VISION OF THE DEPARTMENT
The vision of the Department is to create computing professionals, researchers and entrepreneurs with high technical competency and communication skills by setting high standards in academic excellence and meeting the future needs of the society.

MISSION OF THE DEPARTMENT
The mission of the Department of Computer Science and Engineering is to

- Provide motivated faculty and state of the art facilities for education and research, both in foundational aspects and of relevance to emerging computing trends.
- Develop knowledgeable, industry-ready students with pertinent competencies.
- Inculcate responsibility through sharing of knowledge and innovative computing solutions that benefit the society-at-large.
- Engage in collaborative research with academia and industry for seamless transfer of knowledge resulting in patentable solutions.
- Generate adequate resources for research activities from sponsored projects and consultancy.

PROGRAM EDUCATIONAL OBJECTIVES:

1. Prepare students to understand the foundational concepts in Computer Science and Engineering.
2. Enable students to integrate theory and practice for problem solving.
3. Empower students to critically analyze current trends and future issues from a system perspective at multiple levels of detail and abstraction.
4. Prepare students to critically analyze existing literature, identify the gaps and propose innovative and research oriented solutions for Big Data.
5. Enable students to pursue lifelong multidisciplinary learning as professional engineers and scientists.
6. Enable students to effectively communicate technical information, function effectively on teams, and apply computer engineering solutions within a global, societal, and environmental context by following ethical practices.
PROGRAM OUTCOMES (POs):
Engineering Graduates will be able to:

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<thead>
<tr>
<th>PO #</th>
<th>Graduate Attribute</th>
<th>Programme Outcomes</th>
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<tbody>
<tr>
<td>1</td>
<td>Research Aptitude</td>
<td>An ability to independently carry out research / Investigations, identify problems and develop solutions to solve practical problems.</td>
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<td>2</td>
<td>Technical documentation</td>
<td>An ability to write and present a substantial technical report/document.</td>
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<tr>
<td>3</td>
<td>Technical competence</td>
<td>Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program</td>
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<tr>
<td>4</td>
<td>Handle complex problems</td>
<td>Use research based knowledge, methods, appropriate techniques, resources and tools to solve complex engineering issues with an understanding of the limitations.</td>
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<tr>
<td>5</td>
<td>Environmental Sustainability and societal Ethics</td>
<td>Ensure development of socially relevant and ecofriendly indigenous products by applying technical knowledge, ethical principles and, sound engineering practices</td>
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<tr>
<td>6</td>
<td>Life-long learning</td>
<td>Recognize the need for independent, life-long learning and engage in the broadest context of technological change.</td>
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MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES
A broad relation between the programme educational objective and the outcomes is given in the following table

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<th>PROGRAMME EDUCATIONAL OBJECTIVES</th>
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## Mapping of Course Outcome and Programme Outcome

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# ANNA UNIVERSITY, CHENNAI
## UNIVERSITY DEPARTMENTS
### M.E. COMPUTER SCIENCE AND ENGINEERING
#### (SPECIALIZATION IN BIG DATA ANALYTICS)
##### REGULATIONS – 2023
###### CHOICE BASED CREDIT SYSTEM
##### CURRICULA AND SYLLABI

## SEMESTER I

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### SUMMARY

**NAME OF THE PROGRAMME: M.E. COMPUTER SCIENCE AND ENGINEERING (BIG DATA ANALYTICS)**

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UNIT I  LINEAR PROGRAMMING  
Formulation – Graphical solution – Simplex method – Two phase method -Transportation and Assignment Problems

UNIT II  SIMULATION  
Discrete Event Simulation – Monte – Carlo Simulation – Stochastic Simulation – Applications to real time problems.

UNIT III  ESTIMATION THEORY  

UNIT IV  TESTING OF HYPOTHESIS  

UNIT V  MULTIVARIATE ANALYSIS  

TOTAL: 60 PERIODS

COURSE OUTCOMES:
At the end of the course, students will be able to
CO1 Formulate and find optimal solution in the real life optimizing/allocation/assignment problems involving conditions and resource constraints.
CO2 Simulate appropriate application/distribution problems.
CO3 Obtain the value of the point estimators using the method of moments and method of maximum likelihood.
CO4 Apply the concept of various test statistics used in hypothesis testing for mean and variances of large and small samples.
CO5 Get exposure to the principal component analysis of random vectors and matrices.

REFERENCES:
RM3151 RESEARCH METHODOLOGY AND IPR L T P C
2 1 0 3

UNIT I RESEARCH PROBLEM FORMULATION
Objectives of research, types of research, research process, approaches to research; conducting literature review- information sources, information retrieval, tools for identifying literature, Indexing and abstracting services, Citation indexes, summarizing the review, critical review, identifying research gap, conceptualizing and hypothesizing the research gap

UNIT II RESEARCH DESIGN AND DATA COLLECTION
Statistical design of experiments- types and principles; data types & classification; data collection - methods and tools

UNIT III DATA ANALYSIS, INTERPRETATION AND REPORTING
Sampling, sampling error, measures of central tendency and variation.; test of hypothesis-concepts; data presentation- types of tables and illustrations; guidelines for writing the abstract, introduction, methodology, results and discussion, conclusion sections of a manuscript; guidelines for writing thesis, research proposal; References – Styles and methods, Citation and listing system of documents; plagiarism, ethical considerations in research

UNIT IV INTELLECTUAL PROPERTY RIGHTS
Concept of IPR, types of IPR – Patent, Designs, Trademarks and Trade secrets, Geographical indications, Copy rights, applicability of these IPR; IPR & biodiversity; IPR development process, role of WIPO and WTO in IPR establishments, common rules of IPR practices, types and features of IPR agreement, functions of UNESCO in IPR maintenance.

UNIT V PATENTS
Patents – objectives and benefits of patent, concept, features of patent, inventive steps, specifications, types of patent application; patenting process - patent filling, examination of patent, grant of patent, revocation; equitable assignments; Licenses, licensing of patents; patent agents, registration of patent agents.

COURSE OUTCOMES
Upon completion of the course, the student can
CO1: Describe different types of research; identify, review and define the research problem
CO2: Select suitable design of experiment s; describe types of data and the tools for collection of data
CO3: Explain the process of data analysis; interpret and present the result in suitable form
CO4: Explain about Intellectual property rights, types and procedures
CO5: Execute patent filing and licensing

TOTAL: 45 PERIODS
REFERENCES:
2. Soumitro Banerjee, “Research methodology for natural sciences”, IISc Press, Kolkata, 2022,

CP3151 DATA STRUCTURES AND ALGORITHMS

UNIT I BASIC STRUCTURES AND ALGORITHM
Stack- Queue - Linked List Implementation - Min/Max heap – Algorithm Analysis- Asymptotic Analysis- Solving Recurrence Relation – Amortized Analysis

UNIT II BALANCED TREE STRUCTURES

UNIT III MELDABLE HEAP STRUCTURES

UNIT IV NP COMPLETENESS
NP Classes- Polynomial Time Verification – Theory of Reducibility - NP Completeness Proof for Vertex Cover & Hamiltonian Cycle

UNIT V APPROXIMATION ALGORITHMS
Approximation Algorithms: Vertex Cover & Euclidean Travelling Salesperson Problem- Randomized Algorithms: Closest Pair Problem & Minimum Spanning Trees

REFERENCES

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Understand, design and implement balanced search structures
CO2: Analyse algorithms for time complexity
CO3: Understand and implement different meldable priority queues
CO4: Appreciate Approximation and randomized algorithm design
CO5: Apply various data structures for solving problems

CO-PO Mapping

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CP3153  MULTICORE ARCHITECTURES  L T P C

UNIT I  FUNDAMENTALS OF COMPUTER DESIGN AND ILP  9

UNIT II  MEMORY HIERARCHY DESIGN  9

UNIT III  MULTIPROCESSOR ISSUES  9

UNIT IV  EXPLOITING DIFFERENT TYPES OF PARALLELISM  9

UNIT V  DOMAIN SPECIFIC ARCHITECTURES  9
Introduction to Domain Specific Architectures - Guidelines for DSAs. Case Studies - Example Domain: Deep Neural Networks - Google’s Tensor Processing Unit - Microsoft Catapult - Intel Crest - Pixel Visual Core. CPUs Versus GPUs Versus DSAs.

TOTAL: 45 PERIODS

REFERENCES

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Discuss and evaluate the performance of computer systems
CO2: Discuss and point out the various ways of exploiting ILP
CO3: Point out the various optimizations that can be performed to improve the memory hierarchy design
CO4: Discuss the issues related to multiprocessing and suggest solutions
CO5: Point out the salient features of different multicore architectures and how they exploit different types of parallelism
CO6: Point out the salient features of different example domain specific architectures

CO-PO Mapping

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BD3151 BIG DATA MINING AND ANALYTICS L T P C
3 0 0 3

UNIT I DATA MINING AND LARGE SCALE FILES

UNIT II SIMILAR ITEMS

UNIT III MINING DATA STREAMS
Stream Data Model – Sampling Data in the Stream – Filtering Streams – Counting Distance Elements in a Stream – Estimating Moments – Counting Ones in Window – Decaying Windows
UNIT IV  LINK ANALYSIS AND FREQUENT ITEMSETS  9

UNIT V  CLUSTERING  9

TOTAL: 45 PERIODS

REFERENCES

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Design algorithms by employing Map Reduce technique for solving Big Data problems.
CO2: Identify similarities using appropriate measures.
CO3: Point out problems associated with streaming data and handle them.
CO4: Discuss algorithms for link analysis and frequent itemset mining.
CO5: Design solutions for problems in Big Data by suggesting appropriate clustering techniques.

CO-PO Mapping

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CP3152 DATABASE TECHNOLOGIES L T P C
3 0 0 3

UNIT I  RELATIONAL MODEL  9
UNIT II PARALLEL AND DISTRIBUTED DATABASES

UNIT III ADVANCED DATABASES

UNIT IV ACTIVE TEMPORAL AND DEDUCTIVE DATABASES

UNIT V NOSQL DATABASES

TOTAL: 45 PERIODS

REFERENCES

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1:Design a Relational Database for an Enterprise.
CO2:Design a Distributed Database, Active Database and Temporal Database for an Enterprise.
CO3:Gain the knowledge in advanced databases.
CO4:Comprehend the use of XML Database, Web Database, Spatial Database, Multimedia Database and Deductive Database.
CO5:Use MongoDB NoSQL Database to Maintain Data of an Enterprise.
CO-PO Mapping

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CP3161 DATA STRUCTURES AND ALGORITHMS LABORATORY

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LIST OF EXPERIMENTS:
1. Linked list implementation of Stack and Queue ADTs
2. Binary Search tree
3. Min/Max Heap
4. AVL tree
5. Red- Black tree
6. Splay Tree
7. Leftist Heap
8. Binomial Heap

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

CO1: Apply suitable data structures in problem solving.
CO2: Select suitable search structures for an application
CO3: Understand priority queue implementations
CO4: Differentiate between approximation and Randomized algorithms
CO5: Understand NP complete problem solutions

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TOTAL: 60 PERIODS

BD3111 BIG DATA COMPUTING LABORATORY

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LIST OF EXPERIMENTS:
1. Set up a pseudo-distributed, single-node Hadoop cluster backed by the Hadoop Distributed File System, running on Ubuntu Linux. After successful installation on one node, configuration of a multi-node Hadoop cluster (one master and multiple slaves).
2. MapReduce application for word counting on Hadoop cluster
3. Unstructured data into NoSQL data and do all operations such as NoSQL query with API.

Attested

Director
Centre for Academic Courses
Anna University, Chennai-600 025
4. K-means clustering using map reduce
5. Page Rank Computation
6. Mahout machine learning library to facilitate the knowledge build up in big data analysis.
7. Application of Recommendation Systems using Hadoop/mahout libraries

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Set up single and multi-node Hadoop Clusters.
CO2: Apply Map Reduce technique for various algorithms.
CO3: Design new algorithms that uses Map Reduce to apply on Unstructured and structured data.
CO4: Develop Scalable machine learning algorithms for various Big data applications using Mahout
CO5: Represent NoSQL data.

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CP3251 ADVANCED OPERATING SYSTEMS L T P C
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UNIT I INTRODUCTION

UNIT II DISTRIBUTED OPERATING SYSTEMS

UNIT III DISTRIBUTED RESOURCE MANAGEMENT

UNIT IV REAL TIME OPERATING SYSTEMS
UNIT V MOBILE AND CLOUD OPERATING SYSTEMS 9

REFERENCES

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Identify the features of distributed operating systems.
CO2: Demonstrate the various protocols of distributed operating systems.
CO3: Identify the different features of real time operating systems.
CO4: Discuss the features of mobile operating systems.
CO5: Discuss the features of cloud operating systems.

CO-PO Mapping

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BD3201 BIG DATA QUERY LANGUAGES

UNIT I INTRODUCTION TO BIG DATA 9

UNIT II INTRODUCTION TO R PROGRAMMING 9
UNIT III DATA ANALYSIS USING R AND HADOOP

UNIT IV PROGRAMMING WITH PIG

UNIT V PROGRAMMING WITH HIVE
Introduction – Data Types and File Formats – HiveQL: Data Definition – Databases in Hive – Data Manipulation – Queries – Views

PRACTICAL EXERCISES
1. Perform descriptive and predictive analytics using “R programming”
2. Loading data into HDFS using R & Perform various HDFS commands
3. MapReduce application for word counting on R HADOOP after successful installation of three R packages (rhdfs, rmr, and rhbase)
4. “Pig” installation & Develop Pig Scripts and call UDF’s to accomplish functionalities to meet the problem objectives & Embedding PIG Latin in Python

TOTAL: 75 PERIODS

REFERENCES

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1:Design the Big data using tools.
CO2:Design applications using R & HADOOP.
CO3:Design applications using RHADOOP & RHIPE.
CO4:Develop Pig scripts for Big data applications.
CO5:Design Big data applications schema and use HIVEQL.
UNIT I  INTRODUCTION TO DATA WAREHOUSING  

UNIT II  SUPERVISED LEARNING METHODS  

UNIT III  UNSUPERVISED AND REINFORCEMENT LEARNING  

UNIT IV  PROBABILISTIC GRAPHICAL MODELS AND EVOLUTIONARY LEARNING  

UNIT V  NEURAL NETWORKS AND DEEP LEARNING  

CO-PO Mapping

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CP3252  MACHINE LEARNING  
L T P C  
3 0 3 4.5
SUGGESTED LIST OF EXPERIMENTS

1. Problem solving using Regression models: Linear regression, Logistic regression and to evaluate the performance.
2. Problem solving using Classification: SVM, K-nearest Neighbour, and Decision Trees and evaluate the performance.
3. Solving problems based on Decision by committee approach: Bagging and Boosting application
4. Problem solving using unsupervised learning models: Clustering algorithms and to evaluate the performance.
5. Application of dimensionality reduction techniques for numeric and text and image data.
6. Game development and robotic application development using reinforcement learning model.
7. Implement Bayesian Inference in Gene Expression Analysis
8. Implement Sequential Learning using Hidden Markov Model
9. Application of CRFs in Natural Language Processing
11. Image Classification using Convolutional Neural Networks with cross validation.

TOTAL: 90 PERIODS

REFERENCES


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

CO1: Explain the basic concepts of machine learning
CO2: Analyze linear and non-linear techniques for classification problems
CO3: Apply unsupervised and reinforcement algorithms, probabilistic and evolutionary approaches for the given problems
CO4: Analyze importance of neural networks in machine learning and deep learning
CO5: Identify applications suitable for different types of Machine Learning and to Implement appropriate learning algorithm for an application and to analyze the results.

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Attested

Director
UNIT I  EVOLUTION OF IT ORGANIZATIONS

UNIT II  PROJECT DEVELOPMENT LIFE CYCLE (PDLC)
Know Your Customer (KYC) process – Business case preparation – Cost-benefit analysis – Benchmarking – Approval and execution. Artefacts: User Requirements Specification (URS), System Requirements Specification (SRS), High-Level Design (HLD), Low-Level Design (LLD), testing phases

UNIT III  CUSTOMER ACQUISITION PROCESS
Non-Disclosure Agreement (NDA) - Request for Information (RFI) - Request for Quotation (RFQ) - Request for Proposal (RFP) - Award of Contracts, Various types of Contracts such as Fixed Price (FP), Time and Material (T&M), Outcome-Based.

UNIT IV  PROJECT EXECUTION MODELS

UNIT V  INDUSTRY STANDARDS

TOTAL: 60 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Understand the IT organizations governance and various factors influencing them.
CO2: Understand the customer acquisition process and the working models of various IT organizations and services.
CO3: Understand the technologies for various requirements & develop competences in those respective technical areas to deliver transformational projects.
CO4: Understand the value creation by the supporting organisation to deliver world class software projects and to gain highest customer satisfaction to the QCD.
CO5: Apply breakthrough technical competencies in producing futuristic models, estimation of NFRs, Risks.
# Cyber Security

## Unit I: Introduction
- Need for Cyber security
- History of Cyber security
- Defining Cyberspace and Cyber security Standards
- CIA Triad – Cyber security Framework

## Unit II: Attacks and Countermeasures
- Malicious Attacks, Threats, and Vulnerabilities
- Scope of cyber-attacks
- Tools used to attack computer systems
- Security breach
- Risks, vulnerabilities and threats
- Malware – malicious software attack
- Social engineering attack
- Wireless network attack
- Web application attack
- Intrusion Detection Systems - Virtual Private Networks – Cryptographic Techniques

## Unit III: Securing the Infrastructure
- Infrastructure Security in the Real World
- Understanding Access-Control and Monitoring Systems
- Understanding Video Surveillance Systems
- Understanding Intrusion-Detection and Reporting Systems

## Unit IV: Securing Local Hosts and Networks
- Local Host Security in the Real World
- Securing Devices
- Protecting the Inner Perimeter
- Protecting Remote Access
- Local Network Security in the Real World
- Networking Basics
- Understanding Networking Protocols
- Understanding Network Servers
- Understanding Network Connectivity Devices
- Understanding Network Transmission Media Security

## Unit V: Tools

## TOTAL: 45 PERIODS

## References

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Analyze and evaluate the cyber security needs of an organization.
CO2: Analyze the security issues in networks and computer systems to secure an infrastructure.
CO3: Design operational cyber security strategies and policies.
CO4: Apply critical thinking and problem-solving skills to detect current and future attacks on an organization's computer systems and networks.
CO5: Understand the functionality of cyber security tools.

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BD3001 LINKED OPEN DATA AND ITS APPLICATIONS 3 0 0 3

UNIT I INTRODUCTION 9

UNIT II RDF & SPARQL 9
RDF database systems–RDF and Semantic Web – Encoding, storage, indexing – Query processing – reasoning– SPARQL– Improving Linked Data quality

UNIT III PUBLISHING & CONSUMING LINKED OPEN DATA 9

UNIT IV RECOMMENDATION SYSTEMS 9
Recommendation systems: A Model for Recommendation Systems, Content-Based Recommendations, Collaborative Filtering, Dimensionality Reduction

UNIT V LARGE-SCALE MACHINE LEARNING 9
Mining social network graphs – Social Networks as Graphs, Clustering of Social-Network Graphs, Discovery of Communities, Partitioning of Graphs, Overlapping Communities, Simrank, Counting
COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Create, Store & Retrieve LOD.
CO2: Design methodologies for publishing & consuming LOD.
CO3: Use RDF & SPARQL to query LOD.
CO4: Design recommendation algorithms based on LOD.
CO5: Design algorithms for handling LOD using large-scale machine learning.

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Total: 45 periods

REFERENCES

UNIT I INTRODUCTION
9
Definition of data intensive computing - Data science - Big data -5Vs – Architecture - Data-intensive computing platforms: notion of parallel and distributed computing systems used in both HPC and commercial domains - similarities and differences in hardware and software stacks.

UNIT II DATA PARALLEL FRAMEWORKS
9
Runtime and high-level programming frameworks in data-intensive computing - MapReduce/Hadoop, MPI/OpenMP/OpenCL, Spark, etc.

UNIT III FILE AND STORAGE SYSTEMS
9
Parallel I/O and storage systems for handling large amount of data efficiently – HDFS, MooseFS, iRODS, Ceph, GlusterFS, Lustre.
UNIT IV  NOSQL DATA MODELS
Key-value store (Dynamo) - column store (BigTable, HBase, Cassandra) - document-based (MongoDB, CouchDB) - object store - graph-based, etc.

UNIT V  VIRTUALIZATION
Data intensive computing under virtualization environment – OpenStack, Docker

REFERENCES
3. Benjamin Depardon, Gaël Le Mahec, Cyril Séguin. Analysis of Six Distributed File Systems. [Research Report] 2013, pp.44. ⟨hal-00789086⟩

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Design applications that involve data intensive computing.
CO2: Suggest appropriate architecture for data intensive computing systems.
CO3: Decide on the appropriate techniques of Map Reduce, MongoDB, for the different applications.
CO4: Identify parallel processing techniques for data intensive computing.

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BD3003  DATA VISUALIZATION  L T P C
3 0 0 3

UNIT I  INTRODUCTION
Context of data visualization – Definition, Methodology, Visualization design objectives. Key Factors – Purpose, visualization function and tone, visualization design options – Data representation, Data Presentation, Seven stages of data visualization, widgets, data visualization tools.

UNIT II  VISUALIZING DATA METHODS
Mapping - Time series - Connections and correlations – Indicator-Area chart-Pivot table- Scatter charts, Scatter maps - Tree maps, Space filling and non-space filling methods-Hierarchies and Recursion - Networks and Graphs-Displaying Arbitrary Graphs-node link graph-Matrix representation for graphs- Info graphics

TOTAL: 45 PERIODS
UNIT III  DATA VISUALIZATION USING R  9
Reading and getting data into R (External Data): Using CSV files, XML files, Web Data, JSON files, Databases, Excel files. Working with R Charts and Graphs:
Histograms, Boxplots, Bar Charts, Line Graphs, Scatter plots, Pie Charts

UNIT IV  INTERACTIVE DATA VISUALIZATION  9

UNIT V  SECURITY DATA VISUALIZATION  9
Port scan visualization - Vulnerability assessment and exploitation - Firewall log visualization - Intrusion detection log visualization -Attacking and defending visualization systems – Creating security visualization system.

TOTAL: 45 PERIODS

REFERENCES

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Understand the representation of complex and voluminous data.
CO2: Design and use various methodologies present in data visualization.
CO3: Understand the various process and tools used for data visualization.
CO4: Use interactive data visualization to make inferences.
CO5: Discuss the process involved and security issues present in data visualization.

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BD3004  REAL TIME DATA STREAMING  L T P C
3 0 0 3

UNIT I  INTRODUCTION TO DATA STREAMS  9
Data stream models - basic streaming methods – applications. Change detection - maintaining histograms from data streams
UNIT II  STREAM MINING ALGORITHMS  
Evaluating streaming algorithms - learning from data streams - evaluation issues – open issues. Clustering from data streams - clustering examples - clustering variables. Frequent pattern mining - frequent Itemset mining - heavy hitters - mining frequent item set from data streams - sequence pattern mining.

UNIT III  CLASSIFICATION METHODS IN DATA STREAMS  
Decision trees from data streams - very fast decision tree algorithm (VFDT) – extensions - OLIN: info-fuzzy algorithms. Novelty detection in data streams - learning and novelty - novelty detection as a one-class classification problem - learning new concepts - the online novelty and drift detection algorithms.

UNIT IV  ANALYSIS OF STREAM DATA  
Multi-dimensional analysis of data - architecture for on-line analysis of data streams - stream data cube computation. Load shedding in data stream systems - load shedding for aggregation queries - load shedding in aurora - load shedding for sliding window joins - load shedding for classification queries.

UNIT V  ADVANCED CONCEPTS ON STREAM COMPUTING  
Synopsis construction in data streams - sampling methods - wavelets – sketches – histograms. Join processing in data streams - indexig and querying data streams - dimensionality reduction and forecasting on streams - distributed mining of data streams.

TOTAL: 45 PERIODS

REFERENCES

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Understand the applicability and utility of different machine learning algorithms.
CO2: Describe and apply current research trends in data-stream processing.
CO3: Analyze the suitability of stream mining algorithms for data stream systems.
CO4: Program and build stream processing systems, services and applications.
CO5: Solve problems in real-world applications that process data streams.

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UNIT I  INTRODUCTION TO BIG DATA ACQUISITION  
Big Data framework - fundamental concepts of Big Data management and analytics – Current challenges and trends in Big Data Acquisition.

UNIT II  DATA COLLECTION AND TRANSMISSION  

UNIT III  DATA PRE-PROCESSING  
Data pre-processing overview-Sampling - Missing Values - Outlier Detection and Treatment - Standardizing Data - Categorization - Weights of Evidence Coding - Variable Selection and Segmentation.

UNIT IV  DATA ANALYTICS  

UNIT V  TOOLS AND APPLICATIONS  
Popular Big Data Techniques and tools- Map Reduce paradigm and the Hadoop system Big Data Infrastructures - Big Data Security - Big Data Applications – Finance, Healthcare

TOTAL: 45 PERIODS

REFERENCES

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1:Identify the various sources of Big Data.
CO2:Apply several key big data technologies used for storage, analysis and manipulation of data.
CO3:Design new algorithms for collecting Big Data from various sources.
CO4:Design algorithms for pre-processing Big Data other than the traditional approaches.
CO5:Design methodologies to extract data from structured and un-structured data for analytics.
UNIT I DISTRIBUTED SYSTEMS AND ENABLING TECHNOLOGIES

UNIT II VIRTUALIZATION
Implementation Levels of Virtualization - Virtualization Structures, Tools and Mechanisms - Virtualization of CPU, Memory, and I/O Devices - Virtual Clusters and Resource Management - Virtualization for Data-Center Automation.

UNIT III CLOUD COMPUTING

UNIT IV EXPLORING CLOUD PLATFORMS AND SERVICES

UNIT V SECURITY AND INTER-CLOUD
Trust Management - Defence Strategies - Distributed Intrusion/Anomaly Detection - Data and Software Protection Techniques - Reputation-Guided Protection of Data Centers - Inter-cloud Resource Management.

PRACTICAL EXERCISES
1. Experiment with public SaaS.
2. Create a software using public PaaS.
3. Experiment storage services in cloud.
4. Create VMs in public cloud platforms.
5. Experiment with load balancing.
6. Experiment with elasticity in the cloud.
7. Interlink storage services with VMs.
8. Set up a virtual private cloud using public cloud platforms.
9. Set up an open source private cloud.
10. Experiment with CLI in the open source private cloud.

REFERENCES

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Articulate the main concepts, key technologies, strengths and limitations of cloud computing.
CO2: Identify the architecture, infrastructure and delivery models of cloud computing.
CO3: Explain the core issues of cloud computing such as security, privacy and interoperability.
CO4: Choose the appropriate technologies, algorithms and approaches for the related issues.
CO5: Set up and use cloud platforms and services.

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CP3063 ETHICAL HACKING L T P C
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UNIT I INTRODUCTION TO HACKING

UNIT II INFORMATION SECURITY
Types of malware – Types of Vulnerabilities- Types of attacks and their prevention mechanism - Keystroke Logging - Denial of Service (DoS /DDoS) - Waterhole attack - brute force - phishing and fake WAP- Eavesdropping- Man-in-the-middle- Session Hijacking - Clickjacking - Cookie Theft -
URL Obfuscation - buffer overflow - DNS poisoning - ARP poisoning - Identity Theft - IoT Attacks - BOTs and BOTNETs

UNIT III INFORMATION GATHERING AND SCANNING 9

UNIT IV EXPLOITATION 9

UNIT V ENTERPRISE SECURITY 9

TOTAL: 45 PERIODS

REFERENCES

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Use the various security tools to assess the computing system.
CO2: Predict the vulnerabilities across any computing system using penetration testing
CO3: Identify prediction mechanism to prevent any kind of attacks
CO4: Protect the system from malicious software and worms
CO5: Analyze the risk and support the organization for effective security measures.
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CP3062 DIGITAL IMAGE AND VIDEO PROCESSING L T P C

UNIT I FUNDAMENTALS OF IMAGE PROCESSING 9+6

UNIT II IMAGE ENHANCEMENT AND RESTORATION 9+6

UNIT III IMAGE SEGMENTATION AND MORPHOLOGY 9+6

UNIT IV BASICS OF VIDEO PROCESSING 9+6
Introduction – Video Sampling and Interpolation- Motion Detection and Estimation – Video Enhancement and Restoration

UNIT V VIDEO SEGMENTATION, TRACKING & APPLICATIONS 9+6

LIST OF EXPERIMENTS 30
1. Intensity Transformations
2. Filtering in the Spatial domain
3. Filtering in the Frequency Domain
4. Image Restoration
5. Detection of Discontinuities
6. Region Based Segmentation
7. Morphological operations
8. Feature Extraction
9. Feature Selection
10. Motion Detection and Estimation
11. Video Enhancement and Restoration
12. Video Segmentation
13. Motion Tracking in Video
14. Steganography
15. Watermarking

TOTAL: 75 PERIODS

REFERENCES

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

CO1: Have a clear impression of the breadth and practical scope of digital image processing and have arrived at a level of understanding that it is the foundation for most of the work currently underway in this field.

CO2: Critically analyze the role of video in modern technologies.

CO3: Implement basic image and video processing algorithms.

CO4: Design and develop various applications that incorporate different techniques of Image and Video processing.

CO5: Apply and explore new techniques in the areas of Image and Video Processing.

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CP3073  PRINCIPLES OF CRYPTOGRAPHY  L T P C  3 0 0 3

UNIT I  MATHEMATICAL PRELIMINARIES  9
Group, cyclic group, cyclic subgroup, field, probability. Number Theory: Fermat's theorem, Cauchy's theorem, Chinese remainder theorem, primality testing algorithm, Euclid's algorithm for integers, quadratic residues, Legendre symbol, Jacobi symbol etc.

UNIT II  CRYPTOGRAPHY AND ATTACKS  9
Classical Cryptography, substitution cipher, different type of attack: CMA, CPA, CCA etc, Shannon perfect secrecy, OTP, Pseudo random bit generators, stream ciphers and RC4
UNIT III SYMMETRIC KEY ENCRYPTIONS
Block ciphers: Modes of operation, DES and its variants, AES, Blowfish and Two fish encryption, linear and differential cryptanalysis.

UNIT IV PUBLIC KEY ENCRYPTION AND HASH FUNCTION
RSA cryptosystem, Elliptic curve cryptosystems, homomorphic encryption, Diffie-Hellman key exchange algorithm, Elgamal Cryptosystem, Cryptographic hash functions MD5, SHA

UNIT V DIGITAL SIGNATURES
Digital signatures - notion of existential unforgability under chosen message attacks, Schnorr signature scheme. Zero Knowledge Proofs and Protocols,

TOTAL: 45 PERIODS

REFERENCES
5. Prentice Hall of India, 2006

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Present the exploitation present in the security and learn the basic protocols
CO2: Apply the different cryptographic operations and key exchange protocols
CO3: Apply zero knowledge proofs and Exchange of Secrets
CO4: Analyze various cryptography techniques and its applications
CO5: Apply cryptographic Hash function to the real world application to achieve secured system.

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UNIT I ARCHITECTURES AND MODELS 9+6

UNIT II CONNECTIVITY 9+6
Communications Criteria –PHY/MAC layer- Network Layer–Transport Layer –Application Transport Methods– Application Layer-Interoperability in IoT.

UNIT III SYSTEM DEVELOPMENT 9+6
Design Methodology –Case study –Basic blocks of IoT device –Raspberry Pi –Board, Interfaces, Linux, Sensors, Programming –Arduino –Other IoT Devices.

UNIT IV DATA ANALYTICS AND IoT SECURITY 9+6

UNIT V IoT IN INDUSTRY 9+6

TOTAL: 75 PERIODS
REFERENCES
7. Matt Richardson & Shawn Wallace, Getting Started with Raspberry Pi, O'Reilly(SPD), 2014

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Explain the underlying architectures and models in IoT.
CO2: Analyze different connectivity technologies for IoT.
CO3: Develop simple applications using Arduino / Raspberry Pi.
CO4: Apply data analytics techniques to IoT.
CO5: Study the needs and suggest appropriate solutions for Industrial applications

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CP3052 ADVANCED SOFTWARE ENGINEERING L T P C
3 0 0 3

UNIT I PROCESS MODELS

UNIT II REQUIREMENTS MODELING

UNIT III ARCHITECTURE AND DESIGN CONCEPTS

UNIT IV SOFTWARE QUALITY AND TESTING

UNIT V DEVOPS

TOTAL: 45 PERIODS

REFERENCES

37

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Select Appropriate Process Model for Software Development.
CO2: Analyze user requirements and design S/W using object-oriented methodology in UML
CO3: Apply the various design patterns in software development
CO4: Incorporate appropriate quality factors and standards during Software Development
CO5: Apply software testing techniques in various software development stages
CO6: Understand the application of DevOps for software development

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CP3060 DEEP LEARNING L T P C
3 0 2 4

UNIT I BASICS FOR DEEP LEARNING

UNIT II INTRODUCTION TO DEEP LEARNING
Basic concept of Neurons – Perceptron Learning – Multilayer Perceptrons - Deep Feed Forward Networks - Back Propagation – Data representation for Neural Networks - Datasets for deep learning- cross validation - Bias-Variance Tradeoff- Gradient based optimization – Regularization
for Deep learning: Parameter norm Penalties, data set augmentation, Dropout, Multi task learning, Early stopping – Hyperparameters for deep learning.

UNIT III CONVOLUTIONAL NEURAL NETWORKS

UNIT IV SEQUENCE MODELING USING RECURRENT NETS
Recurrent Neural Networks (RNN) - Bidirectional RNN - Long Short-Term Memory (LSTM) - GRU – Attention and Applications -GPT, BERTs and Variants -Encoder-decoder sequence to sequence architectures – Recursive Neural Networks - Performance metrics for text processing- Case Study – Text generation with LSTM, Speech Processing and Image Captioning using RNNs.

UNIT V UNSUPERVISED AND DEEP GENERATIVE MODELS

PRACTICAL EXERCISES
Environment: TensorFlow/Keras
Processor: GPU or Cloud GPUs
1. Implement a perceptron to evaluate logical operations including XOR
2. Implement a Multi-Layer Perceptron and train the model using feed forward algorithm.
3. Build a MLP and train it using backpropagation algorithm with gradient decent optimization
4. Demonstrate the contexts of under fitting, Overfitting and good fit with MLP and generalize the model you built.
5. Build and evaluate a convolutional Neural Network model for image classification
6. Implement Transfer Learning concept for Sentence classification in Convolutional Neural Networks.
7. Build and evaluate variational autoencoder for image generation
8. Build and evaluate RNN structure (LSTM/GRU) to do PoS tagging, Sentence Classification, and Text Generation.
9. Build a GAN to generate image from text and evaluate the performance.
10. Implement Sentiment Analysis using Recursive Neural Networks
11. Build a Deep learning model for speech recognition
12. Implement Object Detection using Yolo V6
13. Build a Deep learning model to summarize a video with Attention Models

TOTAL: 75 Periods

REFERENCES

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Understand the role of Applied Mathematics and the need of Deep learning.
CO2: To optimize and generalize deep neural networks for better performance.
CO3: To design and implement Convolutional and recurrent Neural Networks and Critically Analyse in Image and text Related Projects
CO4: To design and implement Deep Learning Applications.
CO5: To learn deep generative networks implications in unsupervised learning.

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CP3082 WEB CONTENT DESIGN AND MANAGEMENT L T P C

3 0 2 4

UNIT I PRINCIPLES OF WEB DESIGN 9+6

UNIT II ELEMENTS OF PAGE DESIGN 9+6

UNIT III WEB CONTENT DESIGN 9+6

UNIT IV WEB CONTENT MANAGEMENT 9+6

UNIT V WEB ANALYTICS 9+6

TOTAL: 75 PERIODS
REFERENCES

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Design web pages that follow standards and are usable.
CO2: Design web sites that are appealing.
CO3: Appreciate the usage of Content management System for designing webContent.
CO4: Take advantage of Content Management System tools for managing content for large web sites.
CO5: Use analytics tools for better management.

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CP3075 SEMANTIC WEB L T P C 3 0 0 3

UNIT I THE QUEST FOR SEMANTICS

UNIT II LANGUAGES FOR SEMANTIC WEB AND ONTOLOGIES
UNIT III  ONTOLOGY LEARNING FOR SEMANTIC WEB  
9

UNIT IV  ONTOLOGY MANAGEMENT AND TOOL  
9

UNIT V  APPLICATIONS  
9

TOTAL: 45 PERIODS

REFERENCES

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Create ontology for a given domain.
CO2: Develop an application using ontology languages and tools.
CO3: Understand the concepts of semantic Web.
CO4: Use ontology related tools and technologies for application creation.
CO5: Design and develop applications using semantic web.
CO6: Understand the standards related to semantic web.

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UNIT I INTRODUCTION 9

UNIT II USER INTERFACE DESIGN 9

UNIT III DATA PERSISTENCE 9
Different Data persistence schemes – content provider and resolver – shared preferences – saved instance – file read/write operations – SQLite database – Android in build content providers – user content provider

UNIT IV ANDROID SERVICE COMPONENT 9
Intent Service – Remote service – Service handlers – communication between service and Activity – Broadcast Receivers: Local Broadcast Manager, Dynamic Broadcast Receiver – System Broadcast – Pending Intent, Notifications – Packaging and deployment

UNIT V ANDROID APPLICATION DEVELOPMENT 9
Communication via the web – Telephony Manager: Sending SMS and making calls – Google maps service using API – Publishing Android Apps: Guidelines, policies and process of uploading Apps to Google Play

TOTAL: 45 PERIODS

REFERENCES
4. Android”, O’Reilly, 2011

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Acquire the knowledge on Android OS and its features.
CO2: Acquire knowledge on GUI design required for Android App development.
CO3: Apply the knowledge of persistence Data storage mechanism in Android Apps.
CO4: Develop web based mobile application that accesses internet and location data.
CO5: Apply the knowledge in App development using telephony and Google Map services
CO6: Design and apply the knowledge to publish Android applications into Market
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**CP3055 BLOCKCHAIN TECHNOLOGIES**

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**PRACTICAL EXERCISES**

1. Implement cryptographic hash functions
2. Implement Decentralized Applications
3. Implement a simple program using Web3 Javascript API
4. Set up Go-Ethereum client
5. Set up Python Ethereum Client

**TOTAL: 75 PERIODS**

**REFERENCES**


COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Explain cryptocurrencies and their relationship with the blockchain technology.
CO2: Explain the different steps in the use of Bitcoins.
CO3: Relate Web 3 and Hyperledger to concepts in blockchain technologies.
CO4: Apply blockchains to different real-life problems
CO5: Implement a simple application using Ethereum.

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CP3083 MULTIMEDIA SYSTEMS AND APPLICATIONS

UNIT I MULTIMEDIA ELEMENTS

UNIT II MULTIMEDIA TOOLS and AUTHORING

UNIT III MULTIMEDIA COMPRESSION

Attested

[Signature]

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025
UNIT IV  MULTIMEDIA COMMUNICATION SYSTEMS  9

UNIT V  MULTIMEDIA APPLICATIONS  9
Applications for WWW - Multimedia databases — Indexing and Retrieval, Visualization, Virtual, Augmented and Mixed Reality, Interactive E-learning, HCI and UX design, Games and Animation, Real-Time video conferencing.

TOTAL: 45 PERIODS

REFERENCES

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

CO1: Handle the multimedia elements effectively
CO2: Use Multimedia Hardware and Software for Editing and Authoring multimedia applications
CO3: Implement Compression algorithms for various multimedia applications
CO4: Develop effective strategies to deliver Quality-of-Experience in networked Multimedia applications
CO5: Design and develop multimedia applications in various domains

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UNIT I INTRODUCTION 9

UNIT II RETRIEVAL MODELING 9

UNIT III INDEXING 9

UNIT IV EVALUATION AND PARALLEL INFORMATION RETRIEVAL 9

UNIT V SEARCHING THE WEB 9

TOTAL: 45 PERIODS

REFERENCES

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Build an Information Retrieval system using the available tools.
CO2: Identify and design the various components of an Information Retrieval system.
CO3: Measure effectiveness and efficiency of information retrieval techniques.
CO4: Use parallel Information Retrieval approaches in real world problems.
CO5: Design an efficient search engine and analyze the Web content structure

**CO-PO Mapping**

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**CP3072**  PARALLEL ALGORITHMS  

**UNIT I**  **INTRODUCTION**  
10

**UNIT II**  **PROCESSOR ORGANISATION**  
8
Mesh -Binary Tree Network-Hyper Tree Network - Pyramid – Butterfly- Hypercube –Shuffle-Exchange Networks – Multiprocessor- Multicomputer- Data Mapping

**UNIT III**  **SORTING & SEARCHING**  
9
Sorting Networks – Sorting on a Linear Array – Sorting on CRCW, CREW, EREW – Searching a sorted sequence – Searching a random sequence – Bitonic Sort

**UNIT IV**  **ALGEBRAIC PROBLEMS**  
9

**UNIT V**  **GRAPH ALGORITHMS**  
9

**TOTAL: 45 PERIODS**

**REFERENCES**

**COURSE OUTCOMES:**
Upon completion of the course, the students will be able to
CO1: Understand the difference between sequential and parallel algorithms.
CO2: Design parallel algorithms in various models of parallel computation.
CO3: Understand various parallel processor organizations
CO4: Design parallel searching and sorting algorithms
CO5: Design parallel graph algorithms

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CP3077 SOFT COMPUTING L T P C
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UNIT I SOFT COMPUTING AND FUZZY COMPUTING

UNIT II FUNDAMENTALS OF NEURAL NETWORKS

UNIT III BACK PROPAGATION NETWORKS AND COMPETITIVE NEURAL NETWORKS

UNIT IV GENETIC ALGORITHM
Basic Concepts – Working Principle – Procedures of GA – Flow Chart of GA – Genetic Representation: (Encoding) Initialization and Selection – Genetic Operators: Mutation, Generational Cycle – Applications. Multi-objective Optimization Problem Solving: Concept of multi-objective optimization problems (MOOPs) and issues of solving them -Multi-Objective Evolutionary Algorithm (MOEA) -Non-Pareto approaches to solve MOOPs - Pareto-based approaches to solve MOOPs -Some applications with MOEAs.

UNIT V APPLICATIONS
Control systems; Speech systems; Image processing; Natural language processing and decision making, Handwritten Script Recognition; Automotive Systems and Manufacturing; Decision Support System; Bioinformatics; Investment and trading.
REFERENCES
3. An Introduction to Genetic Algorithm Melanic Mitchell (MIT Press)

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Describe human intelligence and AI Explain how intelligent system works.
CO2: Recognize the feasibility of applying a soft computing methodology for a particular problem.
CO3: Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems.
CO4: Apply genetic algorithms to optimization problems.
CO5: Design neural networks for pattern classification and regression problems
CO6: Develop some familiarity with current research problems and research methods in Soft Computing Techniques

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CP3065  GAME THEORY  L T P C
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UNIT I  INTRODUCTION
UNIT II  GAMES WITH PERFECT INFORMATION

Games with Perfect Information – Strategic games – prisoner's dilemma, matching pennies- Nash equilbria- theory and illustrations – Cournot and Bertrand models of oligopoly- auctions- mixed strategy equilibrium- zero-sum games- Extensive Games with Perfect Information-repeated games (prisoner’s dilemma)- subgame perfect Nash equilibrium; computational issues.

UNIT III  GAMES WITH IMPERFECT INFORMATION


UNIT IV  NON-COOPERATIVE GAME THEORY


UNIT V  MECHANISM DESIGN


REFERENCES

1. Thomas S. Ferguson, Game Theory, Web notes available at (https://www.cs.cmu.edu/afs/cs/academic/class/15859s05/www/ferguson/comb.pdf)

COURSE OUTCOMES:

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

CO1: Discuss the notion of a strategic game and equilibria and identify the characteristics of main applications of these concepts.
CO2: Discuss the use of Nash Equilibrium for other problems.
CO3: Identify key strategic aspects and based on these be able to connect them to appropriate game theoretic concepts given a real world situation.
CO4: Identify some applications that need aspects of Bayesian Games.
CO5: Implement a typical Virtual Business scenario using Game theory.

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CP3051  
ADHOC AND WIRELESS SENSOR NETWORKS  
L T P C  
3 0 0 3

**UNIT I**  
FUNDAMENTALS AND ROUTING PROTOCOLS OF WIRELESS AD HOC NETWORKS  
9

**UNIT II**  
MOBILITY MODELS AND OVERHEAD CONTROL MECHANISMS IN MANETS  
9
Description of Various Mobility Models – Simulation and Analysis of Various Mobility Models – Overhead Analysis in Hierarchical Routing Scheme – Overhead Minimization Techniques – Energy Models

**UNIT III**  
WIRELESS SENSOR NETWORKS (WSN)  
9

**UNIT IV**  
MANAGEMENT AND PERFORMANCE  
9

**UNIT V**  
SECURITY IN ADHOC AND SENSOR NETWORKS  
9

TOTAL: 45 PERIODS
REFERENCES
2. Jing (Selina) He, Mr. Shouling Ji, Yi Pan, Yingshu Li, ”Wireless Ad Hoc and Sensor Networks Management, Performance, and Applications”, CRC Press, 2014

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Identifying suitable routing protocols for various scenarios of ad hoc networks.
CO2: To explore various mobility models for MANETs.
CO3: Identify different issues in wireless sensor networks.
CO4: Analyze various algorithms used in WSN
CO5: Identify and critique security issues in ad hoc and sensor networks

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SE3053 SOFTWARE SECURITY L T P C 3 0 0 3

UNIT I LOW-LEVEL ATTACKS 9

UNIT II WEB SECURITY AND SECURE DESIGN 9

53
UNIT III SECURITY RISK MANAGEMENT

UNIT IV SECURITY TESTING

UNIT V PENETRATION TESTING

TOTAL: 45 PERIODS

REFERENCES

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Identify various vulnerabilities related to memory attacks.
CO2: Apply security principles in software development.
CO3: Evaluate the extent of security risks
CO4: Involve selection of testing techniques related to software security in the testing phase of software development.
CO5: Use tools for securing software.

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UNIT I  INTRODUCTION TO VIRTUALIZATION  

UNIT II  VIRTUAL MACHINES-IMPLEMENTATION AND EMULATION  

UNIT III  HIGH LEVEL LANGUAGE VIRTUAL MACHINE ARCHITECTURE AND IMPLEMENTATION  

UNIT IV  NETWORK AND STORAGE VIRTUALIZATION  

UNIT V  CLOUD AND VM APPLICATIONS  
Service creation environments to develop cloud based applications- Service creation environments to deploy cloud based applications- Development environments for service development; Amazon, Azure and Google App- Introduction to Cloud IT Model- VMWare Server – VMWare ESXi – Citrix Xen Server – Microsoft Virtual PC – Microsoft Hyper-V – Virtual Box, Server Virtualization: Configuring Servers with Virtualization – Adjusting and Tuning Virtual servers – VM Backup – VM Migration, Desktop Virtualization: Terminal services – Hosted Desktop – Web-based Solutions – Localized Virtual Desktops, Network and Storage Virtualization: Virtual Private Networks – Virtual LAN – SAN and VSAN – NAS

TOTAL: 45 PERIODS
REFERENCES

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Understand the virtualization technologies.
CO2: Explore virtual clusters and resource management in virtualized environments.
CO3: Apply various virtual machine programming languages.
CO4: Differentiate between network and storage virtualization.
CO5: Understand the concept of service creation environments for developing cloud-based applications.

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CP3059 DATABASE ADMINISTRATION AND TUNING

UNIT I FUNDAMENTALS OF DATABASE ADMINISTRATION

UNIT II DATABASE SECURITY, BACKUP AND RECOVERY

UNIT III PERFORMANCE MANAGEMENT
Designing the DBMS Environment for Recovery - Types of Recovery - DBA Tools- Monitoring Vs Management- Service level management- Performance parameters- Performance Tuning Tools- Techniques for Optimizing Databases- Database reorganization- Files and datasets- space management- Loading and unloading data- bulk data movement- Client server computing

UNIT IV DATABASES AND INDEX TUNING

UNIT V OPTIMIZATION AND TROUBLESHOOTING

REFERENCES

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: An ability to understand various DBA roles, tasks and tools
CO2: Apply various Database recovery, backup and security privileges and
CO3: Differentiate between monitoring and management in the context of database administration and explain their respective roles in ensuring database performance and availability.
CO4: Effectively tune and optimize relational databases, including query optimization, concurrency control, recovery subsystem tuning, index selection, and hardware considerations.

CO5: Possess the skills to effectively optimize and tune database systems by employing techniques such as normalization, denormalization, clustering, query tuning, performance monitoring, and troubleshooting various subsystems.

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CP3058  DATA WAREHOUSING AND DATA MINING TECHNIQUES  L T P C
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UNIT I  INTRODUCTION TO DATA WAREHOUSING  9

UNIT II  DATA WAREHOUSE PROCESS AND ARCHITECTURE  9

UNIT III  INTRODUCTION TO DATA MINING  9
Data Objects and Attribute Types - Basic Statistical Descriptions of Data - Measuring Data Similarity and Dissimilarity - KDD versus data mining, Stages of the Data Mining Process-task primitives, Data Mining Techniques - Data preprocessing – Data cleaning, Data Integration, Data Transformation and Data Discretization, Data reduction - Association Rule Mining: Frequent Item set Mining Methods – Pattern Evaluation Methods – Association Mining to Correlation Analysis.

UNIT IV  CLASSIFICATION AND CLUSTERING  9
Decision Tree Induction - Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods(Genetic Algorithms, Rough Set Approach, Fuzzy Set Approaches) – Semi-Supervised Classification - Clustering techniques – Partitioning methods : k-means- Hierarchical
Methods: distance based agglomerative and divisive clustering, Probabilistic hierarchical Clustering Density-Based Methods: DBSCAN, DENCLUE – Expectation Maximization -Grid Based Methods – Clustering High-Dimensional Data - Clustering Graph and Network Data - Outlier Analysis.

UNIT V  TRENDS IN DATA MINING  9

TOTAL: 45 PERIODS

REFERENCES

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Evolve multidimensional intelligent model from typical system.
CO2: Design and implement data warehouse and to do Business Analytics.
CO3: Acquire knowledge on data and to prepare data for mining
CO4: Design and deploy classification and clustering techniques.
CO5: Evaluate various mining techniques on complex data objects.

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CP3076  SOCIAL NETWORK ANALYSIS  9

UNIT I  INTRODUCTION  9
Introduction to Semantic Web: Limitations of current Web - Development of Semantic Web - Emergence of the Social Web - Social Network analysis: Development of Social Network Analysis - Key concepts and measures in network analysis - Applications of Social Network Analysis-
Graph Essentials - Graph Basics – Graph Representation- Types of Graphs – Connectivity in Graphs – Special Graphs – Graph Algorithms.

UNIT II MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION 9

UNIT III DETECTING AND MINING COMMUNITIES 9

UNIT IV VISUALIZATION OF SOCIAL NETWORKS 9

UNIT V APPLICATIONS 9

REFERENCES
COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Develop semantic web related applications.
CO2: Represent knowledge using ontology.
CO3: Predict human behaviour in social web and related communities.
CO4: Visualize social networks
CO5: Apply social network analysis techniques in real-life applications

CO-PO Mapping

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SE3054 SOFTWARE TESTING AND QUALITY ASSURANCE L T P C
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UNIT I INTRODUCTION 9

UNIT II TESTING METHODOLOGIES 9

UNIT III TEST STRATEGIES 9

UNIT IV TEST AUTOMATION AND MANAGEMENT 9

UNIT V SOFTWARE QUALITY ASSURANCE 9

TOTAL: 45 PERIODS

REFERENCES

Attended

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Develop Quality plans and use SQA components in project life cycle.
CO2: Analyze the product Quality.
CO3: Judge the use of infrastructure components and use configuration items for Quality control.
CO4: Use various testing methods and verify.
CO5: Assess Quality standards of various software products.

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CP3079 USER INTERFACE DESIGN

UNIT I INTRODUCTION

UNIT II INTERACTION DESIGN

UNIT III ADVANCED INTERACTION DESIGN
Social Media interaction design, Digital Products, Information architecture design, Designing for web, Mobile, web and Mobile usability, Touch Screens, Interaction design for the XR, Best Practices, Ubiquitous computing, IOT and wearable computing, Human-Robot interaction.

UNIT IV EVALUATION

UNIT V FORMAL MODELS, TOOLS, CASE STUDIES
Task analysis, Dialog Notations and Design, Tools - proto.io, mural, material; Case Studies - studying usability of web and mobile apps, touch screens, chatbots.

TOTAL: 45 PERIODS
REFERENCES

10. https://www.nngroup.com
11. https://www.interaction-design.org/
12. www.mural.co
13. https://m3.material.io/

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

CO1: Apply usability principles and user/cognitive modeling for various design tasks.
CO2: Use the different design methods, interaction styles, metaphors, basic design paradigms
CO3: Create advanced interaction designs for a variety of use cases in complex environments.
CO4: Evaluate interaction designs and implementations.
CO5: Use formal models and notation to design interactions for new systems.
CO6: Explore use cases from real world examples and suggest usable designs.

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UNIT I  INTRODUCTION TO SOFTWARE TESTING  09

UNIT II  SOFTWARE RELIABILITY CONCEPTS  10

UNIT III  COMPUTATIONAL SOFTWARE RELIABILITY  08
Computation of software reliability, Functional and Operational Profile, Operational Profiles – Difficulties, Customer Type, User Type, System Mode, Test Selection - Selecting Operations, Regression Test.

UNIT IV  RELIABILITY MODELING  09

UNIT V  RELIABILITY METRICS  09

TOTAL: 45 PERIODS

REFERENCES

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Identify and apply various software metrics, which determine the quality level of software.
CO2: Identify and evaluate the reliability of any given software product.
CO3: Understand the fault handling and failure forecasting techniques in software systems.
CO4: Understand and Comprehend different time-dependent and time-independent software reliability models.

CO5: Design reliability models for evaluating the quality level of software systems based on the requirement.

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CP3081 VISUALIZATION TECHNIQUES L T P C
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UNIT I INTRODUCTION

UNIT II DATA REPRESENTATION - I

UNIT III DATA REPRESENTATION - II

UNIT IV INTERACTION AND DESIGN

UNIT V CURRENT TRENDS

TOTAL: 45 PERIODS

REFERENCES

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Apply mathematics and basic science knowledge for designing information visualizing System.
CO2: Collect data ethically and solve engineering problem in visualizing the information.
CO3: Implement algorithms and techniques for interactive information visualization.
CO4: Conduct experiments by applying various modern visualization tool and solve the space layout problem.
CO5: Analyze and design system to visualize multidisciplinary multivariate Data individually or in teams.
CO6: Develop a cost effective and a scalable information visualization system.

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BD3051 FOUNDATIONS OF DATA SCIENCE

UNIT I INTRODUCTION

UNIT II DESCRIBING DATA
Types of Data – Types of Variables - Describing Data with Tables and Graphs – Describing Data with Averages – Describing Variability – Normal Distributions and Standard (z) Scores

UNIT III DESCRIBING RELATIONSHIPS
error of estimate – interpretation of r² – multiple regression equations – regression towards the mean

UNIT IV PYTHON LIBRARIES FOR DATA WRANGLING

UNIT V DATA VISUALIZATION

TOTAL: 45 PERIODS

REFERENCES

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

CO1: Define the data science process
CO2: Understand different types of data description for data science process
CO3: Gain knowledge on relationships between data
CO4: Use the python libraries for data wrangling
CO5: Apply visualization libraries in python to interpret and explore data

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CP3071 WIRELESS COMMUNICATIONS L T P C
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UNIT I INTRODUCTION TO WIRELESS COMMUNICATION

UNIT II WIRELESS CHANNELS AND CODING 9
Physical Modeling - Input/Output Model - Capacity - Capacity of Flat Fading Channels - Frequency-Selective Fading Channels. Digital Modulation and Detection - Signal Space Analysis - Coding for Wireless Channels: Overview of Code Design-Linear Block Codes - Convolutional Codes - Concatenated Codes - Turbo Codes - Low-Density Parity-Check Codes - Coded Modulation - Coding with Interleaving for Fading Channels - Unequal Error Protection Codes- Joint Source and Channel Coding

UNIT III DIVERSITY AND EQUALISATION 9

UNIT IV MULTICARRIER MODULATION 9
Data Transmission using Multiple Carriers – Multicarrier Modulation with Overlapping Sub channels – Mitigation of Subcarrier Fading – Discrete Implementation of Multicarrier Modulation – Peak to average Power Ratio- Frequency and Timing offset.

UNIT V 5G AND 6G IN WIRELESS COMMUNICATION 9

TOTAL: 45 PERIODS

REFERENCES

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Understand concepts of wireless communication.
CO2: Analyse the different types of wireless channels and coding
CO3: Understand about transmitter and receiver diversity and equalisation.
CO4: Learn about performance of the digital modulation.
CO5: Explore 5G, 6G technology concepts.
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CP3053
AGILE METHODOLOGIES

UNIT I
AGILE METHODOLOGY
Theories for Agile Management – Agile Software Development – Traditional Model vs. Agile Model
- Classification of Agile Methods – Agile Manifesto and Principles – Agile Project Management – Agile Team Interactions – Ethics in Agile Teams - Agility in Design, Testing – Agile Documentations – Agile Drivers, Capabilities and Value

UNIT II
AGILE PROCESSES

UNIT III
AGILITY AND KNOWLEDGE MANAGEMENT

UNIT IV
AGILITY AND REQUIREMENTS ENGINEERING

UNIT V
AGILITY AND QUALITY ASSURANCE

TOTAL: 45 PERIODS

REFERENCES
COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Analyze existing problems with the team, development process and wider organization
CO2: Apply a thorough understanding of Agile principles and specific practices
CO3: Select the most appropriate way to improve results for a specific circumstance or need
CO4: Judge and craft appropriate adaptations to existing practices or processes depending upon analysis of typical problems
CO5: Evaluate likely successes and formulate plans to manage likely risks or problems

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CP3078  STATISTICAL NATURAL LANGUAGE PROCESSING  L T P C 3 0 0 3

UNIT I  MORPHOLOGY AND PART-OF SPEECH PROCESSING  9

UNIT II  SPEECH PROCESSING  9

UNIT III  SYNTAX ANALYSIS  9
UNIT IV  SEMANTIC AND PRAGMATIC INTERPRETATION  9

UNIT V APPLICATIONS  9

TOTAL: 45 PERIODS

REFERENCES

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

CO1: Identify the different linguistic components of given sentences.
CO2: Design a morphological analyser for a language of your choice using finite state automata concepts.
CO3: Implement the Earley algorithm for a language of your choice by providing suitable grammar and words.
CO4: Use a machine learning algorithm for word sense disambiguation.
CO5: Build a tagger to semantically tag words using WordNet.
CO6: Design a business application that uses different aspects of language processing.

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DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025
UNIT I QUANTUM MECHANICS AND QUANTUM COMPUTATION

UNIT II QUANTUM COMPUTERS AND ALGORITHMS
Guiding principles, Conditions for quantum computation, Harmonic oscillator quantum computer, Optical photon quantum computer, Optical cavity quantum electrodynamics, Ion traps, Nuclear magnetic resonance, Other implementation schemes, The quantum Fourier transform and its applications, Quantum search algorithms

UNIT III QUANTUM INFORMATION
Quantum noise and quantum operations : Classical noise and Markov processes, Quantum operations, Examples of quantum noise and quantum operations, Applications of quantum operations, Limitations of the quantum operations formalism, Distance measures for quantum information : Distance measures for classical information, How close are two quantum states?, How well does a quantum channel preserve information?

UNIT IV QUANTUM ERROR-CORRECTION

UNIT V ENTROPY AND INFORMATION THEORY
Entropy : Shannon Entropy, Basic properties of entropy, Von Neumann entropy, Strong sub additivity, Quantum information theory : Distinguishing quantum states and the accessible information, Data compression, Classical information over noisy quantum channels, Quantum information over noisy quantum channels, Entanglement as a physical resource, Quantum cryptography

TOTAL: 45 PERIODS

REFERENCES

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Understand the basics of quantum computing.
CO2: Understand the background of Quantum Mechanics.
CO3: Analyse the computation models.
CO4: Model the circuits using quantum computation. Environments and frameworks.
CO5: Understand the quantum operations such as noise and error-correction.

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SE3051 FORMAL METHODS IN SOFTWARE SYSTEMS L T P C

3 0 0 3

UNIT I INTRODUCTION

UNIT II FORMAL SPECIFICATION STYLE
Model-Oriented – Specifications – Concurrency-Based Specifications – Example Specification Languages.

UNIT III VDM
Introduction to VDM – Basic Types – Quote Types – Compound Types – Optional Types – Functions – Operations – Additional Constructs – Modules.

UNIT IV THE Z NOTATION
The Interchange Language – User-Defined Identifiers – Data Types – Basic Types – Compound Types – Schemas – Additional Constructs.

UNIT V FORMAL SEMANTICS AND TOOLS

TOTAL: 45 PERIODS

REFERENCES

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: To model various classes of software systems within appropriate formalisms
CO2: To model various classes of software systems within appropriate formalisms;
CO3: To interpret and apply the formal languages of the formalisms for modeling software systems
CO4: To apply specific techniques for the analysis and verification of software systems;
CO5: To formulate and prove properties of software systems within studied formalisms

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CP3066 GPU COMPUTING LTPC 3 0 0 3

UNIT I GPU ARCHITECTURE 9

UNIT II CUDA PROGRAMMING 9
CUDA Basics – Multi GPU – Multi GPU Solutions – Optimizing CUDA Applications: Problem Decomposition, Memory Considerations, Transfers, Thread Usage, Resource Contentions.

UNIT III PROGRAMMING ISSUES 9

UNIT IV OPENCL BASICS 9

UNIT V ALGORITHMS ON GPU 9
Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix – Matrix Multiplication – Programming Heterogeneous Cluster.

TOTAL: 45 PERIODS
REFERENCES
7. https://www.khronos.org/opencl/

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Describe GPU Architecture.
CO2: Write programs using CUDA, identify issues and debug them.
CO3: Implement efficient algorithms in GPUs for common application kernels, such as matrix multiplication.
CO4: Write simple programs using OpenCL.
CO5: Given a problem, identify efficient parallel programming patterns to solve it.
CO6: Compare different GPU programming paradigms.

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CP3061    DEVOPS AND MICROSERVICES   L T P C
          3 0 0 3

UNIT I    INTRODUCTION TO DEVOPS

UNIT II   SECURITY IN DEVOPS

UNIT III  INTRODUCTION TO MICROSERVICES
Microservices – Reasons for using Micro services – Challenges – Microservices and SOA
UNIT IV IMPLEMENTATION OF MICROSERVICES
11

UNIT V BUILDING WEBAPPS, WEB SERVICES And MICROSERVICES With SPRING BOOT
7
Example of a Microservices Based Architecture - Technologies for Nanoservices.

REFERENCES
6. CHakradhar Rao Jonagam, Microservices with Kubernetes: Build a continuous delivery pipeline for microservices using Kubernetes, Packt.

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Explain basic DevOps practices
CO2: Be familiar with a Deployment Pipeline and associated tools
CO3: Understand Microservice Architecture
CO4: Be familiar with incident response and disaster recovery
CO5: Develop services using different technologies

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CP3064 FULL STACK WEB APPLICATION DEVELOPMENT L T P C
3 0 2 4

UNIT I OVERVIEW OF FULL STACK
9+6
Lab Exercises:
- Implement JavaScript functions, arrays, objects, strings

UNIT II FRONT-END DEVELOPMENT 9+6
REACT - Virtual DOM, components, props, JSX, Events, conditionals, lists, forms, Routing, Hooks, Redux, Client-server communication, material-ui.

Lab Exercises:
- installing Node.js, Using createRoot() and render() methods,
- Using React Class and function components, properties, events, conditionals, forms
- Implementing simple UI like menus

UNIT III JAVA SPRING BOOT 9+6
Spring Boot core features, architecture - auto configuration, dependency management, application, component scan, starters-starter web, data JPA, actuators, annotation, POM file.

Lab Exercises:
- Implement simple Client-server communication using TOMCAT from REACT client
- installing any IDE like STS (Spring Tool Suite) and configuring for spring application
- Creating Spring Boot project with Spring Initializr
- implementing a simple hello world web application

UNIT IV MONGODB 9+6

Lab Exercises:
- Install MongoDB Atlas Cluster, use Dependencies, Spring Web and Spring Data MongoDB, Docker, Container
- Create a CRUD application with MongoDB and Spring Boot.

UNIT V BUILDING WEBAPPS, WEB SERVICES AND MICROSERVICES WITH SPRING BOOT 9+6
using Spring Boot for Building simple web applications, creating RESTful web service, Microservices architecture, Principles of Microservices and its advantages, Service register & API Gateway, Admin Server & Client, Interservice communication, External API communication, Distributed logging.

Lab Exercises:
- Building RESTful web services with annotations: Rest controller, Request mapping, Request Body, Path Variable.

TOTAL: 75 PERIODS
REFERENCES

7. https://spring.io
8. https://react.dev

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

CO1: Use Javascript and its libraries for building front-end applications
CO2: Use React.js to build client-side applications
CO3: Develop Spring Boot based web applications
CO4: Integrate web applications with MongoDB
CO5: Develop Web applications, RESTful web services and MicroServices using full stack

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CP3054 BIO INFORMATICS L T P C 3 0 0 3

UNIT I INTRODUCTION 9
Bioinformatics - Need for Bioinformatics technologies – Overview of Bioinformatics technologies - Structural bioinformatics – Data format and processing – Secondary resources and applications – Role of Structural bioinformatics – Biological Data Integration System.

UNIT II DATAWAREHOUSING AND DATAMINING IN BIOINFORMATICS 9
Bioinformatics data – Data warehousing architecture – data quality – Biomedical data analysis – DNA data analysis – Protein data analysis – Machine learning – Neural network architecture and applications in bioinformatics- Case Study on Artificial Neural Networks Applications in Protein secondary structure prediction.
UNIT III

GRAPHES


UNIT IV

PHYLOGENETICS AND MODELS OF EVOLUTION


UNIT V

MICROARRAY ANALYSIS


TOTAL: 45 PERIODS

REFERENCES

3. Big Data Analysis for Bioinformatics and Biomedical Discoveries Edited by Shui Qing Ye, CRC Press, Taylor and Francis Group, 2015

COURSE OUTCOMES:

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

CO1: Gather knowledge of basic bioinformatics and computational biology concepts
CO2: Perform analysis of biological data including proteomic, genomic and transcriptomic data and provide meaningful interpretation of the results
CO3: Understand machine learning techniques, microarray data analysis and interpretation of results
CO4: Understand the concepts of modelling for bioinformatics
CO5: Perform analysis of various methods of phylogenetic tree construction and its evolutions

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UNIT I  INTRODUCTION  9

UNIT II  MR COMPUTING ARCHITECTURE  9

UNIT III  MR MODELING  9

UNIT IV  MR PROGRAMMING  9

UNIT V  APPLICATIONS  9

TOTAL: 45 PERIODS

REFERENCES

CP3069  MIXED REALITY  L T P C
3 0 0 3

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

CO1: Discuss the basic concepts of Mixed Reality.
CO2: Design and develop the Mixed Reality applications in different domains.
CO3: Design various models using modelling techniques.
CO4: Perform Mixed Reality Programming with toolkits.
CO5: Understand the working principles of input output devices used in mixed reality applications.
CO6: Evaluate mixed reality-based applications.

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CP3057 CYBER PHYSICAL SYSTEMS L T P C
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UNIT I CYBER-PHYSICAL SYSTEMS

UNIT II CPS - FEEDBACK SYSTEMS

UNIT III CPS - HITL
Taxonomies for HiTL CPS - Data Acquisition : Humans as Sets of Sensors, Humans as Communication Nodes - State Inference: Humans as Processing Nodes - Actuation - HiTL Technologies and Applications - Requirements and Challenges for HiTL Applications - Future of
Human-In-the-Loop Cyber-Physical Systems - Human-in-the-Loop Constraints.

UNIT IV  HUMAN CENTRIC COMPUTING

UNIT V  CPS IMPLEMENTATION ISSUES
From features to automotive software components - Mapping software components to ECUs - CPS Performance Analysis - effect of scheduling, bus latency, sense and actuation faults on control performance, network congestion - Building real-time networks for CPS.

REFERENCES

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

CO1: Explain and analyze the major concepts, philosophical and theoretical perspectives, empirical findings, and historical trends in Cyber-Physical Systems.

CO2: Use Computational knowledge base to create their own methods for answering novel questions of either a theoretical or applied nature, and to critically evaluate the work of others in the same domain.

CO3: Articulate the main concepts, key technologies, strengths and limitations of Human Centered Cyber Physical Systems.

CO4: Point out the challenges in HiTL and able to explain the future of HiTL CPS.

CO5: Be proficient with basic feedback and control research methods, including both theory-driven and applied research design.

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