Prediction- Motion Estimation-Standards: H.261, MPEG-1,2,4,7.

Course Outcomes
Upon completion of this course, the students will be able to:

- Study representation of different multimedia formats.
- Develop new algorithms for multimedia compression
- Explore new techniques in the areas of Multimedia applications
- Explore the possibility of applying Multimedia concepts in various domains

Text Books

Reference Books
Course Code : CS634
Course Title : Principles of Datawarehousing and Data Mining
Number of Credits : 3-0-0-3
Prerequisites (Course code) :
Course Type : PE

Course Objectives
- To understand the principles of Data warehousing and Data Mining.
- To be familiar with the Data warehouse architecture and its Implementation.
- To know the Architecture of a Data Mining system.
- To understand the various Data Pre-processing Methods.
- To understand the various classification and clustering techniques
- To get an introduction to spatial, multimedia and text mining

Course Content

UNIT-I   Data Warehousing

UNIT-II  Data Mining

UNIT-III  Classification and Prediction
Issues Regarding Classification and Prediction – Classification by Decision Tree Introduction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction – Accuracy and Error Measures – Evaluating the Accuracy of a Classifier or Predictor – Ensemble Methods – Model Section.

UNIT-IV  Cluster Analysis
Types of Data in Cluster Analysis – Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model Based Clustering Methods – Clustering High-Dimensional Data – Constraint-Based Cluster Analysis – Outlier Analysis.

UNIT-V  Advanced Mining Techniques
Mining Object, Spatial, Multimedia, Text and Web Data: Multidimensional Analysis and Descriptive Mining of Complex Data Objects – Spatial Data Mining – Multimedia Data Mining – Text Mining – Mining the World Wide Web Introduction to big data, big data analytics, NoSQL systems, Hadoop, PIG and HIVE

Course Outcomes
Upon completion of this course, the students will be able to:
- Technical knowhow of the Data Mining principles and techniques for real time applications.
- Apply the knowledge of data classification to classify any real time data
- Measure the performance of any classification algorithm
- Select and apply proper clustering techniques to build analytical applications
- Discover the knowledge from the high dimensional system
Text Books

Reference Books
Course Code : CS635
Course Title : Hardware Security
Number of Credits : 3-0-0-3
Prerequisites (Course code) :
Course Type : PE

Course Objectives
- To understand the different issues in hardware security
- To introduce the side channel attacks and counter measures to avoid it.
- To study the detection and prevention of Hardware Trojan.
- To know the legal, ethical and professional issues in Information Security.
- To know the aspects of risk management.

Course Content

UNIT - I Preliminaries
Algebra of Finite Fields, Basics of the Mathematical Theory of Public Key Cryptography, Basics of Digital Design on Field-programmable Gate Array (FPGA), Classification using Support Vector Machines (SVMs).


UNIT- II Side-channel Attacks on Cryptographic Hardware
Basic Idea, Current-measurement based Side-channel Attacks (Case Study: Kochers Attack on DES), Design Techniques to Prevent Side-channel Attacks, Improved Side-channel Attack Algorithms (Template Attack, etc.), Cache Attacks

UNIT – III Testability and Verification of Cryptographic Hardware

UNIT – IV Hardware Trojans and Their Detection
Hardware Trojan Nomenclature and Operating Modes, Countermeasures Such as Design and Manufacturing Techniques to Prevent/Detect Hardware Trojans, Logic Testing and Side-channel Analysis based Techniques for Trojan Detection, Techniques to Increase Testing Sensitivity.

UNIT – V Infrastructure Security
Impact of Hardware Security Compromise on Public Infrastructure, Defense Techniques (Case Study: Smart-Grid Security)

Course Outcomes:
Upon completion of this course, the students will be able to:
- Develop algorithms to eliminate side channel attacks.
- Design new techniques that will increase puff response quality.
- Model new arbiter puffs.
- Become aware of various standards in the Information Security System.
- Illustrate the legal, ethical and professional issues in information security.

Text Books

Reference Books
Course Code : CS636  
Course Title : Advanced Digital Design  
Number of Credits : 3-0-0-3  
Prerequisites (Course code) :  
Course Type : PE  

Course Objectives

- To understand the basic building blocks, logic gates, adders, multipliers, shifters and other digital devices
- To apply logic minimization techniques, including Karnaugh Maps
- To learn techniques and tools for programmable logic design

Course Content

UNIT-I Combinational and Sequential logic design
Review of Combinational and Sequential logic design – Structural models of combinational logic – Propagation delay – Behavioral Modeling – Boolean equation based behavioral models of combinational logic – Cyclic behavioral model of flip-flop and latches – A comparison of styles for behavioral modeling – Design documentation with functions and tasks

UNIT-II Synthesis of Combinational and Sequential logic

UNIT-III Design and Synthesis of Datapath Controllers

UNIT-IV Programmable devices
Programmable logic devices – Storage devices – Programmable Logic Array (PLA) – Programmable Array Logic (PAL) – Programmability of PLDs – Complex PLDs – Introduction to Altera and Xilinx FPGAs – Algorithms – Nested loop programs and data flow graphs – Design Example of Pipelined Adder, Pipelined FIR Filter – Circular buffers – FIFOs and Synchronization across clock domains – Functional units for addition, subtraction, multiplication and division – Multiplication of signed binary numbers and fractions.

UNIT-V Postsynthesis Design Validation

Course Outcome

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

- Understand the use standard digital memory devices as components in complex subsystems
- Obtain technical knowhow to design simple combinational logic circuits and logic
- Acquire skill set to develop the necessary software for basic digital systems

Text Book

Reference Books
Course Code : CS637  
Course Title : Real Time Systems  
Number of Credits : 3-0-0-3  
Prerequisites (Course code) :  
Course Type : PE

Course Objectives
- To study issues related to the design and analysis of systems with real-time constraints.
- To learn the features of Real time OS.
- To learn about computer control and hardware requirements for Real time systems.
- To study the methods of developing Real time applications.
- To study the difference between different Real time system development methodologies.

Course Content

UNIT-I  Introduction to real–time computing

UNIT-II  Hardware Requirements for Real-Time Applications

UNIT-III  Languages for Real-Time Applications

UNIT-IV  Real Time Operating Systems

UNIT-V  RTS Development Methodologies

Course Outcomes
Upon completion of this course, the students will be able to:
- Understand classifications of Real time systems.
- Comprehend Real-time programming environments
- Schedule jobs in Real time systems
- Develop real time systems.

Text Books

Reference Books
Course Code : CS638
Course Title : Smart phone computing
Number of Credits : 3-0-0-3
Prerequisites (Course code) :
Course Type : PE

Course Objectives
- Recognize the different challenges in mobile computing
- Estimate the measurement and management of energy for wireless devices
- Categorize about the different interface design issues
- Identify Gesture Recognition
- Privacy and Security in mobile computing

Course Content
UNIT-I Introduction & Programming platforms:
Introduction: Challenges in mobile computing, convergence of sensing, computing, and communications, Introduction to smartphones, tablet, PDA, or other digital mobile devices, Introduction to smartphone system architecture.

Programming platforms: Overview of different mobile programming environments, Difference with the classical programming practices, Introduction to mobile operating systems, iOS, Android, Windows, Mobile application development.

UNIT-II Wireless Energy Management & Localization
Wireless Energy Management: Measurement of energy consumption, WiFi Power Save Mode (PSM), Constant Awake Mode (CAM), Different Sleep States, WiFi Energy management.

Localization: User location and tracking system, Cell tower localization, Spot localization, Logical location, Ambience fingerprinting, War-driving, Localization without war-driving, Indoor localization, Crowd sourcing for localization.

UNIT-III Location Privacy & Context Sensing
Location Privacy: Different approaches, K-anonymity, CliqueCloak, Location Privacy, Applications with location proof.
Lab Component: (if applicable)

UNIT-IV Activity and Gesture Recognition
Activity and Gesture Recognition: Machine Recognition of Human Activities, Mobile Phones to Write in Air, Personalized Gesture Recognition, Content Rating, Recognizing Human without Face Recognition, Phone-to-Phone Action Games, Interface design issues, Touchscreen, Gesture-based Input.

UNIT-V Mobility & Privacy and Security & Miscellany
Mobility: Overview of Mobility models, Automatic Transit Tracking, Mapping, Arrival Time Prediction, Augmenting Mobile 3G with WiFi, Vehicular WiFiHotspots, Code Offload

Privacy and Security: Authentication on Mobile Phones, Activity based Password, Finger Taps usage as Fingerprints

Miscellany: Cloud-based services, Peer-to-peer applications, Delay-tolerance, Mobile social networking.
Course Outcomes
Upon completion of this course, the students will be able to:
• Create and enhance the localization and tracking systems.
• Assess and improve services available for mobile social networking.
• Design secure critical applications on mobile.
• Develop an algorithm for Gesture Recognition
• Develop an algorithm for Security in mobile computing

Text Books
1. Smart Phone and Next Generation Mobile Computing (Morgan Kaufmann Series in Networking), PeiZheng, Lionel Ni, 2005

Reference Books