KERALA TECHNOLOGICAL UNIVERSITY

ERNAKULAM – I CLUSTER

SCHEME AND SYLLABI

FOR

M. Tech. DEGREE PROGRAMME

IN

COMPUTER SCIENCE : SPECIALIZATION IN INFORMATION SYSTEMS

(2015 ADMISSION ONWARDS)
## SCHEME AND SYLLABI FOR M. Tech. DEGREE PROGRAMME IN COMPUTER SCIENCE : SPECIALIZATION IN INFORMATION SYSTEMS

### SEMESTER 1 (CREDITS: 23)

<table>
<thead>
<tr>
<th>Exam Slot</th>
<th>Course No</th>
<th>Course Title</th>
<th>Core/Elective</th>
<th>L-T-P</th>
<th>Internal Marks</th>
<th>End Semester Exam Marks</th>
<th>Duration (hrs)</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>06 CS 6 01 3</td>
<td>Mathematical Foundation For Computer Science</td>
<td>Core</td>
<td>4-0-0</td>
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<td>B</td>
<td>06 CS 6 02 3</td>
<td>Advanced Data Structures</td>
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<td>C</td>
<td>06 CS 6 03 3</td>
<td>Operating System Design</td>
<td>Core</td>
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<td>D</td>
<td>06 CS 6 04 3</td>
<td>Computer System Design and Architecture</td>
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<td>E</td>
<td>06 CS 6 x5 3</td>
<td>Elective I</td>
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<td>3-0-0</td>
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<td>0-0-2</td>
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<table>
<thead>
<tr>
<th>Semester I – 06 CS 6 x5 3</th>
<th>Elective I</th>
</tr>
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<tbody>
<tr>
<td>06 CS 6 15 3</td>
<td>Digital Image Processing</td>
</tr>
<tr>
<td>06 CS 6 25 3</td>
<td>Data Mining Concepts</td>
</tr>
<tr>
<td>06 CS 6 35 3</td>
<td>Object Oriented Software Engineering</td>
</tr>
<tr>
<td>06 CS 6 45 3</td>
<td>Information Theory and Coding</td>
</tr>
<tr>
<td>06 CS 6 55 3</td>
<td>Foundation of Information Security</td>
</tr>
<tr>
<td>06 CS 6 65 3</td>
<td>Wireless Communication</td>
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24 Hrs 23 Credits
### Semester II (Credits: 19)

<table>
<thead>
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<th>Exam Slot</th>
<th>Course No</th>
<th>Course Title</th>
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<th>L-T-P</th>
<th>Internal Marks</th>
<th>End Semester Exam Marks</th>
<th>Duration (hrs)</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>06 CS 6 01 4</td>
<td>Algorithm Analysis and Design</td>
<td>Core</td>
<td>4-0-0</td>
<td>40</td>
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<tr>
<td>B</td>
<td>06 CS 6 02 4</td>
<td>Advanced Computer Networks</td>
<td>Core</td>
<td>3-0-0</td>
<td>40</td>
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<tr>
<td>C</td>
<td>06 CS 6 03 4</td>
<td>Computer Security and Applied Cryptography</td>
<td>Core</td>
<td>3-0-0</td>
<td>40</td>
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<tr>
<td>D</td>
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<td>E</td>
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<td>Advanced Computing Lab II</td>
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**22 Hrs**

**19 Credits**

#### Semester II - 06 CS 6 x4 4 Elective II

- 06 CS 6 14 4 Pattern Recognition
- 06 CS 6 24 4 Natural Language Processing & Text Mining
- 06 CS 6 34 4 Software Architecture
- 06 CS 6 44 4 Soft Computing
- 06 CS 6 54 4 Parallel Computer Architecture
- 06 CS 6 64 4 Wireless Sensor Networks

#### Semester II – 06 CS 6 x5 4 Elective III

- 06 CS 6 15 4 Computer Vision
- 06 CS 6 25 4 Ontology and Semantic Web
- 06 CS 6 35 4 Software Project Management
- 06 CS 6 45 4 Cloud Computing
- 06 CS 6 55 4 Compiler Design
- 06 CS 6 65 4 Advanced Database Concepts
# SEMESTER 3 (CREDITS: 14)

<table>
<thead>
<tr>
<th>Exam Slot</th>
<th>Course No</th>
<th>Course Title</th>
<th>Core/Elective</th>
<th>L-T-P</th>
<th>Internal Marks</th>
<th>End Semester Exam Marks</th>
<th>Duration (hrs)</th>
<th>Credits</th>
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<tbody>
<tr>
<td>A</td>
<td>06 CS 7 x1 3</td>
<td>Elective IV</td>
<td>Elective</td>
<td>3-0-0</td>
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<tr>
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<td>06 CS 7 x2 3</td>
<td>Elective V</td>
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<td>06 CS 7 04 3</td>
<td>Project – Phase I</td>
<td>Project</td>
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20 Hrs 14 Credits

**Semester III – 06 CS 7 x1 3 Elective IV**

- 06 CS 7 11 3 Data Compression
- 06 CS 7 21 3 Data Analytics
- 06 CS 7 31 3 Advanced Software Testing
- 06 CS 7 41 3 High Performance Computing
- 06 CS 7 51 3 Mobile Network Security

**Semester III – 06 CS 7 x2 3 Elective V**

- 06 CS 7 12 3 Content Based Image and Video Retrieval
- 06 CS 7 22 3 Social Network Analytics
- 06 CS 7 32 3 Cyber Forensics
- 06 CS 7 42 3 Real Time Systems
- 06 CS 7 52 3 Advanced Information Security Concepts

# SEMESTER 4 (CREDITS: 12)

<table>
<thead>
<tr>
<th>Exam Slot</th>
<th>Course No</th>
<th>Course Title</th>
<th>Core/Elective</th>
<th>L-T-P</th>
<th>Internal Marks</th>
<th>End Semester Exam Marks</th>
<th>Duration (hrs)</th>
<th>Credits</th>
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<tbody>
<tr>
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<td>06 CS 7 01 4</td>
<td>Project – Phase II</td>
<td>Project</td>
<td>0-0-21</td>
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21 Hrs 12 Credits

**Total Credits for the Course: 68 credits**
SEMESTER I
Course No. | Course Name | L-T-P-Credits | Year of Introduction
--- | --- | --- | ---
06 CS 6 01 3 | MATHEMATICAL FOUNDATIONS FOR COMPUTER SCIENCE | 4-0-0-4 | 2015

PREREQUISITES:
1. Knowledge of probability theory
2. Basic idea of matrices, operations and set theory
3. Knowledge of different types of functions (transitive, asymmetric, symmetric etc) and relations.

COURSE OBJECTIVES:
- To provide students with a good understanding of the concepts of information theoretic methods, linear algebra, fuzzy theory and abstract algebra described in the syllabus.
- To help the students develop the ability to solve problems using the learned concepts.
- To connect the concepts to other domain both within and without mathematics such as machine learning, pattern recognition and cryptography.

SYLLABUS:
Concept of amount of information, Linear Algebra, Crisp sets and Fuzzy sets, Basic concepts of Groups.

EXPECTED OUTCOME:
Students will be able to:
1. Apply the mathematical concepts of information theoretic methods for the identification of information flow over channels (noisy and noiseless).
2. Analyze the fundamental use of matrices in the computer algorithms related to dimensionality reduction and feature extraction.
3. Visualize the use of fuzzy set and apply the concepts of abstract algebra in different algorithms related to cryptography.

TEXT BOOKS:
3. George J Klir and Bo Yuan, "Fuzzy sets and Fuzzy logic” Prentice-Hall of India, 1995

REFERENCES:

COURSE PLAN
<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Concept of amount of information-Entropy-Joint and Conditional Entropy-Relative Entropy-Mutual information-Relationship between Entropy and Mutual information-Rate of information-Channel capacity-Redundancy and efficiency of channels – Huffman Codes</td>
<td>12</td>
<td>25%</td>
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<tr>
<td>II</td>
<td>Linear Algebra – Linear transformation – matrices &amp; operations – eigenvalues and eigenvectors – covariance matrices, modulo arithmetic – Additive and multiplicative inverses of natural numbers under modulo arithmetic - Euler's theorem &amp; Fermat's theorem – Chinese Remainder theorem– Cauchy Schwarz Inequality – Cosine similarity – Function continuity and monotonic functions</td>
<td>14</td>
<td>25%</td>
</tr>
<tr>
<td>III</td>
<td>Crisp sets and Fuzzy sets-, α-cuts, Convex fuzzy sets, Fuzzy cardinality, Algebra of fuzzy sets, Standard fuzzy set operations-(complement, union and intersection), Yager and Sugeno classes. Crisp relations and Fuzzy relations, Operations on Fuzzy relations. Fuzzy Cartesian product. Fuzzy Equivalence relations and similarity relations.</td>
<td>12</td>
<td>25%</td>
</tr>
<tr>
<td>IV</td>
<td>Basic concepts of Groups, rings with examples, Field Theory: basic theory of field extensions, algebraic extensions, classical straightedge and compass constructions, splitting fields and algebraic closures, separable and inseparable extensions, cyclotomic polynomials and extensions</td>
<td>12</td>
<td>25%</td>
</tr>
<tr>
<td>IV</td>
<td>Galois Theory: basic definitions, the fundamental theorem of Galios theory, Finite Fields, composite extensions and Abelian extensions over Q, Galios groups of polynomials, solvable and radical extensions, computations of Galios Groups over Q, Transcendental extensions, inseparable extensions, infinite Galios Groups</td>
<td>10</td>
<td>25%</td>
</tr>
<tr>
<td>Course No.</td>
<td>Course Name</td>
<td>L-T-P-Credits</td>
<td>Year of Introduction</td>
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<tr>
<td>06 CS 6 02 3</td>
<td>ADVANCED DATA STRUCTURES</td>
<td>4-0-0-4</td>
<td>2015</td>
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</table>

**PREREQUISITES:**
- Basics of Datastructures and its implementation
- Fundamentals of algorithm analysis and design

**COURSE OBJECTIVES:**
- Introduce new & advanced data structures
- Introduce algorithmic design and analysis
- Solve problems using different data structures and design techniques, and compare their performance and tradeoffs
- Choose the data structures that effectively model the problem.
- Identify problems where advanced ADTs are appropriate and select or design the most suitable ADT for the given task.

**SYLLABUS:**
Trees, Priority Queues, Data Structures for Disjoint Sets, Maximum Flow.

**EXPECTED OUTCOME:**
The students will be able to
- understand and implement advanced data structures such as trees and heaps.
- evaluate the performance of basic operations (like search, insert, delete) associated with the data structure.
- apply the advanced data structures on domain specific application areas such as computer networks, image segmentation, text mining process scheduling problems etc.

**TEXT BOOKS:**

**REFERENCES:**
- Sara Baase & Allen Van Gelder, Computer Algorithms – Introduction to Design and Analysis, Pearson Education
- Algorithm Design: Jon Kleinberg and Eva Tardos, Addison Wesley

<table>
<thead>
<tr>
<th>COURSE PLAN</th>
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<tbody>
<tr>
<td>Module</td>
<td>Contents</td>
</tr>
<tr>
<td>II</td>
<td>Priority Queues - Single and Double Ended Priority Queues, Leftist Trees, Skew Heaps, Binomial Heaps, Fibonacci Heaps, Pairing Heaps, Symmetric Min-Max Heaps, Interval Heaps</td>
</tr>
<tr>
<td>FIRST INTERNAL EXAM</td>
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<tr>
<td>III</td>
<td>Data Structures for Disjoint Sets, Disjoint-set operations, Linked-list representation of disjoint sets, Disjoint-set, forests, Analysis of union by rank with path compression, Medians and Order Statistics, Minimum and maximum, Selection in expected linear time, Selection in worst-case linear time, Polynomials and the FFT, Representation of polynomials, The DFT and FFT, Efficient FFT implementations</td>
</tr>
<tr>
<td>IV</td>
<td>Maximum Flow-Flow Networks, Ford-Fulkerson method-analysis of Ford-Fulkerson, Edmonds-Karp algorithm, Maximum bipartite matching, Bi-connected Components, Finding strong components.</td>
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<td>SECOND INTERNAL EXAM</td>
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<td>IV</td>
<td>Computational Geometry- Line segment properties, Finding the convex hull, Finding the closest pair of points, Skip lists, Hash Tables: Direct address tables, hash tables, open addressing, rehashing, extensible hashing.</td>
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<tr>
<td>Course No.</td>
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<tr>
<td>06 CS 6 03 3</td>
<td>OPERATING SYSTEM DESIGN</td>
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PREREQUISITES: Nil

COURSE OBJECTIVES:
This course provides a study of internal algorithms and basic structure and organization of file system, processes, and memory management of Unix Operating System, relationship to programmer interface, understanding of how the unix kernel works and a deeper understanding of how unix programs interact with the system.

SYLLABUS:
Overview of the System, File Subsystems, Processes, Memory Management

EXPECTED OUTCOME:
Students will have master understanding of design issues associated with unix operating systems- file system, process and memory management concepts.

REFERENCES:
6. And Implementation of the 4.3 BSD Unix Operating System", Addison Wesley, 1998

COURSE PLAN

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem Exam Marks</th>
</tr>
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<tbody>
<tr>
<td>I</td>
<td>Evolution of operating system -Characteristics of modern operating system- Traditional and Modern Unix systems- Introduction to the Kernel -Architecture of the UNIX operating system - Introduction to system concepts - Kernel data structures - System administration. The Buffer Cache: Buffer headers - Structure of the buffer pool - Scenarios for retrieval of a buffer - Reading and writing disk blocks - Advantages and disadvantages of the buffer cache.</td>
<td>12 Hrs</td>
<td>25%</td>
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<tr>
<td>II</td>
<td>Inode - Regular file - Directories - Conversion of a path name to an Inode - Super block – Inode assignment to a new file - Allocation of disk blocks- System Calls for the</td>
<td>14 Hrs</td>
<td>25%</td>
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</tbody>
</table>
file system: Open - Read - Write - File and record locking
- Adjusting the position of file I/O - Iseek - close - File
creation - Creation of special files - Changing directory,
root, owner, mode - stat and fstat - Pipes - Dup - Mounting
and unmounting file systems - link - unlink - File system
abstraction and maintenance.

| III | Process states and models - Process context - Manipulation of the process address space -Sleep- Process Control - Process creation - Signals - Process termination - Invoking other programs - user id of a process - Changing the size of a process - Shell - System boot and the INIT process - Process Scheduling-Unix concurrency mechanisms - Distributed Process Management - Process migration - Distributed Mutual Exclusion. | 16 Hrs | 25% |
| IV | Swapping - Demand paging - Hybrid System - I/O Subsystem - Driver Interface - Disk Drivers - Terminal Drivers - Streams - Inter process communication - Process tracing - System V IPC - Network Communications - Sockets. | 14 Hrs | 25% |
Course No. | Course Name | L-T-P-Credits | Year of Introduction
---|---|---|---
06 CS 6 04 3 | COMPUTER SYSTEM DESIGN AND ARCHITECTURE | 3-0-0-3 | 2015

PREREQUISITES: NIL

COURSE OBJECTIVES:
Upon completion of this course, students will be able to do the following:

SYLLABUS:
Fundamentals of Computer Design, Instruction Level parallelism, Memory hierarchy, Introduction to storage systems

EXPECTED OUTCOME:
Students who complete the course will have demonstrated the ability to do the following:

REFERENCES:

COURSE PLAN

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<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem Exam Marks</th>
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<tbody>
<tr>
<td>I</td>
<td>Fundamentals of Computer Design-Classes of computers, defining computer architecture, instruction set architecture, encoding an instruction set, trends in technology, power, dependability, measuring performance, benchmarks summarizing performance, Amdahl’s law. Overview of computer architecture, processor performance equation, performance evaluation of processors, simple numerical exercises on Amdahl’s law, and performance.</td>
<td>10 Hrs</td>
<td>25%</td>
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<tr>
<td>II</td>
<td>Instruction Level parallelism- Basic concepts in pipelining, 5-stage RISC pipeline of MIPS processor, various types of pipeline hazards, techniques to minimize hazards, exception handling in pipeline, MIPS pipeline extension for multi cycle operations.</td>
<td>10 Hrs</td>
<td>25%</td>
</tr>
<tr>
<td>III</td>
<td>Memory hierarchy: fundamentals of cache memory, principle of locality, types of misses, block placement, block identification, block replacement, write strategy, average memory access time and cache performance, basic &amp; advanced cache optimizations. SRAM and DRAM technology, DRAM controller architecture, Concepts of channels, rank and banks, row buffer management policy &amp; address mapping. Virtual memory, techniques for address translation, TLB, segmentation and protection. Virtual machine monitors. Case study: AMD Opteron memory hierarchy.</td>
<td>10 Hrs</td>
<td>25%</td>
</tr>
<tr>
<td>IV</td>
<td>Introduction to storage systems: Basic hard disk organization, disk arrays, RAID standards. I/O performance measures and benchmarks. Shared shared memory designs: Symmetric shared memory architecture, cache coherence protocols, snooping protocols and directory based protocols. Memory consistency models.</td>
<td>10 Hrs</td>
<td>25%</td>
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Course No. | Course Name | L-T-P-Credits | Year of Introduction
---|---|---|---
06 CS 6 15 3 | DIGITAL IMAGE PROCESSING | 3-0-0-3 | 2015

**PREREQUISITES:** Matrix operations, linear algebra, probability and calculus

**COURSE OBJECTIVES:**
- To learn fundamental of image processing and different image processing techniques
- To learn morphological operations, image registration and reconstructions

**SYLLABUS:**

**EXPECTED OUTCOME:**
Students who successfully complete this course will be able to:-
- Develop research projects and applications projects using image processing techniques

**TEXT BOOKS:**

**REFERENCES:**

**COURSE PLAN**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
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<tbody>
<tr>
<td>I</td>
<td>Linear systems and shift invariance, Change of basis, Fourier transform, Discrete Fourier Transform, Z transform, Wavelet transform, Toeplitz and circulant matrices, Block matrices and Kronecker products, Random signals, Gaussian distributions, multivariate Gaussian distributions, Markov model, KL transform, Information and entropy.</td>
<td>10</td>
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<tr>
<td>I</td>
<td>Convolution and Correlation. Basic graph theory, Paths, trees and connectivity. Geometric primitives and 2D transformations.</td>
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</tr>
<tr>
<td>II</td>
<td>Elements of visual perception, Image sensing and acquisition, Image sampling and quantization. Image file formats, Brightness and contrast, Intensity transformations and spatial filtering, Histogram Processing, Histogram Equalization, Contrast limited adaptive histogram equalization (CLAHE), Histogram Matching, Local Enhancement, Histogram statistics, Arithmetic operators, Logic operations, Image Subtraction, Image Averaging, Smoothing spatial filters, sharpening spatial filters, Filtering in frequency domain, Image smoothing and sharpening using frequency domain filters. Affine transformations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>Morphological image processing, Erosion, dilation, Opening and closing, Point line and edge detection, Hough transform, Image segmentation, Thresholding, Otsu's method, Region based segmentation, segmentation using watersheds. Graph models in image processing, Markov random fields, basic graph cuts and binary labels. Image compression, Huffman coding, arithmetic coding, JPEG baseline.</td>
<td></td>
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</table>
Course No. | Course Name | L-T-P-Credits | Year of Introduction
---|---|---|---
06 CS 6 25 3 | DATA MINING CONCEPTS | 3-0-0-3 | 2015

**PREREQUISITES:** Mathematical Foundation For Computer Science

**COURSE OBJECTIVES:**
- Be able to understand the concepts, strategies, and methodologies related to the design and construction of data mining.
- Be able to comprehend several data preprocessing methods.
- Be able to determine an appropriate mining strategy for given large dataset.
- Be familiar with different data mining tools, their uses and the issues and challenges in solving problems.
- Be able to obtain knowledge of current data mining applications.

**SYLLABUS:**
Data Mining - Rule Discovery - Classification and Prediction - Cluster Analysis and Applications and Trends in Data Mining

**EXPECTED OUTCOME:**
- Graduates will understand various data mining process and issues.
- Graduates will learn various techniques for data mining, and apply the techniques in solving data mining problems.
- Graduates will have the knowledge on the various data mining tools used solving problems.

**TEXT BOOK:**

**COURSE PLAN**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Data Mining: Introduction to Data Mining - Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction – Attribute selection - Data Discretization and Concept Hierarchy Generation – Attribute construction.</td>
<td>5</td>
<td>25%</td>
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<tr>
<td>II</td>
<td>Rule discovery: Association Rule Mining: -Efficient and scalable frequent item set Mining Methods – Mining Various Kinds of Association Rules – Association Mining to Correlation Analysis – Constraint-Based Association Mining</td>
<td>8</td>
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<tr>
<td>III</td>
<td>Classification and Prediction: Issues Regarding Classification</td>
<td>4</td>
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<tr>
<td>FIRST INTERNAL EXAM</td>
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<tr>
<td><strong>III</strong> Classification and Prediction: Classification by Backpropagation – 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</td>
<td>10</td>
<td>25%</td>
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</tbody>
</table>
Course No. 06 CS 6 35 3
Course Name OBJECT ORIENTED SOFTWARE ENGINEERING
L-T-P-Credits 3-0-0-3
Year of Introduction 2015

PREREQUISITES: Software Engineering

COURSE OBJECTIVES:
- To provide an in depth knowledge on software life-cycle process with object-oriented concept.

SYLLABUS:
Software Life Cycle models, SRS Documentation, UML Diagrams, Analysis Phase, Design Phase, Mapping, Testing & Implementation

EXPECTED OUTCOME:
The students will be able to

4. Understand different software life cycle concept.
5. Study and design SRS documents for software projects.
6. Study and model software projects using different modeling techniques.
7. Understand different techniques to map models to code

TEXT BOOK:

REFERENCES:

COURSE PLAN

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td><strong>SRS Documentation:</strong> Requirements Elicitation – Requirement Documentation-Use Cases- Unified Modeling language-Introduction. <strong>UML Diagrams:</strong> – Class diagrams, Sequence diagrams, Object diagrams, Deploymentdiagrams, Use case diagrams, State</td>
<td>10</td>
<td>25%</td>
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<tr>
<td>FIRST INTERNAL EXAM</td>
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<tr>
<td><strong>IV</strong> <strong>Mapping:</strong> Mapping Design (Models) to Code – Model Transformation- Refactoring- Mapping Associations-Mapping Activities- <strong>Testing &amp; Implementation:</strong> Testing-Configuration Management – Maintenance process- System documentation – program evolution dynamics</td>
<td>10</td>
<td>25%</td>
<td></td>
</tr>
</tbody>
</table>
Course No. | Course Name | L-T-P-Credits | Year of Introduction
--- | --- | --- | ---
06 CS 6 45 3 | INFORMATION THEORY AND CODING | 3-0-0-3 | 2015

PREREQUISITES:
1. A good understanding of probability theory is required.
2. Knowledge of communication theory would be advantageous.
3. A firm knowledge in Discrete Mathematics is required.

COURSE OBJECTIVES:
- To equip students with the basic understanding of the fundamental concept of entropy and information as they are used in communications.
- To enhance knowledge of probabilities, entropy, measures of information.
- To guide the student through the implications and consequences of fundamental theories and laws of information theory and coding theory with reference to the application in modern communication and computer systems.

SYLLABUS:
Source Coding, Channel capacity and coding, Cyclic codes, Convolutional codes

EXPECTED OUTCOME:
Upon completion of this course, students should be able to:
- Calculate the information content of a random variable from its probability distribution.
- Relate the joint, conditional, and marginal entropies of variables in terms of their coupled probabilities.
- Define channel capacities and properties using Shannon's Theorems.
- Construct efficient codes for data on imperfect communication channels.
- Generalize the discrete concepts to continuous signals on continuous channels.

REFERENCES:
9. T. Bergu, “Rate Distortion Theory, a Mathematical Basis for Data Compression” PH Inc. 1971.
## COURSE PLAN

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Source Coding - Introduction to information theory, uncertainty and information, average mutual information and entropy, source coding theorem, Shannon-Fano coding, Huffman coding, Arithmetic coding, Lempel-Ziv algorithm, run-length encoding and rate distortion function.</td>
<td>10</td>
<td>25%</td>
</tr>
<tr>
<td>II</td>
<td>Channel capacity and coding - channel models, channel capacity, channel coding, information capacity theorem, random selection of codes.</td>
<td>5</td>
<td>25%</td>
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</tbody>
</table>

FIRST INTERNAL EXAM

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>Error control coding: linear block codes and their properties, decoding of linear block code, perfect codes, hamming codes, optimal linear codes and MDS codes.</td>
<td>5</td>
<td>25%</td>
</tr>
<tr>
<td>III</td>
<td>Cyclic codes - polynomials, division algorithm for polynomials, a method for generating cyclic codes, matrix description of cyclic codes, burst error correction, fire codes, golay codes, CRC codes, circuit implementation of cyclic codes. BCH codes: minimal polynomials, generator polynomial for BCH codes, decoding of BCH codes, Reed-Solomon codes and nested codes.</td>
<td>10</td>
<td>25%</td>
</tr>
<tr>
<td>IV</td>
<td>Convolutional codes - tree codes and trellis codes, polynomial description of convolutional codes, distance notions for convolutional codes, generation function, matrix description of convolutional codes, viterbi decoding of convolutional codes, distance bounds for convolutional codes, turbo codes and turbo decoding, Trellis Coded Modulation - concept of coded modulation, mapping by set partitioning, ungerboeck’s TCM design rules, TCM decoder.</td>
<td>10</td>
<td>25%</td>
</tr>
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</table>

### Course Details

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>06 CS 6 55 3</td>
<td>FOUNDATION OF INFORMATION SECURITY</td>
<td>3-0-0-3</td>
<td>2015</td>
</tr>
</tbody>
</table>

**PREREQUISITES:**
Prior knowledge on computing and software systems.
COURSE OBJECTIVES:

SYLLABUS:
Security Elements, Watermarking, Web application security, Malware and types

EXPECTED OUTCOME:
Students who successfully complete this course will be able to:

REFERENCES:

COURSE PLAN

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>Watermarking, applications of watermarking, Watermarking host signals: Image, Video, and Audio, Communication-Based Models of Watermarking, Geometric Models of Watermarking, watermark security and cryptography, attacks on watermark, Steganography, Steganographic communications, Steganographic method, steganalysis algorithms.</td>
<td>15</td>
<td>25%</td>
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</tbody>
</table>
### III

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
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</thead>
<tbody>
<tr>
<td>06 CS 6 65 3</td>
<td>WIRELESS COMMUNICATION</td>
<td>3-0-0-3</td>
<td>2015</td>
</tr>
</tbody>
</table>

### IV
Malware and types, basic static analysis techniques, malware analysis in virtual environment, basic dynamic analysis, malware behavior, covert malware launching, packers and unpackers, anti debugging and anti disassembling and anti virtual machine analysis

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>06 CS 6 65 3</td>
<td>WIRELESS COMMUNICATION</td>
<td>3-0-0-3</td>
<td>2015</td>
</tr>
</tbody>
</table>

**PREREQUISITES:**

**COURSE OBJECTIVES:**

**SYLLABUS:**

**EXPECTED OUTCOME:**
Students who successfully complete this course will be able to:-

**REFERENCES:**
## COURSE PLAN

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV</td>
<td>The Cellular Concept: Frequency Assignment and Channel Assignment, Frequency Reuse, Handoff, Sectoring, Microcell zone, Spectral efficiency. Multiple Access techniques: FDMA, TDMA, CDMA, OFDMA, OFDM-CDMA, MIMO-OFDM and QOS issues.</td>
<td>10 Hrs</td>
<td>25%</td>
</tr>
</tbody>
</table>
**Course No.** 06 CS 6 06 3  
**Course Name** RESEARCH METHODOLOGY  
**L-T-P-Credits** 0-2-0-2  
**Year of Introduction** 2015

**PREREQUISITES:** Introduction to statistics.

**COURSE OBJECTIVES:**

- To be aware of ethical practises in research
- To be able to apply appropriate methods for research
- To be able to understand good practises for thesis writing

**SYLLABUS:**

**EXPECTED OUTCOME:**

The students will be able to

- Apply statistical measures for evaluation
- Able to apply correct research methods for the project
- Able to write a thesis and select good publications based on different metrics

**TEXT BOOKS:**

**REFERENCES:**
1. A beginners guide to uncertainty of measurement by Stephanie Bell, NPL Publishing
2. Research Methodology By Francis C. Dane, Brooks/Cole Publishing Company, California

**COURSE PLAN**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Internal Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction - Meaning of Research, Objectives, Motivation, Types of Research. Research process-Problem definition-Objectives of Research- Research design- Data collection –Data Analysis –Interpretation of</td>
<td>10</td>
<td>25%</td>
</tr>
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<td></td>
<td>Results- Validation of Results. Formulation of a Research problem.</td>
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<tr>
<td>II</td>
<td>Basic Statistical measures - Measures of central tendency – Arithmetic Mean, Median, Mode, Geometric Mean, Harmonic Mean</td>
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<td>FIRST INTERNAL EXAM</td>
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<tr>
<td></td>
<td>Measures of variation – Range, Mean Deviation, Quartile Deviation, Coefficient of Variation and Standard Deviation, Measures of skewness</td>
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</tr>
<tr>
<td>IV</td>
<td>Guidelines for writing a PhD thesis - Guidelines for writing the abstract, introduction, methodology, results and discussion, conclusion sections of a manuscript. Impact factor-Validity, Merits, limitations. Other measurements of impact. h-index-advantages, criticism of h-index-modification of h-index, Intellectual property rights (IPR)- forms of IPR- patents-copyrights-Trademarks-Industrial design-geographical indication.</td>
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<tr>
<td>Course No.</td>
<td>Course Name</td>
<td>L-T-P-Credits</td>
<td>Year of Introduction</td>
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<tr>
<td>06 CS 6 07 3</td>
<td>SEMINAR</td>
<td>0-0-2-2</td>
<td>2015</td>
</tr>
</tbody>
</table>

**PREREQUISITES:** Good presentation skills

**COURSE OBJECTIVES:**
- To learn the recent developments in the research areas.

**SYLLABUS:**
Each student shall present a seminar on any topic of interest related to the core / elective courses offered in the first semester of the M. Tech. Programme. He / she shall select the topic based on the References: from international journals of repute, preferably IEEE journals. They should get the paper approved by the Programme Co-ordinator / Faculty member in charge of the seminar and shall present it in the class. Every student shall participate in the seminar. The students should undertake a detailed study on the topic and submit a report at the end of the semester.

**EXPECTED OUTCOME:**
- develop their presentation skills
- acquire the knowledge about emerging research areas
<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
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</thead>
<tbody>
<tr>
<td>06 CS 6 08 3</td>
<td>Advanced Computing Lab I</td>
<td>0-0-2-1</td>
<td>2015</td>
</tr>
</tbody>
</table>

**COURSE OBJECTIVES:** To explore the Data Structures, Mathematical Foundation in Computer Science, Operating Systems, CASE, Computer Architecture etc. and to acquaint them to simulation tools.

**SYLLABUS:**

(Choose any two, left to the choice of the college)

**Part A: (DS and MFCS)**

Experiments would be designed to provide hands-on experience in programming data structures and algorithms, (Any experiment with DS theory course can be added.)

- Implementation of B trees, threaded binary trees, red black trees
- Complexity analysis of sorting algorithms with large input
- Implementation of hashing functions
- Implementation of simple cryptographic algorithms

**Part B Operating Systems**

Experiments would be designed to provide hands-on experience in computer systems, to learn unix system calls, posix threads, operating system concepts,

- Study performance improvement in using threads as compared with process.( Examples like Matrix Multiplication, Hyper quicksort, Merge sort, Traveling Sales Person problem)
- Implement all CPU Scheduling Algorithms using your thread library
- Study the concept of Synchronization and implement the classical synchronization problems using Semaphores, Message queues and shared memory
- NFS server and NFS client implementation using RPC

**Part C: CASE**

Familiarization of UML diagrams using CASE tools
Planning and scheduling using Analysis and design practice using CASE tools
SRS, Design document and Test Plan preparation for a given project.

**Part D: Computer Architecture**

Familiarization of open source CPU tool- GEM5/MARSS
Basic simulations using out of order pipeline
Implementation of Tomasulao dynamic scheduling
Study on CPU performance with varying cache statistics
Implementation of coherence protocols
Implementation of cache replacement algorithms

**EXPECTED OUTCOME:**

M.Tech Syllabus – Computer Science: Specialization in Information Systems  Pg. 28 of 88
- Ability to implement the Data Structures, Mathematical Foundation in Computer Science, Operating Systems, CASE, Computer Architecture etc. and to acquaint them to simulation tools.
- Gaining knowledge about the tools like CASE
SEMESTER 2
### Course No. 06 CS 6 01 4

**Course Name:** ALGORITHM ANALYSIS AND DESIGN  
**L-T-P-Credits:** 4-0-0-4  
**Year of Introduction:** 2015

---

**PREREQUISITES:** Advanced Data Structures

---

**COURSE OBJECTIVES:**

- To improve creative thinking, problem solving and analytical ability
- To analyze the asymptotic performance of algorithms.
- To apply important algorithmic design paradigms and methods of analysis.
  - To synthesize efficient algorithms in common engineering design situations.

---

**SYLLABUS:**

Algorithms - Sorting Networks - String Matching - Randomization - Approximation Algorithms

---

**EXPECTED OUTCOME:**

- **Graduates** will be able to analyze worst-case running times of algorithms using asymptotic analysis.
- **Graduates** will be able to identify when divide-and-conquer paradigm can be applied to solve a problem, derive and solve recurrences describing the performance of divide-and-conquer algorithms.
- **Graduates** will be able to identify when dynamic-programming paradigm can be applied to solve a problem, synthesize dynamic-programming algorithms, and analyze them.
- **Graduates** will be able to identify when greedy paradigm can be applied to solve a problem, synthesize greedy algorithms, and analyze them.
- **Graduates** will be able to explain the different ways to analyze randomized algorithms.
- **Graduates** will be able to explain what an approximation algorithm is, and the benefit of using approximation algorithms.

---

**TEXT BOOKS:**

3. Lectures in Computational Complexity , Jin-Yi Cai , Department of Computer Sciences , University of Wisconsin
4. Algorithm Design: Jon Kleinberg and Eva Tardos, Addison Wesley

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**COURSE PLAN**

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<tr>
<th>Module</th>
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_M.Tech Syllabus – Computer Science: Specialization in Information Systems_  
Pg. 31 of 88
### I Algorithms
- Complexity and notations
- Recurrences
- Algorithmic Techniques: Backtracking
- Branch and bound
- Divide-and-Conquer
- Merge Sort
- Dynamic Programming
- All pair shortest path problem
- Greedy strategy
- Knapsack problem
- Space Bounded Computation (basic concept only)

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### II Sorting Networks
- Comparison networks
- The zero-one principle
- A bitonic sorting network
- A merging network
- A sorting network

**String Matching**
- The naive string-matching algorithm
- The Rabin-Karp algorithm
- String matching with finite automata
- The Knuth-Morris-Pratt algorithm

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**FIRST INTERNAL EXAM**

### III Randomization
- Basic Probability
- Markov’s Inequality
- Chebyshev Inequality
- Universal Hashing
- Expectations
- Tail Bounds
- Chernoff bound
- Markov Chains
- Random Walks
- Applications of randomized algorithms

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### IV Approximation Algorithms
- Approximation Algorithms for NP
- Hard Problems
- Approximation Algorithms for the Traveling Salesman Problem
- Approximation Algorithms for the Knapsack Problem
- Algorithms for Solving Nonlinear Equations
- Bisection Method
- Method of False Position
- Newton’s Method

|   |   | 10 | 25% |
Course No. 06 CS 6 02 4
Course Name ADVANCED COMPUTER NETWORKS
L-T-P-Credits 3-0-0-3
Year of Introduction 2015

PREREQUISITES:
• Basic Awareness of Computer Networks and Reference models.
• Awareness of Data Communication.

COURSE OBJECTIVES:
The Student will be able to:-
• To learn TCP/IP networks and protocols involved in each layer.
• To learn IP distribution and network management practices.

SYLLABUS:
Physical Layer and Data link layer, Network Layer, Transport Layer and ATM Networks, Application Layer

EXPECTED OUTCOME:
Students who successfully complete this course will have demonstrated an ability to:-
• Learn protocols of TCP/IP suite
• Understand IP distribution, Subnetting, network management practices.
• Understand the basics of real-time data transfer

TEXT BOOK:

REFERENCES:
• Kurose and Ross, Computer Networks A systems approach , Pearson Education.

COURSE PLAN

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
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<th>Sem Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>Connecting Devices. ARP, RARP. IP Address – Subnetting / Super netting, Packet Forwarding with Classfull /</td>
<td>5</td>
<td>25%</td>
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<td>FIRST INTERNAL EXAM</td>
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<tr>
<td><strong>II</strong> Components in IP software, Private IP and NAT. ICMP. Routing Protocols - Distance Vector Routing-RIP, Link-State Routing-OSPF</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>III</strong> UDP- Port Addressing, UDP datagram, UDP operation. TCP- TCP services and features, TCP segment, TCP connection, TCP state transitions, TCP module’s algorithm, Flow and Error control, Congestion control. SCTP- SCTP services and features, Packet format, SCTP connection, State Transitions, Flow and Error control. ATM NETWORKS - ATM Layer Structure, ATM Cell, Routing:-VPI, VCI, AAL</td>
<td>10 25%</td>
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</tr>
<tr>
<td><strong>IV</strong> DNS- Distribution of Name Space, Name Resolution, DNS messages, HTTP- Architecture, HTTP Transaction, DHCP - Address allocation, Packet format. SNMP- SMI, MIB, SNMP PDUs, Real Time Data Transfer- RTP, RTCP, Voice over IP- Session Initiation Protocol.</td>
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<td>Course No.</td>
<td>Course Name</td>
<td>L-T-P-Credits</td>
<td>Year of Introduction</td>
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<tr>
<td>06 CS 6 03 4</td>
<td>COMPUTER SECURITY AND APPLIED CRYPTOGRAPHY</td>
<td>3-0-0-3</td>
<td>2015</td>
</tr>
</tbody>
</table>

**PREREQUISITES:**

**COURSE OBJECTIVES:**
To provide an in depth knowledge about computer security, network security and cryptography. The overall aim is to gain an understanding of fundamental cryptographic concepts, approaches and principles of digital information security, linear algebraic concepts, Symmetric and Asymmetric key cryptography, Message Authentication and Hash functions, Network Security

**SYLLABUS:**
Introduction to cryptography Concepts, Symmetric Key cryptography, Message Authentication and Hash functions, Network Security

**EXPECTED OUTCOME:**
The students will be able to
1. Explain the concepts related to applied cryptography, including plaintext, ciphertext, Substitution and transposition techniques.
2. Understand the basic linear algebraic techniques applied to cryptography.
3. Explain the symmetric and asymmetric cryptographic algorithms (DES, AES, RSA etc), and key management techniques like Diffie Hellman key exchange algorithm etc.
4. Explain the data integrity algorithms including Hash and Message Authentication Code algorithms, digital signature.
5. Understand the concepts of network and internet security like IP Security, System security, Intrusion detection techniques.

**TEXT BOOK:**

**REFERENCES:**

### COURSE PLAN

<table>
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<tr>
<th>Module</th>
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<th>Hours</th>
<th>Sem Exam Marks</th>
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</thead>
<tbody>
<tr>
<td>I</td>
<td><strong>Introduction to cryptography Concepts</strong>, approaches and principles of digital information security, types of attacks, model, cryptographic techniques – substitution and transposition techniques, Euclidean algorithm – Congruences: Definitions and properties – linear congruences, residue classes, algebraic structures (groups, rings fields), Galios Filed, Euler’s phi function – Fermat’s Little Theorem – Chinese Remainder Theorem, Factorization methods, Pollard rho</td>
<td>13</td>
<td>25%</td>
</tr>
<tr>
<td>II</td>
<td><strong>Symmetric Key cryptography</strong>: Block cipher design principles and criteria, DES, 2DES, triple DES, AES, RC4, Blowfish, Differential and linear cryptanalysis.</td>
<td>6</td>
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<td></td>
<td><strong>FIRST INTERNAL EXAM</strong></td>
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<td>25%</td>
</tr>
<tr>
<td>II</td>
<td><strong>Asymmetric key cryptography</strong>: Principles of public key crypto systems, RSA , Rabin Cryptosystem, ELgamal cryptosystem, key management, Diffie-Hellman key exchange, elliptic curve cryptography, exponentiation and logarithm, discrete logarithm, primitive roots.</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td><strong>Message Authentication and Hash functions</strong>: Authentication functions, message authentication codes, Hash functions and their security, MD5 , SHA, HMAC. Digital signatures and authentication protocols, Digital Signature standards, Kerberos, X.509 authentication service, PGP.</td>
<td>15</td>
<td>25%</td>
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</table>
### Course No. 06 CS 6 14 4

<table>
<thead>
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<th>Course Name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
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<tbody>
<tr>
<td>PATTERN RECOGNITION</td>
<td>3-0-0-3</td>
<td>2015</td>
</tr>
</tbody>
</table>

#### PREREQUISITES:
Data mining, probability, machine learning and calculus

#### COURSE OBJECTIVES:
The Student will be able to:
- Learn fundamentals of pattern recognition
- Learn different feature extraction and dimensionality reduction techniques.

#### SYLLABUS:
Introduction to Pattern Recognition, Different Estimations, Component Analysis and Discriminants, Non parametric techniques.

#### EXPECTED OUTCOME:
The students will be able to
- Understand the application of pattern recognition in research
- Develop applications using different machine learning techniques.

#### TEXT BOOKS:
1. RO DUDA, Pattern Classification, Wiley India, 2nd Edition, 2006
2. Tou Gonzalves, Pattern recognition principles. 2nd Edition
3. Christopher Bishop, Pattern Recognition and Machine Learning, February 2010, Springer Publication

#### REFERENCES

### COURSE PLAN

<table>
<thead>
<tr>
<th>Module</th>
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<th>Hours</th>
<th>Sem Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction to Pattern Recognition, Design Cycle of Pattern Recognition System, Bayesian Decision Theory – Continuous Features, Two category classification, classifiers, Discriminant Functions and decision Surface, Multi category case, two category case. Bayesian Decision theory- Discrete Features, Independent Binary Features</td>
<td>10</td>
<td>25%</td>
</tr>
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</table>

**FIRST INTERNAL EXAM**

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<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>II</td>
<td>Parameter Estimation- Univariate and multivariate case, Problems of dimensionality, Accuracy, Dimension and Training sample Size, Computational Complexity.</td>
<td>5</td>
</tr>
<tr>
<td>IV</td>
<td>Non parametric techniques – Density estimation, Coverage of the mean, variance, Probabilistic Neural Networks, Choosing the window functions. K-nearest neighbor estimation, Parzen window estimation, Nearest neighbor rule, Distance Measures, Coverage of nearest neighbor, Clustering in Feature selection, Feature selection through entropy minimization. Application of pattern recognition</td>
<td>10</td>
</tr>
</tbody>
</table>
PREREQUISITES: Nil

COURSE OBJECTIVES:
1.

SYLLABUS:
Introduction, Features and Unification, Overview of Text Mining, Finding Structure in a Document Collection

EXPECTED OUTCOME:
Students who successfully complete this course will be able to

REFERENCES:

COURSE PLAN

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<tbody>
<tr>
<td></td>
<td>Methods.</td>
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<td>-------------------------------------------------------------------------</td>
<td></td>
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</tr>
<tr>
<td>IV</td>
<td>Finding Structure in a Document Collection - Similarity of Composite Documents – k-Means Clustering, Hierarchical Clustering .Looking for Information in Documents- Co-reference and Relationship Extraction. Case Studies – Assigning Topics to News Articles, E-mail Filtering. Emerging Directions- Summarization, Distributed Text Mining.</td>
<td>10</td>
<td>25%</td>
</tr>
</tbody>
</table>
Course No. | Course Name | L-T-P-Credits | Year of Introduction
--- | --- | --- | ---
06 CS 6 34 4 | SOFTWARE ARCHITECTURE | 3-0-0-3 | 2015

**PREREQUISITES:** Software Engineering

**COURSE OBJECTIVES:**

- To improve creative thinking, problem solving and analytical ability
- To analyze the asymptotic performance of various architectures.
- To apply important database integration in shared information schemas.
- To synthesize efficient architecture in common engineering design situation

**SYLLABUS:**
Architectures - Architecture Styles - Shared Information Systems - Architectural Design Guidance

**EXPECTED OUTCOME:**
Students who successfully complete this course will be able to

- Graduates will be able to analyze software processes
- Graduates will be able to identify the best Architecture which can be applied to solve a problem.
- Graduates will be able to design shared information systems with database integration applied to solve a problem, and analyze them.
- Graduates will be able to explain the different ways to analyze randomized architectures.
- Graduates will be able to develop user interface architectures and the benefit of using design space and rules for developing user interface architectures.

**TEXT BOOK:**

**COURSE PLAN**

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**FIRST INTERNAL EXAM**


Course No. | Course Name | L-T-P-Credits | Year of Introduction
--- | --- | --- | ---
06 CS 6 44 4 | SOFT COMPUTING | 3-0-0-3 | 2015

**PREREQUISITES:** NIL

**COURSE OBJECTIVES:**

**SYLLABUS:**
Artificial Neural Network, Models Of Neural Network, Genetic Algorithm, Hybrid Systems

**EXPECTED OUTCOME:**
This course requires the student to demonstrate the ability to:

**REFERENCES:**
1. Neural Networks- A Comprehensive foundation, Simon Haykin, 2nd Ed; Pearson
3. Genetic Algorithm & fuzzy Logic Systems - Sanchez, Takanori, Zadeh; World Scientific
4. Genetic Algorithm, Goldberg David E.; Pearson
5. Principles of Softcomputing, S.N. Sivanandam, S.N.Deepa, Wiley India.

**COURSE PLAN**

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<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>I</td>
<td>Basic concept of Soft Computing; Basic concept of neural networks, Mathematical model, Properties of neural network, Typical architectures: single layer, multilayer, competitive layer; Different learning methods: Supervised, Unsupervised &amp; reinforced; Common activation functions; Feed forward, Feedback &amp; recurrent N.N; Application of N.N</td>
<td>11 Hrs</td>
<td>25%</td>
</tr>
<tr>
<td>II</td>
<td>Architecture, Algorithm &amp; Application of -- McCulloh-Pitts, Hebb Net, Perceptron ( with limitations &amp; Perceptron learning rule Convergence theorem), Backpropagation NN, ADALINE, MADALINE, Discrete Hopfield net, BAM, Maxnet , Kohonen Self Organizing Maps Learning Vector Quantization.</td>
<td>11 Hrs</td>
<td>25%</td>
</tr>
<tr>
<td>III</td>
<td>Basic concept; role of GA in optimization, Fitness function, Selection of initial population, Cross over(different types), Mutation, Inversion, Deletion, Constraints Handling; Evolutionary Computation; Genetic Programming; Schema</td>
<td>10 Hrs</td>
<td>25%</td>
</tr>
<tr>
<td>IV</td>
<td>Hybrid systems, GA based BPNN (Weight determination, Application); Neuro Fuzzy Systems, Fuzzy backpropagations networks, architecture, learning, application; Fuzzy Logic controlled G.A.; Application: Travelling Salesman Problem, a fusion approach for multispectral images with synthetic aperture radar for food analysis, GA for internet search technique, case study in Matlab (neural network toolbox, fuzzy logic toolbox, genetic algorithm tool box)</td>
<td>10 Hrs</td>
<td>25%</td>
</tr>
</tbody>
</table>
Course No. 06 CS 6 54 4
Course Name PARALLEL COMPUTER ARCHITECTURE
L-T-P-Credits 3-0-0-3
Year of Introduction 2015

PREREQUISITES: NIL

COURSE OBJECTIVES:

SYLLABUS:
Parallel computer models, Parallel processors standards, On-chip Interconnection systems, Cache memory designs for multi core processors

EXPECTED OUTCOME:
This course requires the student to demonstrate the ability to:

REFERENCES:
5. Selected papers from proceedings of computer architecture conferences-ISCA, HPCA, and MICRO, 2011-2014. (For module 4)

COURSE PLAN

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<tr>
<td>I</td>
<td>Multiprocessors and multi-computers, fundamental design issues in parallel computer models. Parallel application case studies. parallelization process and steps. Snoop based coherence protocols- ESI, MESI. Memory based and cache based directory protocols. Concept of multithreading and hyper-threading</td>
<td>11 Hrs</td>
<td>25%</td>
</tr>
<tr>
<td>II</td>
<td>Super scalar processors, VLIW processors, vector processing and array processing. Basic concepts of GPU and CUDA programming. Organization of GPU based systems. Case study. NVIDIA-Tesla. Multicore programming with OpenMP</td>
<td>11 Hrs</td>
<td>25%</td>
</tr>
<tr>
<td>III</td>
<td>Principles of network on chip (NoC), various topologies, traffic patterns, performance measures, taxonomy of routing algorithms, deterministic, oblivious and adaptive routing, flit buffer and bufferless flow control designs, overview of router architecture, arbitration and allocation.</td>
<td>10 Hrs</td>
<td>25%</td>
</tr>
<tr>
<td>IV</td>
<td>Last level cache management in multi-core designs, locality aware data replication in caches, Cache compression techniques; cache block eviction using reference predictions, cache management using reuse distance, adaptive cooperative set granular caching.</td>
<td>10 Hrs</td>
<td>25%</td>
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<tr>
<td>Course No.</td>
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<td>L-T-P-Credits</td>
<td>Year of Introduction</td>
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<tr>
<td>06 CS 6 64 4</td>
<td>WIRELESS SENSOR NETWORKS</td>
<td>3-0-0-3</td>
<td>2015</td>
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</tbody>
</table>

**PREREQUISITES:** NIL

**COURSE OBJECTIVES:**
- To impart an introduction to wireless communication technology.
- To develop knowledge on how communication happens in wireless environment.
- To provide exposure to cellular concepts.

**SYLLABUS:**

**EXPECTED OUTCOME:**
This course requires the student to demonstrate the ability to:
- The course provides a good understanding of wireless communication.
- The student is provided with mathematical foundation for understanding the principles of wireless communication.
- Enables Student to compare the various digital modulation techniques.
- Enables the students to map the basic concepts of wireless communication with the real world applications.

**REFERENCES:**

**COURSE PLAN**
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<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem Exam Marks</th>
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<tbody>
<tr>
<td>II</td>
<td>Wireless Communication standards, Comparison of IEEE standards, characteristics of mobile radio environment and propagation phenomena- Path loss modeling and signal coverage- free-space propagation, two ray model, distance-power relationship and shadow fading, effects of multi path and Doppler- modeling of multi path fading, Doppler spectrum, multi path delay spread, Coverage in Wireless Sensor Networks – Area Coverage, Point Coverage, Barrier Coverage, Node discovery and localization protocols</td>
<td>14</td>
<td>25%</td>
</tr>
</tbody>
</table>
Course No. | Course Name | L-T-P-Credits | Year of Introduction
---|---|---|---
06 CS 6 15 4 | COMPUTER VISION | 3-0-0-3 | 2015

**PREREQUISITES:** Basics of Image processing, filtering techniques, probability, data mining and machine learning

**COURSE OBJECTIVES:**

- To learn different transformations applied in image processing
- To learn machine learning techniques used in computer vision
- To learn about the feature extraction techniques, object recognition and identification

**SYLLABUS:**

Elements of image processing, Introduction to Machine Learning, Image distance measures, Pinhole camera model.

**EXPECTED OUTCOME:**

Students will be able to:

- develop research projects using computer vision

**TEXT BOOKS:**


**REFERENCES:**

2. David A. Forsyth, Jean Ponce, Computer Vision: A Modern Approach

**COURSE PLAN**

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<th>Module</th>
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</thead>
<tbody>
<tr>
<td>I</td>
<td>Elements of image processing, Intensity transformation and spatial filtering, Histogram processing, Edge detection filters, Image segmentation, Image formation, Geometric primitives and transformations, 2D transformations, 3D transformations, 3D to 2D projections, Photometric image formation, Lighting, Reflectance and shading, Optics..</td>
<td>10</td>
<td>25%</td>
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<tr>
<td>II</td>
<td>Introduction to Machine Learning, Regression, Classification problem, Feature vectors, Dimensionality reduction,</td>
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<td><strong>FIRST INTERNAL EXAM</strong></td>
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<tr>
<td>II</td>
<td>RANSAC, Neural nets, Support Vector Machine, Clustering Methods, k-Nearest Neighbors, k means, Deep convolutional networks.</td>
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<td></td>
</tr>
<tr>
<td>III</td>
<td>Image distance measures, color similarity measures, Texture similarity measures, shape similarity measures, Feature detection and matching, Feature detectors, Feature descriptors, SIFT, SURF, HOG, bag of visual words, Feature matching, Edge detection, edge linking, Computing motion vectors from image sequences. Optical flow. Recognition, Object detection, face recognition, Eigenfaces.</td>
<td>10</td>
<td>25%</td>
</tr>
</tbody>
</table>
PREREQUISITES:
- Basic knowledge about web technologies-HTML, XML
- Basic knowledge about predicate logic
- Programming skill

COURSE OBJECTIVES:
- Describe and define the various concepts and technologies that make up the Semantic Web landscape
- Gives a review of XML language structure and XML document model.
- Describes the concepts of graph-based RDF model, XML syntax-based RDF model, and RDF Schema.
- Analyzes the requirements and features of web ontology language (OWL).
- Describes the syntax and semantics of Horn logic, both monotonic and nonmonotonic, in the framework of Semantic Web.
- Identifies suitable applications for Semantic Web technologies and show some awareness of existing applications.

SYLLABUS:
Semantic Web, Semantic Modelling, RDF/RDFS languages, Ontologies, Inferences, Semantic Web Frameworks

EXPECTED OUTCOME:
Students who successfully complete this course will have demonstrated an ability to
- Develop a working knowledge of the Semantic Web and its associated tools and technologies.
- Understand the concept structure of the semantic web technology and how this technology revolutionizes the World Wide Web and its uses.
- Understand the concepts of metadata, semantics of knowledge and resource, ontology, and their descriptions in XML-based syntax and Web Ontology Language (OWL).
- Understand the core of basic concepts and fundamental theories describe logic semantics and inference with OWL.
- Get familiarized with Semantic Web programming frameworks such as Jena and useful Semantic Web tools.
**TEXT BOOKS:**

**REFERENCES:**
6. Toby Segaran, ColinEvans, Jamie Taylor, Programming the semantic web, O’Reilly, July 2009

### COURSE PLAN

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<th>Module</th>
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<th>Hours</th>
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<tbody>
<tr>
<td>I</td>
<td><strong>Foundations of Semantic Web</strong>&lt;br&gt;Today’s web and keyword based search, Semantic Web, Examples, Semantic web technologies- Semantic Web versus Artificial Intelligence-Overview of Structured Web Documents in XML, A Layered approach to Semantic Web</td>
<td>15</td>
<td>25%</td>
</tr>
<tr>
<td>II</td>
<td><strong>Modeling Information</strong>&lt;br&gt;Resource Description Framework–Basic ideas- RDF triple form- RDF Graph-simple examples-advantages-XML based syntax, RDF Schema- Basic Ideas, Language-Exchanging Information With RDF, Statements As Points, RDF Serializations , RDF/XML, Blank Nodes In RDF, Reification, SPARQL- Simple Query Example</td>
<td>15</td>
<td>25%</td>
</tr>
<tr>
<td>III</td>
<td><strong>Knowledge Representation</strong>&lt;br&gt;Semantics on the web-Expressing Semantics in RDF-Vocabularies, Taxonomies and Ontologies –Introduction to Ontologies-Overview of Ontology Elements -Requirements of ontology languages, Examples of published Ontology-Web Ontology Language OWL, Three species of OWL</td>
<td>15</td>
<td>25%</td>
</tr>
<tr>
<td>IV</td>
<td><strong>Logic and Inference</strong>&lt;br&gt;Predicate Logic and Rule Systems, Horn Logic-Monotonic Rule Systems, Non Monotonic Rule Systems -Rule Languages- RuleML, SWRL. Semantic Web Frameworks , Retrieving Information in a Knowledgebase, Realizing the Semantics of OWL,</td>
<td>15</td>
<td>25%</td>
</tr>
<tr>
<td>Understanding Forward Chaining Inference, Understanding Backward Chaining Inference, Choosing the Right Inference Method- Common Frameworks and Components-Jena, Sesame - RDF store implementations-Retrieval Components-Reasoning Engines</td>
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<td>Course No.</td>
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<td>L-T-P-Credits</td>
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<tr>
<td>06 CS 6 35 4</td>
<td>SOFTWARE PROJECT MANAGEMENT</td>
<td>3-0-0-3</td>
<td>2015</td>
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</tbody>
</table>

**PREREQUISITES:** Nil.

**COURSE OBJECTIVES:**

**SYLLABUS:**
Introduction to Projects and Project Characteristics, Project Planning, Software Metrics & Quality Assurance, Other Topics

**EXPECTED OUTCOME:**
Students who successfully complete this course will have demonstrated an ability to

**REFERENCE:**

**COURSE PLAN**

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</table>
Typical Software Project Plan, Project Monitoring and Control, Project Tracking using Earned Value Analysis, Tracking Gantt, Project Scheduling and Tracking using MS Project.

### III
Software Quality Assurance: Concepts of Quality Assurance, Quality Control, Cost of Quality, Verification and Validation; Quality Planning; Quality Control Tools

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<th>III</th>
<th>10 Hrs</th>
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### IV

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<th>IV</th>
<th>10 Hrs</th>
<th>25%</th>
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</table>
Course No. 06 CS 6 45 4
Course Name CLOUD COMPUTING
L-T-P-Credits 3-0-0-3
Year of Introduction 2015

PREREQUISITES: NIL

COURSE OBJECTIVES:
- To provide architectural as well as technical overview of cloud computing paradigm
- To impart practical working knowledge of working with cloud infrastructures.

SYLLABUS:
Cloud Computing Fundamentals, Cloud Architecture, Programming Models & Applications, Advanced Topics

EXPECTED OUTCOME:
Students will be able to:
1. Understand the working of a cloud infrastructures.
2. Work with cloud applications and programs including Mapreduce and Hadoop.
3. To understand advanced cloud computing concepts, including HPC in cloud and Internet of Things.

TEXT BOOKS:
1. Distributed and Cloud Computing: From Parallel Processing to the Internet of Things – Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra – Morgan Kauffmann.

REFERENCES:
2. Cloud Computing – A Sreenivasan and J. Suresh – Pearson, Chennai
3. Cloud Security: A comprehensive guide to secure Cloud Computing - Krutz, Ronald L and Russell Dean Vines, Wiley India

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<tbody>
<tr>
<td>I</td>
<td>Evolution of Cloud Computing – Parallel computing, Grid computing, Service Oriented Architecture (SOA) and Cloud computing 5-4-3 of Cloud Computing – Characteristics (NIST), Classifications based on deployment model (Public, Private, Hybrid and Community), Classifications based on service model (IaaS, SaaS, PaaS). Virtualization - Basics of Virtualization, Types of</td>
<td>10</td>
<td>25%</td>
</tr>
</tbody>
</table>
| II | Compute, Storage, Database and Networking solutions from enterprise cloud platforms (Amazon, Google, Microsoft). Architectures of open-source cloud platforms (OpenStack, CloudStack, Nebula, Aneka).  
   Data center design – Data center construction, Single cloud site architecture, Redundant 3-tier architecture, Multidatacenter architecture, Cooling Systems.  
   Data center interconnection networks – Software defined networks, Fat-tree interconnection network, and Server-centric network  
   Green cloud concepts and architectures. | 10 | 25% |
|---------------------------------|-----------------|-----|
| III | Parallel and Distributed Programming Paradigms – MapReduce, Twister and Iterative MapReduce, Hadoop Library from Apache.  
Developing cloud applications – CRM, productivity, social networking (using Facebook API, Twitter API, Flickr API and Google Maps API), Media applications, and scientific applications – in Private clouds, Amazon AWS, Azure, Force.com & Google App Engine | 10 | 25% |
| IV | Cloud security - Access control, Attacks on VMs, Storage security, Data security.  
Compliance issues – compliance for the cloud provider vs. compliance for the customer, Ownership of data.  
Cloud for HPC, HTC and ubiquitous computing – containers (Docker, LXC) and light weight Operating Systems (OS).  
Performance of Clouds: Quality of Service (QoS) in Cloud, Performance metrics for HPC/HTC in cloud, Cloud simulations using CloudSim.  
Internet of Things – Federated cloud/InterCloud, Sensor networks, Global Positioning System (GPS), Smart power grid and smart cities. | 10 | 25% |
### Course No. 06 CS 6 55 4
### Course Name: COMPILER DESIGN
### L-T-P-Credits: 3-0-0-3
### Year of Introduction: 2015

**PREREQUISITES:** Awareness of different phases of compilers

**COURSE OBJECTIVES:**
- To learn different optimization techniques used in compilers
- To learn different intermediate languages

**SYLLABUS:**
Principles Of Compiler, Optimization, Register allocation and assignment, Case Studies

**EXPECTED OUTCOME:**
Students will be able to:
- Understand different optimizations used in compilers

**TEXT BOOKS:**
3. Sivarama P. Dandamudi, “Introduction to Assembly language programming: for Pentium and RISC processors”.

**REFERENCES:**
2. Charles N. Fischer, Richard J. Leblanc, “Crafting a compiler with C”, Benjamin-Cummings Publishing Co., Inc. Redwood City, CA, USA

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<tbody>
<tr>
<td>II</td>
<td>Optimization – Early optimization – Constant folding – scalar replacement of aggregates Simplification – value numbering – copy propagation</td>
<td>5</td>
<td>25%</td>
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<tbody>
<tr>
<td>II</td>
<td>Redundancy elimination – loop optimization. Procedure</td>
<td>5</td>
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<tr>
<td>IV</td>
<td>Case Studies – Sun Compilers for SPARC – IBM XL Compilers – Alpha compilers – PA –RISC assembly language – COOL – (Classroom Object oriented language) - Compiler testing tools – SPIM</td>
<td>10</td>
<td>25%</td>
</tr>
</tbody>
</table>
**Course No.** | **Course Name** | **L-T-P-Credits** | **Year of Introduction**  
--- | --- | --- | ---  
06 CS 6 65 4 | ADVANCED DATABASE CONCEPTS | 3-0-0-3 | 2015  

**PREREQUISITES:** NIL  

**COURSE OBJECTIVES:**  
-  

**SYLLABUS:**  
Parallel and Distributed Databases, Object and Object relational databases, Enhanced Data models, Emerging Technologies  

**EXPECTED OUTCOME:**  
Students will be able to:  
-  

**REFERENCES:**  

**COURSE PLAN**  

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*M.Tech Syllabus – Computer Science: Specialization in Information Systems*
<p>| IV   | Big data, Parallel processing and query optimization, Hadoop, MAP REDUCE XML, Object relational data base, Spatial database, Temporal databases, Intelligent databases, Multimedia databases | 10 | 25% |</p>
<table>
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<th>Year of Introduction</th>
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<td>06 CS 6 06 4</td>
<td>MINI PROJECT</td>
<td>0-0-4-2</td>
<td>2015</td>
</tr>
</tbody>
</table>

**SYLLABUS:**
The mini project is designed to develop practical ability and knowledge about tools/techniques in order to solve the actual problems related to the industry, academic institutions or similar area. Students can take up any application level/system level experimental design / implementation tasks of relatively minor intensity and scope as compared to the major-project, pertaining to a relevant domain of study. Projects can be chosen either from the list provided by the faculty or in the field of interest of the student. At the end of each phase, presentation and demonstration of the project should be conducted, which will be evaluated by a panel of examiners. A detailed project report duly approved by the guide in the prescribed format should be submitted by the student for final evaluation.

*Publishing the work in Conference Proceedings/ Journals with National/ International status with the consent of the guide will carry an additional weightage in the review process.*
COURSE OBJECTIVES:
To gain expertise in the areas of Linux, Data processing and Analysis, Information Security, Network Simulation.

SYLLABUS:

Linux Internals
1. Introduction to Linux and Basic commands
   a. Installation of Unix/Linux operating system; understand booting process.
   b. Study of Unix/Linux general purpose utility command list obtained from (man, who, cat, cd, cp, ps, is, mv, rm, mkdir, rmdir, echo, more, date, time, kill, history, chmod, chown, finger, pwd, cal, logout, shutdown, grep, mount) commands.
   c. Study of Bash shell, Bourne shell and C shell in Unix/Linux operating system.
2. Basic Shell Programming
3. Implementing IPC using message queue, Semaphore and Shared Memory.
4. SSH, NFS and SAMBA Configurations.
5. DNS Server & Web server configuration
6. Write a program to print boot block, super block, inode table, data block, set permissions for a file and securing the file using suid bits.

Data Processing and Analysis.
1. Implement various feature selection/extraction technique available in Weka (image/text).
   1. Information Gain
   2. Sequential Selection
   3. Fisher’s Linear Discriminant analysis
   4. Principal Component Analysis (PCA)
2. To perform classification like Decision tree, Naive Bayes, Random Forest, Rotation Forest, SVM, Multinomial Naive Bayes Classifiers using bench mark data sets from UCI Machine Learning Repository (with Weka toolkit).
3. Implement ensemble classification algorithm.
4. Implement clustering techniques (divisive, agglomerative, K-means and K-mediod), and perform clustering using WEKA.
5. Implement linear regression using Weka.
6. Analyze different evaluation metrics such as TPR, FPR, Accuracy, Precision, Recall, AUC, F1-measure, ROC etc in binary class and multiclass classification problems.

Information Security
1. Implement substitution ciphers (a) Playfair cipher (b) Hill cipher
2. Implement S-DES algorithm.
3. Perform encryption and decryption on a file/image using (a) Knapsack cryptosystem (b) RSA algorithm (c) Rabin cryptosystem (d) ELGAMA cryptosystem
4. Configure GnuPG, Configure SSH
5. Managing and creation of encrypted partitions in Linux.
6. Secure Linux File access
7. Generate Self signed certificate

**Network Simulation Lab**

1. A thorough study of packet capturing tool called WireShark.
2. Familiarizing Network Simulator – 2 (NS2) with suitable examples.
3. Simulate a wired network consisting of TCP and UDP Traffic using NS2 and then calculate their respective throughput using AWK script.
5. Performance evaluation of different queues and effect of queues and buffers in wired network environment using NS2.
6. Compare the behavior of different variants of TCP (Tahoe, Reno, Vegas….) in wired network using NS2. Comparison can be done on the congestion window behavior by plotting graph.
7. Simulate a wireless network consisting of TCP and UDP Traffic using NS2 and then calculate their respective throughput using AWK script.
8. Performance evaluation of different ad-hoc wireless routing protocols (DSDV, DSR, AODV …) using NS2.

Create different Wired-cum-Wireless networks and MobileIP Simulations using NS2.

**EXPECTED OUTCOME:**

- Familiarization and internals of Linux.
- Acquiring knowledge of data processing and analysis
- Ability to implement Cipher tools
- Knowledge of Network Simulation tools
SEMESTER 3
Course No. | Course Name | L-T-P-Credits | Year of Introduction
--- | --- | --- | ---
06 CS 7 11 3 | DATA COMPRESSION | 3-0-0-3 | 2015

**PREREQUISITES:** Basic awareness of algorithms and mathematical course

**COURSE OBJECTIVES:**
- To learn compression techniques
- To learn different coding techniques

**SYLLABUS:**
Compression Techniques, The Huffman coding, Arithmetic Coding, Mathematical Preliminaries for Lossy Coding.

**EXPECTED OUTCOME:**
Graduates will be able to:
- develop some compression algorithms

**TEXT BOOKS:**
- Introduction To Data Compression, 3rd Edition, 2010 by Sayood Khalid

**REFERENCES:**
- The Data Compression Dec 2008 by Mark Nelson

### COURSE PLAN

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<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>The Huffman coding algorithm: Minimum variance Huffman codes, Adaptive Huffman coding: Update procedure, Encoding procedure, Decoding procedure.</td>
<td>5</td>
<td>25%</td>
</tr>
<tr>
<td>II</td>
<td>Golomb codes, Rice codes, Tunstall codes, Applications of Huffman coding: Loss less image compression, Text compression, Audio Compression.</td>
<td>5</td>
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</table>

**FIRST INTERNAL EXAM**

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<td>Golomb codes, Rice codes, Tunstall codes, Applications of Huffman coding: Loss less image compression, Text compression, Audio Compression.</td>
<td>5</td>
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</tbody>
</table>

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*Note: This is a partial representation of the syllabus. For a complete syllabus, refer to the official source.*
### IV

Mathematical Preliminaries for Lossy Coding

- Distortion criteria
- Models
- Scalar Quantization: The Quantization problem, Uniform Quantizer, Adaptive Quantization, Non-uniform Quantization
  - Vector Quantization Advantages of Vector Quantization over Scalar Quantization, The Linde-Buzo-Gray Algorithm, Tree structured Vector Quantizers, Structured Vector Quantizers

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</table>
Course No. | Course Name | L-T-P-Credits | Year of Introduction
---|---|---|---
06 CS 7 21 3 | DATA ANALYTICS | 3-0-0-3 | 2015

PREREQUISITES:
- Linear algebra, Calculus. Knowledge of probability theory, statistics, and programming

COURSE OBJECTIVES:
The Student will be able to:-
- To learn different types of data analytics namely descriptive, inferential, and predictive analysis

SYLLABUS:
Descriptive Statistics Introduction, Regression & ANOVA, Supervised Learning with Regression and Classification techniques, Associative Rule Mining

EXPECTED OUTCOME:
Students who successfully complete this course will have demonstrated an ability to:-
- analyze data to convert information to useful knowledge

TEXT BOOK:
- Hastie, Trevor, The elements of statistical learning, Springer 2009

REFERENCES:

COURSE PLAN

<table>
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<tr>
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<th>Hours</th>
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</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Descriptive Statistics Introduction- Probability Distributions Inferential Statistics:- Inferential Statistics through hypothesis tests-Permutation &amp; Randomization Test</td>
<td>10</td>
<td>25%</td>
</tr>
</tbody>
</table>

FIRST INTERNAL EXAM
| III | Supervised Learning with Regression and Classification techniques:- Bias-Variance Dichotomy, Model Validation Approaches, Logistic Regression, Linear Discriminant Analysis- Quadratic Discriminant Analysis- Regression and Classification Trees- Support Vector Machines- Ensemble Methods: Random Forest- Neural Networks- Deep learning | 10 | 25% |
| IV | Associative Rule Mining- Challenges for big data analytics- Creating data for analytics through designed experiments- Creating data for analytics through Active learning- Creating data for analytics through Reinforcement learning | 10 | 25% |
Course No. | Course Name | L-T-P-Credits | Year of Introduction
---|---|---|---
06 CS 7 31 3 | ADVANCED SOFTWARE TESTING | 3-0-0-3 | 2015

**PREREQUISITES:**
- Software Engineering

**COURSE OBJECTIVES:**
- Understand the need of testing and how it contributes to improve software quality.
- Understand the established testing concepts, the fundamental test process, test approaches, and principles to support test objectives.
- Be familiar with different types of testing tools, their uses and the issues and challenges in test automation.

**SYLLABUS:**
Fundamentals of Testing - Approaches to Testing - Test Management - Testing tools

**EXPECTED OUTCOME:**
Graduates will:
- have the knowledge on the different types of software testing and the general principles of testing.
- have the knowledge on how the test process is planned and managed.
- have the knowledge on the essential characteristics of tools used for test automation and the issues and challenges in automating tests.
- be able to effectively participate in reviews of small projects by using the principles of research ethics.
- be able to design and prioritize tests by using established techniques; analyze both functional and non-functional specifications at all test levels for systems with a low complexity.
- be able to analyze different approaches to software testing and select optimal solutions based on the situations.

**TEXT BOOK:**
7. The art of software testing by GJ Myers, Wiley.
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</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td><strong>Approaches to Testing:</strong> Static Testing Structured Group Examinations Static Analysis Control flow &amp; Data flow, Determining Metrics Dynamic Testing Black Box Testing Equivalence Class Partitioning, Boundary Value Analysis, State Transition Test, Cause Effect Graphing and Decision Table Technique and Used Case Testing and Advanced black box techniques White Box Testing Statement Coverage, Branch Coverage, Test of Conditions, Path Coverage, Advanced White Box Techniques, Instrumentation and Tool Support Gray Box Testing, Intuitive and Experience Based Testing</td>
<td>10</td>
<td>25%</td>
</tr>
<tr>
<td>IV</td>
<td><strong>Testing tools:</strong> Automation of Test Execution, Requirement tracker, High Level Review Types of test Tools, Tools for test management and Control, Test Specification, Static Testing, Dynamic Testing, Non functional testing Selection and Introduction of Test Tools Tool Selection and Introduction, Cost Effectiveness of Tool Introduction</td>
<td>10</td>
<td>25%</td>
</tr>
</tbody>
</table>
Course No. | Course Name | L-T-P-Credits | Year of Introduction
---|---|---|---
06 CS 7 41 3 | HIGH PERFORMANCE COMPUTING | 3-0-0-3 | 2015

**PREREQUISITES:** Basic programming skills in any programming language, preferably C and/or C++.

**COURSE OBJECTIVES:**
The Student will be able to:
- impart knowledge of state of the art technologies and innovation in high performance computing and to impart practical lessons of programming parallel algorithms that run on high performance clusters.

**SYLLABUS:**
HPC Fundamentals, Parallel algorithms & applications, Parallel Programming, Advanced HPC Topics.

**EXPECTED OUTCOME:**
The students will be able to
- Understand the basic tenants of HPC paradigm.
- Understand and develop parallel algorithms.
- Develop OpenMP, MPI and CUDA parallel programs.

**TEXT BOOKS:**
1. Introduction to Parallel Computing, Ananth Grama, Anshul Gupta, George Karypis and Vipin Kumar, Pearson.
2. Parallel Programming in C with MPI and OpenMP, Michael J. Quinn, Tata McGraw-Hill Education.

**REFERENCES:**
1. Introduction to Parallel Computing: A practical guide with examples in C, Wesley Petersen and Peter Arbenz, Oxford University Press.
| I | **HPC Fundamentals:**  
Parallel computing. Evolution of supercomputing, Data parallelism, Functional parallelism.  
Interconnection networks – Switch network topologies, 2-D Mesh Network, Binary tree network, Hyper tree network, Butterfly network, Hypercube Network, Shuffle arrays.  
Flynn’s taxonomy, Moore’s Law, Amdhal’s law, Speedup, Efficiency, FLOPS. | 10 | 25% |
| II | **Parallel algorithms & applications:**  
The task/channel model, Ian Foster’s design methodology, Boundary value problem, finding the maximum, N-Body problem.  
LAPACK and BLAS, Monte Carlo methods, Parallel Matrix-Vector multiplication (Rowwise 1-D partitioning, 2-D partitioning), Parallel Matrix-Matrix multiplication (Simple algorithm, Cannon’s algorithm). | 10 | 25% |
| III | **Parallel Programming:**  
Shared address space platforms: OpenMP programming - Parallel for loops, private variables, critical sections, reductions, data parallelism constructs, functional parallelism constructs.  
Message Passing Platforms: MPI programming –basic constructs, Groups and communicators, Point-to-point communication (send, recv) – Collective communications (barrier, broadcast, reduce, scatter, gather, all to all), Benchmarking functions – (MPI_Wtime, MPI_Wtick), Example – one dimensional Matrix-Vector Multiplication, single source shortest path. | 10 | 25% |
| IV | **Advanced HPC Topics:**  
Hybrid parallel computing – combining OpenMP & MPI, Accelerators (GPGPUs) – CUDA & OpenCL, basic CUDA programming. | 10 | 25% |
Course No. | Course Name | L-T-P-Credits | Year of Introduction
--- | --- | --- | ---
06 CS 7 51 3 | MOBILE NETWORK SECURITY | 3-0-0-3 | 2015

PREREQUISITES: Wireless network, Network security concepts

COURSE OBJECTIVES:
- To equip students with the basic understanding of the fundamental concept of wireless security
- To enhance knowledge of security in off-the-shelf technologies and emerging technologies
- To make them aware of privacy and trusted communication mobile network

SYLLABUS:
Introduction to Mobile and Wireless Network and security vulnerabilities, security in off-the-shelf technologies, security in emerging technologies, privacy and trust in mobile network and mobile security

EXPECTED OUTCOME:
Students who successfully complete this course will be able to:-
- Security mechanism in mobile network
- Security issues and available solutions associated with off-the-shelf wireless and mobile technologies such as Bluetooth, WiFi, WiMax, 2G, and 3G.
- Security issues and solutions in emerging wireless and mobile technologies such as ad hoc and sensor networks, cellular 4G and IMS networks.
- Privacy and trust management in mobile network

REFERENCES:
2. Stefanos Gritzalis, Tom Karygiannis, Charalabos Skianis, Security and privacy in mobile and wireless networking, Troubadour, 2009

COURSE PLAN

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<tr>
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<th>Hours</th>
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<tr>
<td><strong>II</strong></td>
<td>Off-the shelf Technologies: Bluetooth security, Wi-Fi security, Wi-Max security, Security in mobile telecommunication network</td>
<td>11</td>
<td>25%</td>
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<tr>
<td></td>
<td>FIRST INTERNAL EXAM</td>
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<tr>
<td><strong>III</strong></td>
<td>Emerging Technologies- Security in Next Generation Mobile network, Security of IP-based network, security in Adhoc network, key management in Adhoc network.</td>
<td>11</td>
<td>25%</td>
</tr>
<tr>
<td><strong>IV</strong></td>
<td>Research direction in security and privacy of mobile networks, Applying trust in mobile and wireless network, mobile security</td>
<td>10</td>
<td>25%</td>
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<tr>
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<td>Year of Introduction</td>
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<tr>
<td>06 CS 7 12 3</td>
<td>CONTENT BASED IMAGE AND VIDEO RETRIEVAL</td>
<td>3-0-0-3</td>
<td>2015</td>
</tr>
</tbody>
</table>

**PREREQUISITES:** Knowledge about multimedia system

**COURSE OBJECTIVES:**
- To learn about Content-Based Image Retrieval with user needs
- To gain knowledge about content-based image and video retrieval system.

**SYLLABUS:**
Fundamentals, Feature extraction and representation, Clustering, The video problem, Overview of the System.

**EXPECTED OUTCOME:**
Students who successfully complete this course will be able to
- apply knowledge of content-based image retrieval system
- model and design of Retrieval system.
- develop Content-Based Image Retrieval system with simple case studies.

**TEXT BOOK:**
- Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze, “Introduction to information Retrieval”, Cambridge University Press, 2008

**REFERENCES:**

**COURSE PLAN**

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<tbody>
<tr>
<td>I</td>
<td>Fundamentals – Definition of CBIR - A typical CBIVR system architecture-User’s perspective-Image use in the community- Users needs for image data</td>
<td>10</td>
<td>25%</td>
</tr>
<tr>
<td>II</td>
<td>Feature extraction and representation- Similarity measurements-Dimension Reduction and High dimensional Indexing</td>
<td>5</td>
<td>25%</td>
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</table>

**FIRST INTERNAL EXAM**

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<tbody>
<tr>
<td>II</td>
<td>Clustering-The Semantic Gap-Learning-Relevance Feedback(RF)- Benchmarking CBIVR solutions</td>
<td>5</td>
<td>25%</td>
</tr>
<tr>
<td>III</td>
<td>The problem – Video Parsing-Video Abstraction and Summarization-Video content representation, Indexing and Retrieval-Video browsing schemes-Examples of Video Retrieval systems.</td>
<td>10</td>
<td>25%</td>
</tr>
<tr>
<td>IV</td>
<td>Overview of the System-User’s Perspective-The RF mode-RFC mode-Experiments and Results</td>
<td>10</td>
<td>25%</td>
</tr>
</tbody>
</table>
Prerequisities: Networks and graph theory

Course objectives:
- Representation and analysis of social networks

Syllabus:
Networks of information, Processes on networks, Models for social influence analysis, Social media

Expected outcome:
The students will be able to:
- Use social networks as a key feature for next generation usage and exploitation of the Web.

Text books:

References:

Course plan:

<table>
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</thead>
<tbody>
<tr>
<td>II</td>
<td>Processes on networks – Percolation and network resilience – Epidemics on networks – Dynamical systems on networks – Network search</td>
<td>10 Hrs</td>
<td>25%</td>
</tr>
<tr>
<td>III</td>
<td>Models for social influence analysis – Systems for expert location – Link prediction – privacy analysis – visualization – Data and text mining in social networks - Social tagging</td>
<td>10 Hrs</td>
<td>25%</td>
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<tr>
<th>Course No.</th>
<th>Course Name</th>
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<th>Year of Introduction</th>
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<tbody>
<tr>
<td>06 CS 7 32 3</td>
<td>CYBER FORENSICS</td>
<td>3-0-0-3</td>
<td>2015</td>
</tr>
</tbody>
</table>

**PREREQUISITES:** NIL

**COURSE OBJECTIVES:**

- Students can establish responsibility and accountability for information security in organizations.
- The students can also design security procedures and policies.

**SYLLABUS:**

Introduction to Cyber forensics, Types of Computer Forensics Systems, Ethical Hacking, Identification of Data.

**EXPECTED OUTCOME:**

- The student will be able to understand contemporary issues in information security management; analyse and prioritise information security risks.
- The student should be able to identify countermeasures and review techniques appropriate to the management of information security risks.
- Students should be able to understand the policy and technology trade-offs involved in developing information security systems of adequate quality.

**REFERENCES:**


**COURSE PLAN**

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<th>Module</th>
<th>Contents</th>
<th>Hours</th>
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</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td><strong>Computer Forensics Technology</strong></td>
<td>12 Hrs</td>
<td>25%</td>
</tr>
<tr>
<td></td>
<td>Introduction to Cyber forensics , Types of Computer Forensics Technology, Types of Military Computer Forensic Technology, Types of Law Enforcement: Computer Forensic Technology, Types of Business Computer Forensic Technology, Specialized Forensics Techniques, Hidden Data and How to Find It, Spyware and Adware, Encryption Methods and Vulnerabilities, Protecting Data from Being Compromised Internet Tracing Methods, Security and Wireless Technologies, Avoiding Pitfalls with Firewalls Biometric Security Systems</td>
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</tbody>
</table>
| II | **Computer Forensics Systems**  
| III | **Ethical Hacking**  
| IV | **Identification of Data**  
Course No. | Course Name | L-T-P-Credits | Year of Introduction
--- | --- | --- | ---
06 CS 7 42 3 | REAL TIME SYSTEMS | 3-0-0-3 | 2015

PREREQUISITES: NIL

COURSE OBJECTIVES:

SYLLABUS:
Issues in Real Time Computing, Programming Languages And Tools, Real Time Databases, Communication, Evaluation Techniques

EXPECTED OUTCOME:
- Explain the issues related to the design and analysis of systems with real-time constraints.
- Describe the foundation for programming languages developed for real time programming

TEXT BOOK:

REFERENCES:

COURSE PLAN

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<tbody>
<tr>
<td>II</td>
<td>PROGRAMMING LANGUAGES AND TOOLS – Desired Language characteristics, Data Typing, Control structures, Facilitating Hierarchical Decomposition, Packages, Run-time (Exception) Error handling, Overloading and Generics, Multitasking, Low Level programming, Task scheduling, Timing Specifications, Programming Environments, Run-time Support.</td>
<td>10</td>
<td>25%</td>
</tr>
<tr>
<td>III</td>
<td>REAL TIME DATABASES - Basic Definition, Real time Vs General Purpose Databases, Main Memory Databases, Transaction priorities, Transaction Aborts, Concurrency Control</td>
<td>10</td>
<td>25%</td>
</tr>
<tr>
<td></td>
<td>Issues, Disk Scheduling Algorithms, Two-phase Approach to improve Predictability, Maintaining Serialization Consistency, Databases for Hard Real Time systems.</td>
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<tr>
<td>06 CS 7 52 3</td>
<td>ADVANCED INFORMATION SECURITY CONCEPTS</td>
<td>3-0-0-3</td>
<td>2015</td>
</tr>
</tbody>
</table>

**PREREQUISITES:** Basics of Programming and computer security

**COURSE OBJECTIVES:**

- To learn different secure coding practices
- To learn ethical hacking practices
- To learn web, cloud and biometric security concepts

**SYLLABUS:**
Secure Coding, Ethical Hacking, Web application and Cloud security, Biometric Security.

**EXPECTED OUTCOME:**
Students will be able to:

- Apply secure coding practices
- Apply ethical hacking practices
- Demonstrate Web, Cloud and Biometric security practices

**REFERENCES:**
2. CEH: Certified Ethical Hacker Study Guide, Kimberly Graves, SERIOUS SKILLS.
5. Ronald L. Krutz, Russell Dean Vines, Cloud Security, Wiley publication 2010

**COURSE PLAN**

<table>
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<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem Exam Marks</th>
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</thead>
<tbody>
<tr>
<td>II</td>
<td>Ethical Hacking: Hacking Fundamentals, Reconnaissance, Scanning and Enumeration, Sniffers, ARP poisoning and MAC Flooding, Denial of Service, Session Hijacking, Social Engineering Web server-working, vulnerability and attack, Web Application Penetration Testing, Structure of Penetration Testing, reverse engineering (using debuggers such ollydbg or immunity debugger),</td>
<td>10</td>
<td>25%</td>
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<tr>
<td>Digital Forensics (different approaches basic idea)</td>
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### FIRST INTERNAL EXAM

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<th>Course No.</th>
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<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
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<tbody>
<tr>
<td>06 CS 7 03 3</td>
<td>SEMINAR</td>
<td>0-0-2-2</td>
<td>2015</td>
</tr>
</tbody>
</table>

**PREREQUISITES:**
- Good presentation skills and knowledge about the area of study

**COURSE OBJECTIVES:**
- To learn the recent developments in the research areas/ area of interest.

**SYLLABUS:**
Each student shall present a seminar on any topic of interest related to the core / elective courses offered in the M. Tech. Programme. He / she shall select the topic based on the References: from international journals of repute, preferably IEEE journals. They should get the paper approved by the Programme Co-ordinator / Faculty member in charge of the seminar and shall present it in the class. Every student shall participate in the seminar. The students should undertake a detailed study on the topic and submit a report at the end of the semester.

**EXPECTED OUTCOME:**
The students will be able to:
- develop their presentation skills
- acquire the knowledge about emerging research areas or topic of interest
M.Tech Syllabus – Computer Science: Specialization in Information Systems

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</thead>
<tbody>
<tr>
<td>06 CS 7 04 3</td>
<td>PROJECT – PHASE I</td>
<td>0-0-12-6</td>
<td>2015</td>
</tr>
</tbody>
</table>

**PREREQUISITES:**
- Knowledge about programming languages and topic of interest

**COURSE OBJECTIVES:**
- To develop a project in emerging research area

**SYLLABUS:**
In master’s thesis Phase-I, the students are expected to select an emerging research area in Computer Science or related fields. After conducting a detailed literature survey, they should compare and analyze research work done and review recent developments in the area and prepare an initial design of the work to be carried out as Master’s Thesis. It is expected that the students should refer National and International Journals and conference proceedings while selecting a topic for their thesis. He/She should select a recent topic from a reputed International Journal, preferably IEEE/ACM. Emphasis should be given for introduction to the topic, literature survey, and scope of the proposed work along with some preliminary work carried out on the thesis topic.

Students should submit a copy of Phase-I thesis report covering the content discussed above and highlighting the features of work to be carried out in Phase-II of the thesis.

The candidate should present their thesis work and the assessment will be made on the basis of the work and the presentation, by a panel of internal examiners in which one will be the internal guide.

**EXPECTED OUTCOME:**
- The students will be able to
  - understand the emerging research areas
  - enhance their programming ability
  - apply the knowledge acquired to develop any application or research projects
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<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
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<tbody>
<tr>
<td>06 CS 7 01 4</td>
<td>PROJECT – PHASE II</td>
<td>0-0-21-12</td>
<td>2015</td>
</tr>
</tbody>
</table>

**PREREQUISITES:**
- Knowledge about programming languages
- Knowledge about research area/topic of study

**COURSE OBJECTIVES:**
- To develop a project in emerging research area

**SYLLABUS:**
In the fourth semester, the student has to continue the thesis work and after successfully finishing the work, he / she has to submit a detailed bounded thesis report. The work carried out should lead to a publication in a National / International Conference or Journal. The papers received acceptance before the M.Tech evaluation will carry specific weightage.

Students should submit a copy of Project work report.

The candidate should present the thesis work and the assessment will be made on the basis of the work and the presentation, by a panel of examiners in which one will be the internal guide.

**EXPECTED OUTCOME:**
- The students will be able to
  - understand the emerging research areas/ topic of interest
  - enhance their programming ability
  - apply the knowledge acquired to develop any application or research projects