ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
M.E. COMPUTER SCIENCE AND ENGINEERING
REGULATIONS – 2017
CHOICE BASED CREDIT SYSTEM

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):
1. To enable graduates to pursue research, or have a successful career in academia or industries associated with Computer Science and Engineering, or as entrepreneurs.
2. To provide students with strong foundational concepts and also advanced techniques and tools in order to enable them to build solutions or systems of varying complexity.
3. To prepare students to critically analyze existing literature in an area of specialization and ethically develop innovative and research oriented methodologies to solve the problems identified.

PROGRAM SPECIFIC OBJECTIVES (PSOs):
1. To analyze, design and develop computing solutions by applying foundational concepts of computer science and engineering.
2. To apply software engineering principles and practices for developing quality software for scientific and business applications.
3. To adapt to emerging information and communication technologies (ICT) to innovate ideas and solutions to existing/novel problems.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:
1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

**MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES:**
A broad relation between the programme objective and the outcomes is given in the following table.

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<th>2:Significant</th>
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2
MAPPING OF PROGRAM SPECIFIC OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the Program Specific Objectives and the outcomes is given in the following table:

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Contribution: 1: Reasonable, 2: Significant, 3: Strong
# M.E. COMPUTER SCIENCE AND ENGINEERING
## SEMESTER COURSE WISE PO MAPPING

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**TOTAL NO. OF CREDITS: 70**
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<td>MP5291</td>
<td>Real Time Systems</td>
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<td>2.</td>
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## SEMESTER III

### ELECTIVE III

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<td>1.</td>
<td>CP5003</td>
<td>Performance Analysis of Computer Systems</td>
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### SEMESTER III
#### ELECTIVE IV

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### SEMESTER III
#### ELECTIVE V

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<td>Data Visualization Techniques</td>
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<td>Reconfigurable Computing</td>
<td>PE</td>
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<td>CP5097</td>
<td>Mobile Application Development</td>
<td>PE</td>
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<td>Bio Informatics</td>
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<td>PE</td>
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</tbody>
</table>
OBJECTIVES:
This course is designed to provide the solid foundation on topics in applied probability and various statistical methods which form the basis for many other areas in the mathematical sciences including statistics, modern optimization methods and risk modeling. It is framed to address the issues and the principles of estimation theory, testing of hypothesis and multivariate analysis.

UNIT I    PROBABILITY AND RANDOM VARIABLES

UNIT II    TWO DIMENSIONAL RANDOM VARIABLES
Joint distributions – Marginal and conditional distributions – Functions of two dimensional random variables – Regression curve – Correlation.

UNIT III    ESTIMATION THEORY

UNIT IV    TESTING OF HYPOTHESIS
Sampling distributions – Type I and Type II errors – Small and large samples – Tests based on Normal, t, Chi square and F distributions for testing of mean, variance and proportions – Tests for independence of attributes and goodness of fit.

UNIT V    MULTIVARIATE ANALYSIS
Random vectors and matrices – Mean vectors and covariance matrices – Multivariate normal density and its properties – Principal components - Population principal components – Principal components from standardized variables

TOTAL: 60 PERIODS

OUTCOMES:
After completing this course, students should demonstrate competency in the following topics:
- Basic probability axioms and rules and the moments of discrete and continuous random variables.
- Consistency, efficiency and unbiasedness of estimators, method of maximum likelihood estimation and Central Limit Theorem.
- Use statistical tests in testing hypotheses on data.
- Perform exploratory analysis of multivariate data, such as multivariate normal density, calculating descriptive statistics, testing for multivariate normality.

The students should have the ability to use the appropriate and relevant, fundamental and applied mathematical and statistical knowledge, methodologies and modern computational tools.
REFERENCES:


CP5151ADVANCED DATA STRUCTURES AND ALGORITHMS L T P C

OBJECTIVES:

- To understand the usage of algorithms in computing.
- To learn and use hierarchical data structures and its operations
- To learn the usage of graphs and its applications.
- To select and design data structures and algorithms that is appropriate for problems.
- To study about NP Completeness of problems.

UNIT I ROLE OF ALGORITHMS IN COMPUTING


UNIT II HIERARCHICAL DATA STRUCTURES


UNIT III GRAPHS

UNIT IV  ALGORITHM DESIGN TECHNIQUES

UNIT V  NP COMPLETE AND NP HARD

TOTAL: 60 PERIODS

OUTCOMES:
Upon the completion of the course the students should be able to:
- Design data structures and algorithms to solve computing problems
- Design algorithms using graph structure and various string matching algorithms to solve real-life problems
- Apply suitable design strategy for problem solving

REFERENCES:

CP5152  ADVANCED COMPUTER ARCHITECTURE  L  T  P  C
3  0  0  3

OBJECTIVES:
- To introduce the students to the recent trends in the field of Computer Architecture and identify performance related parameters.
- To learn the different multiprocessor issues.
- To expose the different types of multicore architectures.
- To understand the design of the memory hierarchy.

UNIT I  FUNDAMENTALS OF COMPUTER DESIGN AND ILP

UNIT II  MEMORY HIERARCHY DESIGN
UNIT III  MULTIPROCESSOR ISSUES  9
Introduction- Centralized, Symmetric and Distributed Shared Memory Architectures –Cache Coherence Issues – Performance Issues – Synchronization – Models of Memory Consistency – Case Study-Interconnection Networks – Buses, Crossbar and Multi-stage Interconnection Networks

UNIT IV  MULTICORE ARCHITECTURES  9

UNIT V  VECTOR, SIMD AND GPU ARCHITECTURES  9

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of this course, the students should be able to:
- Identify the limitations of ILP.
- Discuss the issues related to multiprocessing and suggest solutions
- Point out the salient features of different multicore architectures and how they exploit parallelism.
- Discuss the various techniques used for optimising the cache performance
- Design hierarchal memory system
- Point out how data level parallelism is exploited in architectures

REFERENCES:
OBJECTIVES:

- To be able to read and understand sample open source programs and header files.
- To learn how the processes are implemented in Linux.
- To understand the implementation of the Linux file system.
- To study Linux memory management data structures and algorithms.
- To acquire the knowledge in the implementation of interprocess communication.
- To understand how program execution happens in Linux.

UNIT I  INTRODUCTION
Basic Operating System Concepts - Overview of Unix File System - Files - Links - Types - Inodes
- Memory Management - Device Drivers.

UNIT II  PROCESSES
- System Calls - Kernel Threads - Destroying Processes - Termination - Removal.

UNIT III  FILE SYSTEM
The Virtual File System (VFS) - Role - File Model - System Calls - Data Structures - Super Block, Inode, File, dentry Objects - dentry Cache - Files Associated with a Process - Filesystem Types - Special Filesystems - Filesystem Type Registration - Filesystem Handling - Namespaces - Mounting - Unmounting - Implementation of VFS System Calls.

UNIT IV  MEMORY MANAGEMENT
Page frame management - page descriptors - non-uniform memory access - memory zones - reserved page frames - zoned page frame allocator - kernel mappings - buddy system algorithm - page frame cache - zone allocator.

UNIT V  PROCESS COMMUNICATION AND PROGRAM EXECUTION

TOTAL: 45 PERIODS

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

- To explain the functionality of a large software system by reading its source.
- To revise any algorithm present in a system.
- To design a new algorithm to replace an existing one.
- To appropriately modify and use the data structures of the Linux kernel for a different software system.
REFERENCES:

CP5154 ADVANCED SOFTWARE ENGINEERING

<table>
<thead>
<tr>
<th>OBJECTIVES:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- To understand Software Engineering Lifecycle Models</td>
</tr>
<tr>
<td>- To do project management and cost estimation</td>
</tr>
<tr>
<td>- To gain knowledge of the System Analysis and Design concepts.</td>
</tr>
<tr>
<td>- To understand software testing approaches</td>
</tr>
<tr>
<td>- To be familiar with DevOps practices</td>
</tr>
</tbody>
</table>

UNIT I INTRODUCTION

UNIT II SOFTWARE REQUIREMENT SPECIFICATION

UNIT III ARCHITECTURE AND DESIGN

UNIT IV TESTING
Testing – Unit testing – Black box testing– White box testing – Integration and System testing– Regression testing – Debugging - Program analysis – Symbolic execution – Model Checking

UNIT V DEVOPS

TOTAL: 45 PERIODS
OUTCOMES:
At the end of this course, the students will be able to:

- Understand the advantages of various Software Development Lifecycle Models
- Gain knowledge on project management approaches as well as cost and schedule estimation strategies
- Perform formal analysis on specifications
- Use UML diagrams for analysis and design
- Architect and design using architectural styles and design patterns
- Understand software testing approaches
- Understand the advantages of DevOps practices

REFERENCES:

CP5191 MACHINE LEARNING TECHNIQUES

OBJECTIVES:

- To introduce students to the basic concepts and techniques of Machine Learning.
- To have a thorough understanding of the Supervised and Unsupervised learning techniques
- To study the various probability based learning techniques
- To understand graphical models of machine learning algorithms

UNIT I INTRODUCTION


UNIT II LINEAR MODELS

UNIT III  TREE AND PROBABILISTIC MODELS  

UNIT IV  DIMENSIONALITY REDUCTION AND EVOLUTIONARY MODELS  

UNIT V  GRAPHICAL MODELS  

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of this course, the students will be able to:
- Distinguish between, supervised, unsupervised and semi-supervised learning
- Apply the appropriate machine learning strategy for any given problem
- Suggest supervised, unsupervised or semi-supervised learning algorithms for any given problem
- Design systems that uses the appropriate graph models of machine learning
- Modify existing machine learning algorithms to improve classification efficiency

REFERENCES:
OBJECTIVES:
- To acquire the knowledge of using advanced tree structures.
- To learn the usage of heap structures.
- To understand the usage of graph structures and spanning trees.

LIST OF EXPERIMENTS:
Each student has to work individually on assigned lab exercises. Lab sessions could be scheduled as one contiguous four-hour session per week or two two-hour sessions per week. There will be about 15 exercises in a semester. It is recommended that all implementations are carried out in Java. If C or C++ has to be used, then the threads library will be required for concurrency. Exercises should be designed to cover the following topics:

EXPERIMENTS:
1. Implementation of Merge Sort and Quick Sort-Analysis
2. Implementation of a Binary Search Tree
3. Red-Black Tree Implementation
4. Heap Implementation
5. Fibonacci Heap Implementation
6. Graph Traversals
7. Spanning Tree Implementation
8. Shortest Path Algorithms (Dijkstra's algorithm, Bellmann Ford Algorithm)
9. Implementation of Matrix Chain Multiplication
10. Activity Selection and Huffman Coding Implementation.

TOTAL: 60 PERIODS

OUTCOMES:
Upon Completion of this course, the students will be able to:
- Design and implement basic and advanced data structures extensively.
- Design algorithms using graph structures
- Design and develop efficient algorithms with minimum complexity using design techniques.

OBJECTIVES:
- To understand the principles required for network design
- To explore various technologies in the wireless domain
- To study about 3G and 4G cellular networks
- To understand the paradigm of Software defined networks
UNIT I NETWORK DESIGN

UNIT II WIRELESS NETWORKS

UNIT III CELLULAR NETWORKS

UNIT IV 4G NETWORKS

UNIT V SOFTWARE DEFINED NETWORKS

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of this course, the students should be able to
• Identify the components required for designing a network
• Design a network at a high-level using different networking technologies
• Analyze the various protocols of wireless and cellular networks
• Discuss the features of 4G and 5G networks
• Experiment with software defined networks
REFERENCES:

CP5291 SECURITY PRACTICES L T P C
3 0 0 3

OBJECTIVES:
• To learn the core fundamentals of system and web security concepts
• To have through understanding in the security concepts related to networks
• To deploy the security essentials in IT Sector
• To be exposed to the concepts of Cyber Security and encryption Concepts
• To perform a detailed study of Privacy and Storage security and related Issues.

UNIT I SYSTEM SECURITY
Building a secure organization- A Cryptography primer- detecting system Intrusion- Preventing system Intrusion- Fault tolerance and Resilience in cloud computing environments- Security web applications, services and servers.

UNIT II NETWORK SECURITY

UNIT III SECURITY MANAGEMENT
UNIV IV  CYBER SECURITY AND CRYPTOGRAPHY  9
Cyber Forensics- Cyber Forensics and Incidence Response - Security e-Discovery - Network Forensics - Data Encryption- Satellite Encryption - Password based authenticated Key establishment Protocols.

UNIT V  PRIVACY AND STORAGE SECURITY  9

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of this course the students should be able to
- Understand the core fundamentals of system security
- Apply the security concepts related to networks in wired and wireless scenario
- Implement and Manage the security essentials in IT Sector
- Able to explain the concepts of Cyber Security and encryption Concepts
- Able to attain a through knowledge in the area of Privacy and Storage security and related Issues.

REFERENCES:

CP5292  INTERNET OF THINGS  L T P C
3 0 0 3

OBJECTIVES:
- To understand the fundamentals of Internet of Things
- To learn about the basics of IOT protocols
- To build a small low cost embedded system using Raspberry Pi.
- To apply the concept of Internet of Things in the real world scenario.

UNIT I  INTRODUCTION TO IoT  9
Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology

UNIT II  IoT ARCHITECTURE  9
M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture
UNIT III IoT PROTOCOLS

UNIT IV BUILDING IoT WITH RASPBERRY PI & ARDUINO

UNIT V CASE STUDIES AND REAL-WORLD APPLICATIONS
Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs - Cloud for IoT - Amazon Web Services for IoT.

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of this course, the students should be able to:
- Analyze various protocols for IoT
- Develop web services to access/control IoT devices.
- Design a portable IoT using Rasperry Pi
- Deploy an IoT application and connect to the cloud.
- Analyze applications of IoT in real time scenario

REFERENCES:

CP5293 BIG DATA ANALYTICS L T P C
3 0 0 3

OBJECTIVES:
- To understand the competitive advantages of big data analytics
- To understand the big data frameworks
- To learn data analysis methods
- To learn stream computing
- To gain knowledge on Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics
UNIT I INTRODUCTION TO BIG DATA

UNIT II HADOOP FRAMEWORK
Distributed File Systems - Large-Scale FileSystem Organization – HDFS concepts - MapReduce Execution, Algorithms using MapReduce, Matrix-Vector Multiplication – Hadoop YARN

UNIT III DATA ANALYSIS
Statistical Methods:Regression modelling, Multivariate Analysis - Classification: SVM & Kernel Methods - Rule Mining - Cluster Analysis, Types of Data in Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density Based Methods, Grid Based Methods, Model Based Clustering Methods, Clustering High Dimensional Data - Predictive Analytics – Data analysis using R.

UNIT IV MINING DATA STREAMS

UNIT V BIG DATA FRAMEWORKS

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course, the students will be able to:
- Understand how to leverage the insights from big data analytics
- Analyze data by utilizing various statistical and data mining approaches
- Perform analytics on real-time streaming data
- Understand the various NoSql alternative database models

REFERENCES:
2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.
OBJECTIVES:
- To implement Map Reduce programs for processing big data
- To realize storage of big data using Hbase, MongoDB
- To analyse big data using linear models
- To analyse big data using machine learning techniques such as SVM / Decision tree classification and clustering

LIST OF EXPERIMENTS

Hadoop
1. Install, configure and run Hadoop and HDFS
2. Implement word count / frequency programs using MapReduce
3. Implement an MR program that processes a weather dataset

R
4. Implement Linear and logistic Regression
5. Implement SVM / Decision tree classification techniques
6. Implement clustering techniques
7. Visualize data using any plotting framework
8. Implement an application that stores big data in Hbase / MongoDB / Pig using Hadoop / R.

TOTAL: 60 PERIODS

OUTCOMES:
Upon Completion of this course, the students will be able to:
- Process big data using Hadoop framework
- Build and apply linear and logistic regression models
- Perform data analysis with machine learning methods
- Perform graphical data analysis

LIST OF SOFTWARE FOR A BATCH OF 30 STUDENTS:

Hadoop
YARN
R Package
Hbase
MongoDB

REFERENCES:
2. Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani, “An Introduction to Statistical Learning with Applications in R”, Springer Publications, 2015(Corrected 6th Printing)
In this course, students will develop their scientific and technical reading and writing skills that they need to understand and construct research articles. A term paper requires a student to obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas. The work involves the following steps:

1. Selecting a subject, narrowing the subject into a topic
2. Stating an objective.
3. Collecting the relevant bibliography (atleast 15 journal papers)
4. Preparing a working outline.
5. Studying the papers and understanding the authors contributions and critically analysing each paper.
6. Preparing a working outline
7. Linking the papers and preparing a draft of the paper.
8. Preparing conclusions based on the reading of all the papers.
9. Writing the Final Paper and giving final Presentation

Please keep a file where the work carried out by you is maintained. Activities to be carried out

<table>
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<tr>
<th>Activity</th>
<th>Instructions</th>
<th>Submission week</th>
<th>Evaluation</th>
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<tbody>
<tr>
<td>Selection of area of interest and Topic</td>
<td>You are requested to select an area of interest, topic and state an objective</td>
<td>2nd week</td>
<td>Based on clarity of thought, current relevance and clarity in writing</td>
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<tr>
<td>Stating an Objective</td>
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</tr>
</tbody>
</table>
| Collecting Information about your area & topic | 1. List 1 Special Interest Groups or professional society  
2. List 2 journals  
3. List 2 conferences, symposia or workshops  
4. List 1 thesis title  
5. List 3 web presences (mailing lists, forums, news sites)  
6. List 3 authors who publish regularly in your area  
7. Attach a call for papers (CFP) from your area. | 3rd week        | 3% (the selected information must be area specific and of international and national standard) |
| Collection of Journal papers in the topic in the context of the objective – collect 20 & then filter | • You have to provide a complete list of references you will be using. Based on your objective - Search various digital libraries and Google Scholar  
• When picking papers to read - try to:  
  • Pick papers that are related to each other in some ways and/or that are in the same field so that you can write a meaningful survey out of them,  
  • Favour papers from well-known journals and conferences,  
  • Favour “first” or “foundational” papers in the field (as indicated in other people’s survey paper),  
  • Favour more recent papers,  
  • Pick a recent survey of the field so you can quickly gain an overview,  
  • Find relationships with respect to each other and to your topic area (classification scheme/categorization)  
  • Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered | 4th week | 6%  
( the list of standard papers and reason for selection) |
|---|---|---|
| Reading and notes for first 5 papers | Reading Paper Process  
• For each paper form a Table answering the following questions:  
  • What is the main topic of the article?  
  • What was/were the main issue(s) the author said they want to discuss?  
  • Why did the author claim it was important?  
  • How does the work build on other’s work, in the author’s opinion?  
  • What simplifying assumptions does the author claim to be making?  
  • What did the author do?  
  • How did the author claim they were going to evaluate their work and compare it to others?  
  • What did the author say were the limitations of their research?  
  • What did the author say were the important directions for future research? Conclude with limitations/issues not addressed by the paper (from the perspective of your survey) | 5th week | 8%  
( the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper) |
<table>
<thead>
<tr>
<th>Activity Description</th>
<th>Task Description</th>
<th>Week</th>
<th>Percentage</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading and notes for next 5 papers</td>
<td>Repeat Reading Paper Process</td>
<td>6th</td>
<td>8%</td>
<td>(the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)</td>
</tr>
<tr>
<td>Reading and notes for final 5 papers</td>
<td>Repeat Reading Paper Process</td>
<td>7th</td>
<td>8%</td>
<td>(the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)</td>
</tr>
<tr>
<td>Draft outline 1 and Linking papers</td>
<td>Prepare a draft Outline, your survey goals, along with a classification / categorization diagram</td>
<td>8th</td>
<td>8%</td>
<td>(this component will be evaluated based on the linking and classification among the papers)</td>
</tr>
<tr>
<td>Abstract</td>
<td>Prepare a draft abstract and give a presentation</td>
<td>9th</td>
<td>6%</td>
<td>(Clarity, purpose and conclusion)</td>
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<td>6% Presentation &amp; Viva Voce</td>
</tr>
<tr>
<td>Introduction Background</td>
<td>Write an introduction and background sections</td>
<td>10th</td>
<td>5%</td>
<td>(Clarity)</td>
</tr>
<tr>
<td>Sections of the paper</td>
<td>Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey</td>
<td>11th</td>
<td>10%</td>
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**TOTAL: 30 PERIODS**
OBJECTIVES:

- To understand the design of databases.
- To acquire knowledge on parallel and distributed databases and its applications.
- To study the usage and applications of Object Oriented and Intelligent databases.
- To understand the emerging databases like Mobile, XML, Cloud and Big Data

UNIT I  PARALLEL AND DISTRIBUTED DATABASES  9

UNIT II  INTELLIGENT DATABASES  9

UNIT III  XML DATABASES  9

UNIT IV  MOBILE DATABASES  9
Mobile Databases: Location and Handoff Management - Effect of Mobility on Data Management - Location Dependent Data Distribution - Mobile Transaction Models - Concurrency Control - Transaction Commit Protocols

UNIT V  MULTIMEDIA DATABASES  9

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, a students should be able:
- To develop skills on databases to optimize their performance in practice.
- To analyze each type of databases and its necessity
- To design faster algorithms in solving practical database problems
REFERENCES:

CP5001 PRINCIPLES OF PROGRAMMING LANGUAGES L T P C 3 0 0 3

OBJECTIVES:
• To understand and describe syntax and semantics of programming languages.
• To understand Data, Data types, and Bindings.
• To learn the concepts of functional and logical programming.
• To explore the knowledge about concurrent Programming paradigms.

UNIT I ELEMENTS OF PROGRAMMING LANGUAGES

UNIT II DATA TYPES-ABSTRACTION
Introduction - Primitive Data Types- Character String Types- User-Defined Ordinal Types- Array types- Associative Arrays-Record Types- Tuple Types-List Types -Union Types - Pointer and Reference Types -Type Checking- Strong Typing -Type Equivalence - Theory and Data Types-Variables-The Concept of Binding -Scope - Scope and Lifetime - Referencing Environments - Named Constants- The Concept of Abstraction- Parameterized Abstract Data Types- Encapsulation Constructs- Naming Encapsulations

UNIT III FUNCTIONAL PROGRAMMING
UNIT IV LOGIC PROGRAMMING

UNIT V CONCURRENT PROGRAMMING

OUTCOMES:
Upon completion of this course, the students will be able to
- Describe syntax and semantics of programming languages
- Explain data, data types, and basic statements of programming languages
- Design and implement subprogram constructs, Apply object - oriented, concurrency, pro
- and event handling programming constructs
- Develop programs in LISP, ML, and Prolog.

REFERENCES:

CP5071 IMAGE PROCESSING AND ANALYSIS

OBJECTIVES:
- To understand the image processing concepts and analysis
- To understand the image processing techniques
- To familiarize the image processing environment and their applications,
- To appreciate the use of image processing in various applications

UNIT I IMAGE PROCESSING FUNDAMENTALS
UNIT II IMAGE ENHANCEMENT AND RESTORATION


UNIT III IMAGE SEGMENTATION AND MORPHOLOGY


UNIT IV IMAGE ANALYSIS AND CLASSIFICATION

Image segmentation- pixel based, edge based, region based segmentation. Active contour models and Level sets for medical image segmentation, Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, feature and statistical image classification.

UNIT V IMAGE REGISTRATION AND VISUALIZATION

Rigid body visualization, Principal axis registration, Interactive principal axis registration, Feature based registration, Elastic deformation based registration, Image visualization – 2D display methods, 3D display methods, virtual reality based interactive visualization.

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of this course, a students should be able to:
- Design and implement algorithms for image processing applications that incorporates different concepts of medical Image Processing
- Familiar with the use of MATLAB and its equivalent open source tools
- Critically analyze different approaches to image processing applications
- Explore the possibility of applying Image processing concepts in various applications

REFERENCES:
1. Alasdair McAndrew, —Introduction to Digital Image Processing with Matlab‖, Cengage Learning 2011,India
OBJECTIVES:
- Understand the characteristics of web applications
- Learn to Model web applications
- Be aware of Systematic design methods
- Be familiar with the testing techniques for web applications

UNIT I INTRODUCTION TO WEB ENGINEERING 9
Motivation, Categories of Web Applications, Characteristics of Web Applications.

UNIT II WEB APPLICATION ARCHITECTURES & MODELLING WEB APPLICATIONS 9
Introduction- Categorizing Architectures- Specifics of Web Application Architectures,
Modeling Requirements, Hypertext Modeling, Hypertext Structure Modeling Concepts,

UNIT III WEB APPLICATION DESIGN 9
Design for WebApps- Goals-Design Process-Interactive Design- Principles and Guidelines-

UNIT IV TESTING WEB APPLICATIONS 9
Introduction-Fundamentals-Test Specifics in Web Engineering-Test Approaches-

UNIT V PROMOTING WEB APPLICATIONS AND WEB PROJECT MANAGEMENT 9
Introduction-challenges in launching the web Application-Promoting Web Application-

TOTAL : 45 PERIODS
OUTCOMES:
Upon completion of this course, the students should be able to:

- Explain the characteristics of web applications.
- Model web applications.
- Design web applications.
- Test web applications.

REFERENCES:

CP5092 CLOUD COMPUTING TECHNOLOGIES L T P C
3  0  0  3

OBJECTIVES:
- To understand the concepts of virtualization and virtual machines
- To gain expertise in server, network and storage virtualization.
- To understand and deploy practical virtualization solutions and enterprise solutions
- To gain knowledge on the concept of virtualization that is fundamental to cloud computing
- To understand the various issues in cloud computing
- To be able to set up a private cloud
- To understand the security issues in the grid and the cloud environment

UNIT I VIRTUALIZATION
9

UNIT II VIRTUALIZATION INFRASTRUCTURE
9
UNIT III  CLOUD PLATFORM ARCHITECTURE  9
Cloud deployment models: public, private, hybrid, community – Categories of cloud computing:
Everything as a service: Infrastructure, platform, software - A Generic Cloud Architecture Design –
Layered cloud Architecture Development – Virtualization Support and Disaster Recovery –
Architectural Design Challenges - Public Cloud Platforms : GAE,AWS – Inter-cloud Resource Management

UNIT IV  PROGRAMMING MODEL  9
Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions,
specifying input and output parameters, configuring and running a job –Developing Map Reduce
Applications - Design of Hadoop file system –Setting up Hadoop Cluster - Cloud Software
Environments - Eucalyptus, Open Nebula, Open Stack, Nimbus

UNIT V  CLOUD SECURITY  9
Cloud Infrastructure security: network, host and application level – aspects of data security,
provider data and its security, Identity and access management architecture, IAM practices in the
cloud, SaaS, PaaS, IaaS availability in the cloud - Key privacy issues in the cloud –Cloud Security
and Trust Management

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of this course, the students should be able to:
- Employ the concepts of storage virtualization, network virtualization and its management
- Apply the concept of virtualization in the cloud computing
- Identify the architecture, infrastructure and delivery models of cloud computing
- Develop services using Cloud computing
- Apply the security models in the cloud environment

REFERENCES:
OBJECTIVES:
• To learn real time operating system concepts, the associated issues & Techniques.
• To understand design and synchronization problems in Real Time System.
• To explore the concepts of real time databases.
• To understand the evaluation techniques present in Real Time System.

UNIT I REAL TIME SYSTEM AND SCHEDULING 9

UNIT II SOFTWARE REQUIREMENTS ENGINEERING 9

UNIT III INTERTASK COMMUNICATION AND MEMORY MANAGEMENT 9

UNIT IV REAL TIME DATABASES 9
Real time Databases – Basic Definition, Real time Vs General Purpose Databases, Main Memory Databases, Transaction priorities, Transaction Aborts, Concurrency control issues, Disk Scheduling Algorithms, Two– phase Approach to improve Predictability – Maintaining Serialization Consistency – Databases for Hard Real Time Systems.

UNIT V EVALUATION TECHNIQUES AND CLOCK SYNCHRONIZATION 9

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of this course, the students should be able to:
• Apply principles of real time system design techniques to develop real time applications.
• Make use of database in real time applications.
• Make use of architectures and behaviour of real time operating systems.
• Apply evaluation techniques in application.
REFERENCES:

CP5093 MOBILE AND PERVERSIVE COMPUTING L T P C
3 0 0 3

OBJECTIVES:
• To learn the basic architecture and concepts till Third Generation Communication systems.
• To understand the latest 4G Telecommunication System Principles.
• To introduce the broad perspective of pervasive concepts and management
• To explore the HCI in Pervasive environment
• To apply the pervasive concepts in mobile environment

UNIT I INTRODUCTION

UNIT II OVERVIEW OF A MODERN 4G TELECOMMUNICATIONS SYSTEM

UNIT III PERVERSIVE CONCEPTS AND ELEMENTS
UNIT IV  
HCI IN PERVERSIVE COMPUTING
Prototype for Application Migration - Prototype for Multimodalities - Human–Computer Interface in Pervasive Environments - HCI Service and Interaction Migration - Context-Driven HCI Service Selection - Interaction Service Selection Overview - User Devices - Service-Oriented Middleware Support - User History and Preference - Context Manager - Local Service Matching - Global Combination - Effective Region - User Active Scope - Service Combination Selection Algorithm

UNIT V  
PERVERSIVE MOBILE TRANSACTIONS

TOTAL :45 PERIODS

OUTCOMES:
Upon completion of this course the students should be able to:
- Obtain a thorough understanding of Basic architecture and concepts of till Third Generation Communication systems.
- Explain the latest 4G Telecommunication System Principles.
- Incorporate the pervasive concepts.
- Implement the HCI in Pervasive environment.
- Work on the pervasive concepts in mobile environment.

REFERENCES:
OBJECTIVES:
- To familiarize the issues in parallel computing.
- To describe distributed memory programming using MPI.
- To understand shared memory paradigm with Pthreads and with OpenMP.
- To learn the GPU based parallel programming using OpenCL.

UNIT I  FOUNDATIONS OF PARALLEL PROGRAMMING

UNIT II  DISTRIBUTED MEMORY PROGRAMMING WITH MPI

UNIT III  SHARED MEMORY PARADIGM WITH PTHREADS

UNIT IV  SHARED MEMORY PARADIGM: OPENMP

UNIT V  GRAPHICAL PROCESSING PARADIGMS: OPENCL AND INTRODUCTION TO CUDA

OUTCOMES:
Upon completion of this course, the students should be able to:
- Identify issues in parallel programming.
- Develop distributed memory programs using MPI framework.
- Design and develop shared memory parallel programs using Pthreads and using OpenMP.
- Implement Graphical Processing OpenCL programs.
REFERENCES:

CP5094 INFORMATION RETRIEVAL TECHNIQUES

OBJECTIVES:
• To understand the basics of information retrieval with pertinence to modeling, query operations and indexing
• To get an understanding of machine learning techniques for text classification and clustering.
• To understand the various applications of information retrieval giving emphasis to multimedia IR, web search
• To understand the concepts of digital libraries

UNIT I INTRODUCTION: MOTIVATION

UNIT II MODELING

UNIT III INDEXING
Static and Dynamic Inverted Indices – Index Construction and Index Compression. Searching - Sequential Searching and Pattern Matching. Query Operations -Query Languages – Query Processing - Relevance Feedback and Query Expansion - Automatic Local and Global Analysis – Measuring Effectiveness and Efficiency

UNIT IV CLASSIFICATION AND CLUSTERING
Text Classification and Naïve Bayes – Vector Space Classification – Support vector machines and Machine learning on documents. Flat Clustering – Hierarchical Clustering –Matrix decompositions and latent semantic indexing – Fusion and Meta learning
UNIT V  SEARCHING THE WEB


TOTAL : 45 PERIODS

OUTCOMES:

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

- Build an Information Retrieval system using the available tools.
- Identify and design the various components of an Information Retrieval system.
- Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval.
- Design an efficient search engine and analyze the Web content structure.

REFERENCES:


CP5072 SOFTWARE ARCHITECTURES AND DESIGN L T P C
3 0 0 3

OBJECTIVES:

- To understand the need, design approaches for software architecture to bridge the dynamic requirements and implementation.
- To learn the design principles and to apply for large scale systems
- To design architectures for distributed heterogeneous systems, environment through brokerage interaction
- To build design knowledge on service oriented and model driven architectures and the aspect oriented architecture.
- To develop appropriate architectures for various Case studies like semantic web services, supply chain cloud services.

UNIT I


UNIT II

UNIT III 9

UNIT IV 9

UNIT V 9
Aspect Oriented Architectures- AOP in UML, AOP tools, Architectural aspects and middleware Selection of Architectures, Evaluation of Architecture Designs, Case Study: Online Computer Vendor, order processing, manufacture & shipping – inventory, supply chain cloud service Management, semantic web services

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of this course, the students should be able to:
- Understand the need of software architecture for sustainable dynamic systems.
- Have a sound knowledge on design principles and to apply for large scale systems
- Design architectures for distributed heterogeneous systems
- Have good knowledge on service oriented and model driven architectures and the aspect oriented architecture.
- Have a working knowledge to develop appropriate architectures through various case studies.

REFERENCES:
2. Software Architecture Design Illuminated, Kai Qian Jones and Bartlett Publishers Canada, 2010

CP5003 PERFORMANCE ANALYSIS OF COMPUTER SYSTEMS L T P C
3 0 0 3

OBJECTIVES:
- To understand the mathematical foundations needed for performance evaluation of computer systems
- To understand the metrics used for performance evaluation
- To understand the analytical modeling of computer systems
- To enable the students to develop new queuing analysis for both simple and complex systems
- To appreciate the use of smart scheduling and introduce the students to analytical techniques for evaluating scheduling policies
UNIT I       OVERVIEW OF PERFORMANCE EVALUATION  9

UNIT II      MARKOV CHAINS AND SIMPLE QUEUES  9

UNIT III     MULTI-SERVER AND MULTI-QUEUE SYSTEMS  9
Server Farms: M/M/k and M/M/k/k – Capacity Provisioning for Server Farms – Time Reversibility and Burke’s Theorem – Networks of Queues and Jackson Product Form – Classed and Closed Networks of Queues.

UNIT IV      REAL-WORLD WORKLOADS  9

UNIT V       SMART SCHEDULING IN THE M/G/1  9
Performance Metrics – Scheduling Non-Preemptive and Preemptive Non-Size-Based Policies - Scheduling Non-Preemptive and Preemptive Size-Based Policies – Scheduling - SRPT and Fairness.

TOTAL : 45 PERIODS

OUTCOMES :
Upon completion of this course, the students should be able to
- Identify the need for performance evaluation and the metrics used for it
- Distinguish between open and closed queuing networks
- Use Little’e law and other operational laws
- Apply the operational laws to open and closed systems
- Use discrete-time and continuous-time Markov chains to model real world systems
- Develop analytical techniques for evaluating scheduling policies

REFERENCES:
OBJECTIVES:
- To learn the fundamentals of natural language processing
- To appreciate the use of CFG and PCFG in NLP
- To understand the role of semantics and pragmatics

UNIT I  INTRODUCTION  9

UNIT II  SPEECH  9

UNIT III  SYNTAX  9

UNIT IV  SEMANTICS AND PRAGMATICS  9
The Representation of Meaning - Computational Semantics - Lexical Semantics - Computational Lexical Semantics - Computational Discourse.

UNIT V  APPLICATIONS  9

TOTAL :45 PERIODS

OUTCOMES:
Upon completion of this course, the students should be able to:
- To tag a given text with basic Language features
- To design an innovative application using NLP components
- To implement a rule based system to tackle morphology/syntax of a language
- To design a tag set to be used for statistical processing for real-time applications
- To compare and contrast use of different statistical approaches for different types of NLP applications.

REFERENCES:
OBJECTIVES:
- To review image processing techniques for computer vision.
- To understand shape and region analysis.
- To understand Hough Transform and its applications to detect lines, circles, ellipses.
- To understand three-dimensional image analysis techniques.
- To understand motion analysis.
- To study some applications of computer vision algorithms.

UNIT I IMAGE PROCESSING FOUNDATIONS

UNIT II SHAPES AND REGIONS

UNIT III HOUGH TRANSFORM

UNIT IV 3D VISION AND MOTION

UNIT V APPLICATIONS

OUTCOMES:
Upon completion of this course, the students should be able to
- Implement fundamental image processing techniques required for computer vision.
- Perform shape analysis.
- Implement boundary tracking techniques.
- Apply chain codes and other region descriptors.
- Apply Hough Transform for line, circle, and ellipse detections.
- Apply 3D vision techniques.
- Implement motion related techniques.
- Develop applications using computer vision techniques.

TOTAL : 45 PERIODS
REFERENCES:

CP5096 SPEECH PROCESSING AND SYNTHESIS L T P C
3 0 0 3

OBJECTIVES:
- To understand the mathematical foundations needed for speech processing
- To understand the basic concepts and algorithms of speech processing and synthesis
- To familiarize the students with the various speech signal representation, coding and recognition techniques
- To appreciate the use of speech processing in current technologies and to expose the students to real–world applications of speech processing

UNIT I FUNDAMENTALS OF SPEECH PROCESSING 9

UNIT II SPEECH SIGNAL REPRESENTATIONS AND CODING 9

UNIT III SPEECH RECOGNITION 9

UNIT IV TEXT ANALYSIS 9
UNIT V  SPEECH SYNTHESIS
Attributes – Formant Speech Synthesis – Concatenative Speech Synthesis – Prosodic
Modification of Speech – Source-filter Models for Prosody Modification – Evaluation of TTS
Systems.

TOTAL :  45 PERIODS

OUTCOMES:
Upon completion of this course, the students should be able to
• Identify the various temporal, spectral and cepstral features required for identifying
  speech units – phoneme, syllable and word
• Determine and apply Mel-frequency cepstral coefficients for processing all types of
  signals
• Justify the use of formant and concatenative approaches to speech synthesis
• Identify the apt approach of speech synthesis depending on the language to be
  processed
• Determine the various encoding techniques for representing speech.

REFERENCES:
2. Lawrence Rabiner and Biing-Hwang Juang, “Fundamentals of Speech Recognition”,
   2002.
5. Xuedong Huang, Alex Acero, Hsiao-Wuen Hon, “Spoken Language Processing – A

CP5005  SOFTWARE QUALITY ASSURANCE AND TESTING

OBJECTIVES:
• To understand the basics of testing, test planning &design and test team organization
• To study the various types of test in the life cycle of the software product.
• To build design concepts for system testing and execution
• To learn the software quality assurance ,metrics, defect prevention techniques
• To learn the techniques for quality assurance and applying for applications.

UNIT I  SOFTWARE TESTING - CONCEPTS, ISSUES, AND TECHNIQUES
Quality Revolution, Verification and Validation, Failure, Error, Fault, and Defect,
Objectives of Testing, Testing Activities, Test Case Selection White-Box and Black , test
Planning and design, Test Tools and Automation, , Power of Test. Test Team Organization
and Management-Test Groups, Software Quality Assurance Group , System Test Team
Hierarchy, Team Building.

UNIT II  SYSTEM TESTING
System Testing - System Integration Techniques-Incremental, Top Down Bottom Up
Sandwich and Big Bang, Software and Hardware Integration, Hardware Design Verification
Tests, Hardware and Software Compatibility Matrix Test Plan for System Integration. Built-
in Testing. functional testing - Testing a Function in Context. Boundary Value Analysis,
Decision Tables. acceptance testing - Selection of Acceptance Criteria, Acceptance Test
Plan, Test Execution Test. software reliability - Fault and Failure, Factors Influencing
Software, Reliability Models
UNIT III  SYSTEM TEST CATEGORIES

UNIT IV  SOFTWARE QUALITY

UNIT V  SOFTWARE QUALITY ASSURANCE

OUTCOMES:
Upon completion of this course, the students should be able to
- Perform functional and nonfunctional tests in the life cycle of the software product.
- Understand system testing and test execution process.
- Identify defect prevention techniques and software quality assurance metrics.
- Apply techniques of quality assurance for typical applications.

REFERENCES:
3. Software Quality Assurance - From Theory to Implementation, Daniel Galin, Pearson Education Ltd UK, 2004
4. Software Quality Assurance, Milind Limaye, TMH ,New Delhi, 2011
OBJECTIVES:

- To understand the goals, complexity of software systems, the role of specification activities and qualities to control complexity.
- To understand the fundamentals of abstraction and formal systems.
- To learn fundamentals of logic reasoning- Propositional Logic, temporal logic and apply to models systems.
- To understand formal specification models based on set theory, calculus and algebra and apply to a case study.
- To learn Z, Object Z and B Specification languages with case studies.

UNIT I SPECIFICATION FUNDAMENTALS


UNIT II FORMAL METHODS


UNIT III LOGIC


UNIT IV SPECIFICATION MODELS

UNIT V  FORMAL LANGUAGES 9

TOTAL :45 PERIODS

OUTCOMES:
Upon completion of this course, the students should be able to
• Understand the complexity of software systems, the need for formal specifications activities and qualities to control complexity.
• Gain knowledge on fundamentals of abstraction and formal systems
• Learn the fundamentals of logic reasoning- Propositional Logic, temporal logic and apply to models systems
• Develop formal specification models based on set theory, calculus and algebra and apply to a typical case study
• Have working knowledge on Z, Object Z and B Specification languages with case studies.

REFERENCES:

CP5073  EMBEDDED SOFTWARE DEVELOPMENT  L T P C
3 0 0 3

OBJECTIVES:
• To understand the architecture of embedded processor, microcontroller and peripheral devices.
• To interface memory and peripherals with embedded systems.
• To study the embedded network environment.
• To understand challenges in Real time operating systems.
• To study, analyze and design applications on embedded systems.
UNIT I  EMBEDDED PROCESSORS  9

UNIT II  EMBEDDED COMPUTING PLATFORM  9

UNIT III  EMBEDDED NETWORK ENVIRONMENT  9

UNIT IV  REAL-TIME CHARACTERISTICS  9

UNIT V  SYSTEM DESIGN TECHNIQUES  9

TOTAL: 45 PERIODS

OUTCOME:
Upon completion of the course, the students should be able to
- Understand different architectures of embedded processor, microcontroller and peripheral devices. Interface memory and peripherals with embedded systems.
- Work with embedded network environment.
- Understand challenges in Real time operating systems.
- Design and analyze applications on embedded systems.

REFERENCES:
OBJECTIVES:
- To understand the components of the social network.
- To model and visualize the social network.
- To mine the users in the social network.
- To understand the evolution of the social network.
- To know the applications in real time systems.

UNIT I INTRODUCTION

UNIT II MODELING AND VISUALIZATION

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

UNIT IV EVOLUTION

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

TOTAL: 45 PERIODS
OUTCOMES:
Upon Completion of the course, the students should be able to

- Work on the internals components of the social network
- Model and visualize the social network
- Mine the behaviour of the users in the social network
- Predict the possible next outcome of the social network
- Apply social network in real time applications

REFERENCES:

CP5007 BIO-INSPIRED COMPUTING

OBJECTIVES:
- To Learn bio-inspired theorem and algorithms
- To Understand random walk and simulated annealing
- To Learn genetic algorithm and differential evolution
- To Learn swarm optimization and ant colony for feature selection
- To understand bio-inspired application in image processing

UNIT I INTRODUCTION

UNIT II RANDOM WALK AND ANEALING

UNIT III GENETIC ALGORITHMS AND DIFFERENTIAL EVOLUTION
UNIT IV  SWARM OPTIMIZATION AND FIREFLY ALGORITHM  

UNIT V  APPLICATION IN IMAGE PROCESSING  

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of the course, the students should be able to
- Implement and apply bio-inspired algorithms
- Explain random walk and simulated annealing
- Implement and apply genetic algorithms
- Explain swarm intelligence and ant colony for feature selection
- Apply bio-inspired techniques in image processing.

REFERENCES:
4. Xin-She Yang, "Nature Ispired Optimization Algorithm, Elsevier First Edition 2014
5. Yang, Cui, Xiao, Gandomi, Karamanoglu, "Swarm Intelligence and Bio-Inspired Computing", Elsevier First Edition 2013

CP5008  COMPILER OPTIMIZATION TECHNIQUES  
L  T  P  C  
3  0  0  3

OBJECTIVES:
- To be aware of different forms of intermediate languages and analyzing programs.
- To understand optimizations techniques for simple program blocks.
- To apply optimizations on procedures, control flow and parallelism.
- To learn the inter procedural analysis and optimizations.
- To explore the knowledge about resource utilization.

UNIT I  INTERMEDIATE REPRESENTATIONS AND ANALYSIS  
UNIT II  EARLY AND LOOP OPTIMIZATIONS  9
Importance of Code Optimization
Early Optimizations: Constant-Expression Evaluation -
Scalar Replacement of Aggregates - Algebraic Simplifications and Re-association - Value
Numbering - Copy Propagation - Sparse Conditional Constant Propagation. Redundancy
Elimination: Common - Subexpression Elimination - Loop-Invariant Code Motion - Partial-
Redundancy Elimination - Redundancy Elimination and Reassociation - Code Hoisting.
Loop Optimizations: Induction Variable Optimizations - Unnecessary Bounds Checking
Elimination.

UNIT III  PROCEDURE OPTIMIZATION AND SCHEDULING  9
Procedure Optimizations: Tail-Call Optimization and Tail-Recursion Elimination - Procedure
Integration - In-Line Expansion - Leaf-Routine Optimization and Shrink Wrapping. Code
Scheduling: Instruction Scheduling - Speculative Loads and Boosting - Speculative
Scheduling - Software Pipelining - Trace Scheduling - Percolation Scheduling. Control-Flow
and Low-Level Optimizations : Unreachable-Code Elimination - Straightening - If
Simplifications - Loop Simplifications -Loop Inversion – Un-switching - Branch Optimizations
- Tail Merging or Cross Jumping - Conditional Moves - Dead-Code Elimination - Branch
Prediction - Machine Idioms and Instruction Combining.

UNIT IV  INTER PROCEDURAL OPTIMIZATION  9
Symbol table – Runtime Support - Interprocedural Analysis and Optimization: Interprocedural
Control Flow Analysis - The Call Graph - Interprocedural Data-Flow Analysis -
Interprocedural Constant Propagation - Interprocedural Alias Analysis - Interprocedural
Optimizations - Interprocedural Register Allocation - Aggregation of Global References.

UNIT V  REGISTER ALLOCATION AND OPTIMIZING FOR MEMORY  9
Register Allocation: Register Allocation and Assignment - Local Methods - Graph Coloring –
Priority Based Graph Coloring - Other Approaches to Register Allocation. Optimization for
the Memory Hierarchy: Impact of Data and Instruction Caches - Instruction-Cache
Optimization - Scalar Replacement of Array Elements - Data-Cache Optimization - Scalar
vs. Memory-Oriented Optimizations.

TOTAL :  45  PERIODS

OUTCOMES:
Upon completion of this course, the student should be able to:
- Identify the different optimization techniques for simple program blocks.
- Design performance enhancing optimization techniques.
- Perform the optimization on procedures.
- Ensure better utilization of resources.

REFERENCES:
1. Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, "Compilers: Principles, Techniques, and
5. Steven Muchnick, “Advanced Compiler Design and Implementation", Morgan
OBJECTIVES:

- To develop skills to both design and critique visualizations.
- To introduce visual perception and core skills for visual analysis.
- To understand visualization for time-series analysis.
- To understand visualization for ranking analysis.
- To understand visualization for deviation analysis.
- To understand visualization for distribution analysis.
- To understand visualization for correlation analysis.
- To understand visualization for multivariate analysis.
- To understand issues and best practices in information dashboard design.

UNIT I  CORE SKILLS FOR VISUAL ANALYSIS  9

UNIT II  TIME-SERIES, RANKING, AND DEVIATION ANALYSIS  9

UNIT III  DISTRIBUTION, CORRELATION, AND MULTIVARIATE ANALYSIS  9

UNIT IV  INFORMATION DASHBOARD DESIGN  9

UNIT V  INFORMATION DASHBOARD DESIGN  9

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of the course, the students should be able to:

- Explain principles of visual perception
- Apply core skills for visual analysis
- Apply visualization techniques for various data analysis tasks
- Design information dashboard
REFERENCES:

CP5010  RECONFIGURABLE COMPUTING

OBJECTIVES:
- To understand the need for reconfigurable computing
- To expose the students to various device architectures
- To examine the various reconfigurable computing systems
- To understand the different types of compute models for programming reconfigurable architectures
- To expose the students to HDL programming and familiarize with the development environment
- To expose the students to the various placement and routing protocols
- To develop applications with FPGAs

UNIT I  DEVICE ARCHITECTURE

UNIT II  RECONFIGURABLE COMPUTING ARCHITECTURES AND SYSTEMS

UNIT III  PROGRAMMING RECONFIGURABLE SYSTEMS

UNIT IV  MAPPING DESIGNS TO RECONFIGURABLE PLATFORMS
UNIT V APPLICATION DEVELOPMENT WITH FPGAS
Case Studies of FPGA Applications – System on a Programmable Chip (SoPC) Designs.

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, the students should be able to:

- Identify the need for reconfigurable architectures.
- Discuss the architecture of FPGAs.
- Point out the salient features of different reconfigurable architectures.
- Build basic modules using any HDL.
- Develop applications using any HDL and appropriate tools.
- Design and build an SoPC for a particular application.

REFERENCES:
4. Reconfigurable Computing: From FPGAs to Hardware/Software Codesign 2011 Edition by Joao Cardoso (Editor), Michael Hübne, Springer

CP5097 MOBILE APPLICATION DEVELOPMENT

OBJECTIVES:
- Understand system requirements for mobile applications.
- Generate suitable design using specific mobile development frameworks.
- Generate mobile application design.
- Implement the design using specific mobile development frameworks.
- Deploy the mobile applications in marketplace for distribution.

UNIT I INTRODUCTION
Introduction to mobile applications – Embedded systems - Market and business drivers for mobile applications – Publishing and delivery of mobile applications – Requirements gathering and validation for mobile applications.

UNIT II BASIC DESIGN
Introduction – Basics of embedded systems design – Embedded OS - Design constraints for mobile applications, both hardware and software related – Architecting mobile applications – User interfaces for mobile applications – touch events and gestures – Achieving quality constraints – performance, usability, security, availability and modifiability.
UNIT III  ADVANCED DESIGN
Designing applications with multimedia and web access capabilities – Integration with GPS and social media networking applications – Accessing applications hosted in a cloud computing environment – Design patterns for mobile applications.

UNIT IV  ANDROID

UNIT V  IOS
Introduction to Objective C – iOS features – UI implementation – Touch frameworks – Data persistence using Core Data and SQLite – Location aware applications using Core Location and Map Kit – Integrating calendar and address book with social media application – Using Wifi - iPhone marketplace.

TOTAL :45 PERIODS

OUTCOMES:
Upon completion of the course, the students should be able to:
- Describe the requirements for mobile applications.
- Explain the challenges in mobile application design and development.
- Develop design for mobile applications for specific requirements.
- Implement the design using Android SDK.
- Implement the design using Objective C and iOS.
- Deploy mobile applications in Android and iPhone marketplace for distribution.

REFERENCES:

CP5075  BIO INFORMATICS  L  T  P  C
3  0  0  3

OBJECTIVES:
- To get exposed to the fundamentals of bioinformatics.
- To learn bio-informatics algorithm and phylogenetic concept.
- To understand open problems and issues in replication and molecular clocks.
- To learn assemble genomes and corresponding theorem.
- To study and exposed to the domain of human genomics.
UNIT I INTRODUCTION AND FUNDAMENTALS

UNIT II BIOINFORMATICS ALGORITHM AND ANALYSIS
Sequence alignment and similarity searching in genomic databases: BLAST and FASTA – additional bioinformatics analysis involving nucleic acid sequences-additional bioinformatics analysis involving protein sequences – Phylogenetic Analysis.

UNIT III DNA REPPLICATION AND MOLECULAR CLOCKS

UNIT IV ASSEMBLE GENOMES AND SEQUENCES

UNIT V HUMAN GENOME

TOTAL : 45 PERIODS

OUTCOMES:
Upon Completion of the course, the students should be able to:

- Deploy the genomics technologies in Bioinformatics.
- Able to distinct efficient algorithm and issues.
- Deploy the replication and molecular clocks in bioinformatics.
- Work on assemble genomes and sequences.
- Use the Microarray technologies for genome expression.

REFERENCES:
2. Istvan Miklos,Renyi Institute, “Introduction to algorithms in bioinformatics”,Springer 2016
OBJECTIVES:
- To understand the storage architecture and available technologies.
- To learn to establish & manage datacenter.
- To learn security aspects of storage & data center.

UNIT I  STORAGE TECHNOLOGY  9
Review data creation and the amount of data being created and understand the value of data to a business, challenges in data storage and data management, Solutions available for data storage, Core elements of a data center infrastructure, role of each element in supporting business activities.

UNIT II  STORAGE SYSTEMS ARCHITECTURE  9
Hardware and software components of the host environment, Key protocols and concepts used by each component ,Physical and logical components of a connectivity environment, Major physical components of a disk drive and their function, logical constructs of a physical disk, access characteristics, and performance Implications, Concept of RAID and its components, Different RAID levels and their suitability for different application environments: RAID 0, RAID 1, RAID 3, RAID 4, RAID 5, RAID 0+1, RAID 1+0, RAID 6, Compare and contrast integrated and modular storage systems ,ligh-level architecture and working of an intelligent storage system.

UNIT III  INTRODUCTION TO NETWORKED STORAGE  9
Evolution of networked storage, Architecture, components, and topologies of FC-SAN, NAS, and IP-SAN, Benefits of the different networked storage options, understand the need for long-term archiving solutions and describe how CAS full fill the need, understand the appropriateness of the different networked storage options for different application environments.

UNIT IV  INFORMATION AVAILABILITY, MONITORING & MANAGING DATACENTERS  9
List reasons for planned/unplanned outages and the impact of downtime, Impact of downtime -Business continuity (BC) and disaster recovery (DR) ,RTO and RPO, Identifying single points of failure in a storage infrastructure and list solutions to mitigate these failures, architecture of backup/recovery and the different backup/ recovery topologies, replication technologies and their role in ensuring information availability and business continuity, Remote replication technologies and their role in providing disaster recovery and business continuity capabilities. Identify key areas to monitor in a data center, Industry standards for data center monitoring and management, Key metrics to monitor for different components in a storage infrastructure, Key management tasks in a data center.

UNIT V  SECURING STORAGE AND STORAGE VIRTUALIZATION  9
Information security, Critical security attributes for information systems, Storage security domains,List and analyzes the common threats in each domain, Virtualization technologies, block-level and file-level virtualization technologies and processes.

TOTAL  45 PERIODS
OUTCOMES:
Upon completion of this course, a student should be able to:

- Select from various storage technologies to suit for required application.
- Apply security measures to safeguard storage & farm.
- Analyse QoS on Storage.

REFERENCES:
1. EMC Corporation, "Information Storage and Management: Storing, Managing, and Protecting Digital Information", Wiley, India, 2010