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.

PROGRAMME EDUCATIONAL OBJECTIVES:
1. Demonstrate the ability to develop software systems of varying size and complexity using appropriate theory, principles and practices of Software Engineering.
2. Empower students to critically analyze current trends and future issues from a system perspective at multiple levels of detail and abstraction using appropriate tools, technologies and best practices.
3. Prepare students to critically analyze and identify gaps in the existing literature and propose innovative and appropriate solutions needed to the industry.
4. Ability to improve and expand skills through lifelong multidisciplinary learning as professional engineers, participation in professional activities and development of managerial and leadership skills.
5. Enable students to effectively communicate technically, function effectively on teams, and apply Software solutions within a global, societal, and environmental context by following ethical practices.
PROGRAM OUTCOMES (POs):

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<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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<tr>
<td>2</td>
<td>Technical documentation</td>
<td>An ability to write and present a substantial technical report/ document.</td>
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<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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### 4. Mapping of Course Outcome and Programme Outcome

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**Total No. of Credits:** 74

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**TOTAL CREDITS**  20
### SUMMARY

**NAME OF THE PROGRAMME: M.E. SOFTWARE ENGINEERING**

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</table>
UNIT I  LINEAR PROGRAMMING  12
Formulation – Graphical solution – Simplex method – Two phase method -Transportation and Assignment Problems

UNIT II  SIMULATION  12
Discrete Event Simulation – Monte – Carlo Simulation – Stochastic Simulation – Applications to real time problems.

UNIT III  ESTIMATION THEORY  12

UNIT IV  TESTING OF HYPOTHESIS  12

UNIT V  MULTIVARIATE ANALYSIS  12

TOTAL: 60 PERIODS

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:
UNIT I  RESEARCH PROBLEM FORMULATION  9
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  9
Statistical design of experiments- types and principles; data types & classification; data collection
- methods and tools

UNIT III  DATA ANALYSIS, INTERPRETATION AND REPORTING  9
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  9
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  9
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.

TOTAL: 45 PERIODS

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
REFERENCES:

CP3151 DATA STRUCTURES AND ALGORITHMS L T P C 3 0 0 3

UNIT I BASIC STRUCTURES AND ALGORITHM 9
Stack- Queue - Linked List Implementation - Min/Max heap – Algorithm Analysis- Asymptotic Analysis- Solving Recurrence Relation – Amortized Analysis

UNIT II BALANCED TREE STRUCTURES 9

UNIT III MELDABLE HEAP STRUCTURES 9

UNIT IV NP COMPLETENESS 9
NP Classes- Polynomial Time Verification – Theory of Reducibility - NP Completeness Proof for Vertex Cover & Hamiltonian Cycle

UNIT V APPROXIMATION ALGORITHMS 9
Approximation Algorithms: Vertex Cover & Euclidean Travelling Salesperson Problem- Randomized Algorithms: Closest Pair Problem & Minimum Spanning Trees

TOTAL: 45 PERIODS

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

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SE3101 SOFTWARE ARCHITECTURE L T P C 3 0 0 3

UNIT I INTRODUCTION
9

UNIT II DESIGN METHODOLOGIES
9
Structured design- Design practices-Stepwise refinement – Incremental design- Structured system analysis and design –Jackson structured programming – Jackson system Development.

UNIT III ARCHITECTURAL DESCRIPTION DOCUMENTATION AND EVALUATION 9

UNIT IV ARCHITECTURE DESIGN
9
Typical architectural design-Dataflow-Independent components-Call and return – Using styles in design – Architectural design space-Design space of architectural elements – Design space of architectural styles.

UNIT V IMPLEMENTATION AND CONFORMANCE TO ARCHITECTURE 9

TOTAL: 45 PERIODS

REFERENCES

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Develop Software applications starting from software architecture and design.
CO2: Learn and evaluate existing software architectures.
CO3: Realize importance of architectural documentation and document them.
CO4: Employ various software architecture design components.
CO5: Design methods for improving software quality from the perspective of software architecture.

CO-PO Mapping

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SE3102 SOFTWARE REQUIREMENTS ENGINEERING L T P C 3 0 0 3

UNIT I REQUIREMENTS ENGINEERING OVERVIEW 9

UNIT II REQUIREMENTS ELICITATION 9

UNIT III REQUIREMENTS ANALYSIS 9

UNIT IV REQUIREMENTS DEVELOPMENT 9

UNIT V REQUIREMENTS VALIDATION
Validation objectives – Analysis of requirements validation – Activities – Properties – Requirement reviews – Requirements testing – ISO 31000 – Case tools for requirements engineering.

TOTAL: 45 PERIODS

REFERENCES

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Prepare SRS including the details of requirements engineering.
CO2: Describe the stages of requirement elicitation.
CO3: Analyze software requirements gathering.
CO4: Integrate the requirements well during requirements analysis.
CO5: Use various methodologies for requirements development.

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CP3152 DATABASE TECHNOLOGIES

UNIT I RELATIONAL MODEL

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
8. David Lane, Hugh.E.Williams, Web Database Applications with PHP and MySQL, O'Reilly Media; 2nd edition, 2004

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.

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15
LIST OF EXPERIMENTS:
1. Linked list implementation of Stack and Queue ADTs
2. Implementation of Binary Search tree
3. Implementing Min/Max Heap
4. Implementing AVL tree
5. Implementing Red-Black tree
6. Implementing Splay Tree
7. Implementing Leftist Heap
8. Implementing 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

SUGGESTED LIST OF EXERCISES:
Choose any one application for performing the following phases.

1. Program Analysis and Project Planning.
   Thorough study of the problem – Identify project scope, Objectives, Infrastructure –
   PROJECT PLAN DOCUMENTATION
2. Software Requirement Analysis Describe the individual Phases / Modules of the project, Identify deliverables – SRS DOCUMENTATION

3. Data Modeling Use work products – Data dictionary, Use case diagrams and activity diagrams, build and test class diagrams, Sequence diagrams, add interface to class diagrams. – DESIGN DOCUMENTATION

4. 4. Software Development and Debugging Use technology of your choice to develop and debug the application– CODE DOCUMENTATION

5. Software Testing Perform validation testing, Coverage analysis, memory leaks, develop test case hierarchy and Site monitor. – TEST CASE DOCUMENTATION

SUGGESTED LIST OF APPLICATIONS:
1. Inventory System.
2. Book Lending Application.
4. Online Help Portal.
5. Student Marks Analyzing System.
6. Credit Card Processing
7. Stock Maintenance System
8. Airline Reservation System
9. Recruitment system
10. Course Registration System.
11. Foreign trading system
12. Online Payment Portal.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Prepare project plan.
CO2: Prepare SRS as per standards.
CO3: Prepare and use design document.
CO4: Prepare and use code document.
CO5: Prepare and use test case documentation at appropriate stages of software development process

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UNIT I  INTRODUCTION

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

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
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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CP3251 ADVANCED OPERATING SYSTEMS L T P C
3 0 0 3

UNIT I INTRODUCTION

UNIT II DISTRIBUTED OPERATING SYSTEMS

UNIT III DISTRIBUTED RESOURCE MANAGEMENT 9

UNIT IV REAL TIME OPERATING SYSTEMS 9

UNIT V MOBILE AND CLOUD OPERATING SYSTEMS 9

TOTAL: 45 PERIODS

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.

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UNIT I  PROCESS MODELS  9

UNIT II  REQUIREMENTS MODELING  9

UNIT III  ARCHITECTURE AND DESIGN CONCEPTS  9

UNIT IV  SOFTWARE QUALITY AND TESTING  9

UNIT V  DEVOPS  9

SUGGESTED LIST OF EXERCISES: 45
1. Prepare SRS for a real time Application
2. Model Entity Relationship Diagram and Data Flow Diagram for the selected case study
3. Model the following UML Diagrams for the selected Case study
   a) Class Diagram
   b) Use Case Diagram
   c) Sequence Diagram
   d) Component diagram
   e) State Transition Diagram
   f) Activity Diagram
   g) Deployment Diagram
4. Code Generation from UML Diagram
5. Testing
   a) Unit Testing
   b) Integration Testing

TOTAL: 90 PERIODS
REFERENCES

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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CP3261 PROFESSIONAL PRACTICES

UNIT I EVOLUTION OF IT ORGANIZATIONS
Governance Structure- Decentralized and Ad Hoc Governance – Centralized Governance
Offerings and revenues – Geography and niche products–Growth trajectory- Comprehend the roles and functions of supporting organizations (R&D, Innovation, Infrastructure, L&D,
Knowledge Management, Asset Creation).

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.

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UNIT I  INTRODUCTION  9
Need for Cyber security - History of Cyber security - Defining Cyberspace and Cyber security - Standards - CIA Triad – Cyber security Framework

UNIT II  ATTACKS AND COUNTERMEASURES  9

UNIT III  SECURING THE INFRASTRUCTURE  9
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  9
Local Host Security in the Real World - Securing Devices - Protecting the Inner Perimeter - Protecting Remote Access

UNIT V  TOOLS  9

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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SE3001 INFORMATION SECURITY  L T P C  3 0 0 3

UNIT I INTRODUCTION  9

UNIT II SECURITY INVESTIGATION  9

UNIT III RISK MANAGEMENT  9
Overview of Risk Management - Risk Identification and Assessment - Risk Control Strategies - Selecting a Risk Control Strategy - Quantitative Versus Qualitative Risk Control Practices - Integration of Risk Management in SDLC.

UNIT IV AUTHENTICATION AND AUTHORIZATION  9

UNIT V SECURITY TECHNOLOGY AND REAL WORLD SECURITY PROTOCOLS  9

TOTAL: 45 PERIODS

REFERENCES
COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Discuss the basics of information security
CO2: Illustrate the legal, ethical and professional issues in information security
CO3: Demonstrate the aspects of risk management.
CO4: Differentiate the functions of IDS and Firewall
CO5: Design and implementation of Security Techniques.

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SE3002 INTEGRATED SOFTWARE PROJECT MANAGEMENT   L T P C
3 0 0 3

UNIT I    PROJECT MANAGEMENT & COSTING     9
Software Project Management approaches – Project Acquisition – Initiation – Planning –
PERTExecution and Control – CPM – Change Management – Project Closure – Agile SPM
Problems in Software Estimation – Algorithmic Cost Estimation Process, Function Points,
COCOMO II (Constructive Cost Model) – Estimating Web Application Development – Concepts of
Finance, Activity Based Costing and Economic Value Added (EVA) – Balanced Score Card.

UNIT II   PROCESS MODELS & LIFECYCLE MANAGEMENT     9
Software Engineering Process Models - Adaptive Software Development (ASD) - DSDM - SCRUM
– Crystal -Feature Driven Development (FDD) - ISO 9000: 2000 - SPICE – SIX SIGMA – CMMI.
SLIM (Software Life cycle Management) – PLM (Product Lifecycle Management) – PDM (Product
Data Management) - PLM, PDM Applications – Pre-PLM Environment – Change Management.

UNIT III   RISK MANAGEMENT     9
Perspectives of Risk Management - Risk Definition – Risk Categories – Risk Assessment:
Approaches, techniques, and good practices – Risk Identification / Analysis / Prioritization – Risk
Control (Planning / Resolution / Monitoring) – Risk Retention – Risk Transfer - Failure Mode and
Effects Analysis (FMEA) – Operational Risks – Supply Chain Risk Management.

UNIT IV   METRICS     9
Need for Software Metrics – scope – basics – framework for software measurement -
Classification of Software Metrics: Product Metrics (Size Metrics, Complexity Metrics, Halstead’s
Product Metrics, Quality Metrics), and Process metrics (Empirical Models, Statistical Models,
Theory-based Models, Composite Models, and Reliability Models) – measuring internal and
external product attributes

26
UNIT V  PEOPLE MANAGEMENT  9
Leadership styles – Developing Leadership skills – Leadership assessment – Motivating People –
Organizational strategy – Management – Team building – Delegation – Art of Interviewing People -
Team Management – Rewarding - Client Relationship Management

TOTAL: 45 PERIODS

REFERENCES
1. Murali Chemuturi, Thomas M. Cagley : Mastering Software Project Management: Best
3. Antonio Borghesi, Barbara Gaudenzi: Risk Management: How to Assess, Transfer and
2012.

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Identify the various elements of the software management process framework
CO2: Use available open-source estimation tools for cost estimation
CO3: Identify existing risks and perform a risk assessment
CO4: Design a software metric for software project management
CO5: Modify the art of interviewing people for a given scenario.

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SE3003  SOFTWARE VERIFICATION AND VALIDATION  L T P C  3 0 0 3

UNIT I  INTRODUCTION  9
Principles Of Verification And Validation – Software Architecture Frameworks – Model Driven

UNIT II  SOFTWARE VERIFICATION  9
Verification and Validation Life Cycle – Traceability Analysis – Interface Analysis – Design and
Formal Proofs – Model Based Verification and Validation - Program Verification Techniques –
Formal Methods of Software Verification – Clean Room Methods.
UNIT III TESTING STRATEGIES

UNIT IV TOOLS

UNIT V ACCESSIBLE SOFTWARE VERIFICATION WITH DAFNY
Dafny: Language, Verifier, and IDEs - Verifying an Imperative Procedure - Integers - Ghost vs. Compiled - Stating and Proving a Lemma

REFERENCES

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Identify the different techniques for verification and validation.
CO2: Use available traceability analysis tools on sample requirements.
CO3: Modify existing coverage analysers in terms of functionality or features used.
CO4: Design system test cases.
CO5: Use test case generators and test management tools.

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UNIT I  AGENTS – OVERVIEW  
Agent Definition – Agent Programming Paradigms – Agent Vs Object – Aglet – Mobile Agents – Agent Frameworks – Agent Reasoning.

UNIT II  JAVA AGENTS  

UNIT III  MULTIAGENT SYSTEMS  

UNIT IV  INTELLIGENT SOFTWARE AGENTS  
Interface Agents – Agent Communication Languages – Agent Knowledge Representation – Agent Adaptability – Belief Desire Intension – Mobile Agent Applications – Introduction to Chat Bot

UNIT V  APPLICATION OF AGENTS  

TOTAL: 45 PERIODS

REFERENCES

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

CO1: Create / develop an agent based system for a particular task.
CO2: Design an application that uses different security issues for intelligent agents.
CO3: Effectively apply agent-based technologies in the development and application of distributed information systems that use software agents.
CO4: Interface agents through Agent communication languages.
CO5: Apply technologies for solving agent security issues.

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## UNIT I INTRODUCTION
Need for Sentiment Analysis – Problem of Sentiment Analysis - Subjectivity – Stance – Words to Discourse – Pragmatics – Natural Language Processing issues – Opinion Definition – Sentiment Analysis Tasks – Opinion Summarization – Types of Opinion – Subjectivity and Emotion – Author and Reader Standpoint

## UNIT II DOCUMENT SENTIMENT CLASSIFICATION
Sentiment Classification Using Supervised Learning – Unsupervised Learning – Rating Prediction – Cross-Domain Sentiment Classification – Cross-Language Sentiment Classification – Sentence Subjectivity and Classification – Subjectivity Classification – Sentence Sentiment Classification – Conditional Sentences - Sarcastic Sentences – Cross-Language Subjectivity and Sentiment Classification – Discourse Information for Sentiment Classification

## UNIT III ASPECT-BASED SENTIMENT ANALYSIS

## UNIT IV OPINION SUMMARIZATION

## UNIT V TOOLS FOR SENTIMENT ANALYSIS

### REFERENCES

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Apply the various algorithms to perform opinion mining and classification.
CO2: Learn various supervised and unsupervised machine learning methods for sentiment analysis.
CO3: Generate sentiment lexicons by applying NLP techniques.
CO4: Solve problems with opinion summarization.
CO5: Learn to use tools for sentiment analysis.

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SE3006 SOFTWARE TEST AUTOMATION L T P C

UNIT I INTRODUCTION
Automated Testing – Background on software testing – Automated test life cycle methodology (ATLM) – Test Maturity Model – Test Automation Development – Overcoming false expectations of automated testing – benefits – Test tool proposal

UNIT II TEST FRAMEWORK AND AUTOMATION
Automated Test Tool Evaluation and selection – Organization’s system engineering environment – tools that support the testing life cycle – Test Tool Research – Hands-on Tool evaluation -Test process analysis – Test tool consideration – Selecting the test automation approach - Test team management – Organization Structure of a Test Team – Test Program Tasks – Test Effort Sizing

UNIT III TEST PLANNING AND DESIGN

UNIT IV TESTING THE APPLICATIONS
UNIT V  CASE STUDIES

TOTAL: 45 PERIODS

REFERENCES

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

CO1: Identify the different test tools.
CO2: Use available testing tools to test some software applications.
CO3: Modify existing test metrics based on functionality or features used.
CO4: Design test cases and execute them.
CO5: Implement test scripts for automating test execution.

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SE3007  SOFTWARE ENGINEERING ECONOMICS

UNIT I  INTRODUCTION

UNIT II  LIFE CYCLE ECONOMICS
UNIT III  RISK AND UNCERTAINTY  10

UNIT IV  ECONOMIC ANALYSIS METHODS  11
For-Profit Decision Analysis - Minimum Acceptable Rate of Return - Return on Investment - Return on Capital Employed - Cost-Benefit Analysis - Cost-Effectiveness Analysis - Break-Even Analysis

UNIT V  PRACTICAL CONSIDERATIONS  8
The “Good Enough” Principle - Friction-Free Economy – Ecosystems - Offshoring and Outsourcing

TOTAL: 45 PERIODS

REFERENCES

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Understand and be able to apply the key software engineering economic fundamentals to real-world software economic issues.
CO2: Illustrate through example the key software life cycle economics, including product and process life cycles; portfolios; proposals; investment decisions; pricing and costing, and earned value management (EVM).
CO3: Apply the concepts of risk and uncertainty to real-world software development projects, including goals; estimates; prioritization and decision making.
CO4: Perform best-practice economic analysis methods.
CO5: Relate and interpret the “good-enough” principle; friction-free economy; ecosystems and outsourcing.

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SE3053  SOFTWARE SECURITY  L T P C  3 0 0 3

UNIT I  LOW-LEVEL ATTACKS  9
Need for Software Security – Memory-Based Attacks – Low-Level Attacks Against Heap And Stack - Stack Smashing – Buffer Overflow – Code Injection - Format String Attacks – ROP (Return
Oriented Programming) – Defense against Memory-Based Attacks – Stack Canaries – Non-Executable Data - Address Space Layout Randomization (ASLR)- Memory-Safety Enforcement - Control-Flow Integrity (CFI) – Randomization

UNIT II  WEB SECURITY AND SECURE DESIGN
9

UNIT III  SECURITY RISK MANAGEMENT
9

UNIT IV  SECURITY TESTING
9

UNIT V  PENETRATION TESTING
9

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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SE3054 SOFTWARE TESTING AND QUALITY ASSURANCE  L T P C 3 0 0 3

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

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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SE3052 SOFTWARE RELIABILITY METRICS AND MODELS L T P C

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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SE3051 FORMAL METHODS IN SOFTWARE SYSTEMS L T P C


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.

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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CP3056   CLOUD COMPUTING TECHNOLOGIES         L T P C
3 0 2 4

UNIT I   DISTRIBUTED SYSTEMS AND ENABLING TECHNOLOGIES 9

UNIT II   VIRTUALIZATION 9
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 9
UNIT IV     EXPLORING CLOUD PLATFORMS AND SERVICES     9
Compute Services – Storage Services – Database Services – Application Services – Content
Delivery Services – Analytics Services – Deployment and Management Services – Identity and
Access Management Services – Open Source Private Cloud Softwares.

UNIT V     SECURITY AND INTER-CLOUD     9
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     30
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.
11. Mini Project

TOTAL: 75 PERIODS

REFERENCES
Parallel Processing to the Internet of Things”, Morgan Kauffman imprint of Elsevier, 2012.

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
3 0 0 3

UNIT I INTRODUCTION TO HACKING 9

UNIT II INFORMATION SECURITY 9
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 -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
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UNIT I FUNDAMENTALS OF IMAGE PROCESSING 9+6

UNIT II IMAGE ENHANCEMENT AND RESTORATION 9+6

UNIT III IMAGE SEGMENTATION AND MORPHOLOGY 9+6
Detection of Discontinuities – Edge operators- Edge Linking and Boundary Detection – Thresholding – Region Based Segmentation – Motion Segmentation- Binary and Gray level morphology operations – Erosion, Dilation, Opening and Closing Operations Distance Transforms

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

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

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

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 unforugatility under chosen message attacks, Schnor signature scheme. Zero Knowledge Proofs and Protocols,

TOTAL: 45 PERIODS

REFERENCES

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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**CP3068  INTERNET OF THINGS  9+6**

**UNIT I  ARCHITECTURES AND MODELS**

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

**UNIT III  SYSTEM DEVELOPMENT**
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**

**UNIT V  IoT IN INDUSTRY**

**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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CP3060 DEEP LEARNING L T P C
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UNIT I BASICS FOR DEEP LEARNING
UNIT II  INTRODUCTION TO DEEP LEARNING  9

UNIT III  CONVOLUTIONAL NEURAL NETWORKS  9

UNIT IV  SEQUENCE MODELING USING RECURRENT NETS  9
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  9

PRACTICAL EXERCISES  30
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
14  Build a Deep Learning model to evaluate energy efficiency in IoT devices.

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


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 web content.
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
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UNIT I THE QUEST FOR SEMANTICS
UNIT II LANGUAGES FOR SEMANTIC WEB AND ONTOLOGIES

UNIT III ONTOLOGY LEARNING FOR SEMANTIC WEB

UNIT IV ONTOLOGY MANAGEMENT AND TOOL

UNIT V APPLICATIONS

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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CP3070 MOBILE APPLICATION DEVELOPMENT L T P C
3 0 0 3

UNIT I INTRODUCTION

UNIT II USER INTERFACE DESIGN

UNIT III DATA PERSISTENCE
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
Intent Service – Remote service – Service handlers – communication between service and Activity – BroadcastReceiver: Local BroadcastManager, Dynamic BroadcastReceiver – System Broadcast – Pending Intent, Notifications – Packaging and deployment

UNIT V ANDROID APPLICATION DEVELOPMENT
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  L T P C
3 0 2 4

UNIT I  INTRODUCTION  9

UNIT II  FOUNDATIONS  9

UNIT III  WEB3 AND HYPERLEDGER  9

UNIT IV  SMART CONTRACTS & ETHEREUM  9
Smart Contracts - Definition - Recardian contracts - Ethereum blockchain - Ethereum network - Components of Ethereum ecosystem - Programming languages - Ethereum development environment - Non-Fungible Token (NFT).

UNIT V  ALTERNATIVE BLOCKCHAINS AND APPLICATIONS  9

PRACTICAL EXERCISES  30
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
L T P C 3 0 0 3

UNIT I MULTIMEDIA ELEMENTS

UNIT II MULTIMEDIA TOOLS and AUTHORING

Attested

52
UNIT III  MULTIMEDIA COMPRESSION  

UNIT IV  MULTIMEDIA COMMUNICATION SYSTEMS  

UNIT V  MULTIMEDIA APPLICATIONS  
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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Attested

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

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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 9

UNIT II SIMILAR ITEMS 9

UNIT III MINING DATA STREAMS 9
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.

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CP3072 PARALLEL ALGORITHMS

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UNIT I INTRODUCTION

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

UNIT III SORTING & SEARCHING
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

UNIT V GRAPH ALGORITHMS

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
3 0 0 3

UNIT I SOFT COMPUTING AND FUZZY COMPUTING 9

UNIT II FUNDAMENTALS OF NEURAL NETWORKS 9

UNIT III BACK PROPAGATION NETWORKS AND COMPETITIVE NEURAL NETWORKS 9
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.

TOTAL: 45 PERIODS

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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UNIT I Introduction

UNIT II Games with Perfect Information
Games with Perfect Information – Strategic games – prisoner’s dilemma, matching pennies - Nash equilibria - 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

UNIT II MOBILITY MODELS AND OVERHEAD CONTROL MECHANISMS IN MANETS
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)

60
UNIT IV MANAGEMENT AND PERFORMANCE

UNIT V SECURITY IN ADHOC AND SENSOR NETWORKS

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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UNIT I  INTRODUCTION TO VIRTUALIZATION  9

UNIT II  VIRTUAL MACHINES-IMPLEMENTATION AND EMULATION  9

UNIT III  HIGH LEVEL LANGUAGE VIRTUAL MACHINE ARCHITECTURE AND IMPLEMENTATION  9

UNIT IV  NETWORK AND STORAGE VIRTUALIZATION  9

UNIT V  CLOUD AND VM APPLICATIONS  9
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 L T P C 3 0 0 3

UNIT I FUNDAMENTALS OF DATABASE ADMINISTRATION 9

UNIT II DATABASE SECURITY, BACKUP AND RECOVERY 9
Backups - Full vs. Incremental Backups - Database Objects and Backups-Concurrent Access Issues - Backup Consistency - Log Archiving and Backup.

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

TOTAL: 45 PERIODS

REFERENCES

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
3 0 0 3

UNIT I INTRODUCTION TO DATA WAREHOUSING

UNIT II DATA WAREHOUSE PROCESS AND ARCHITECTURE

UNIT III INTRODUCTION TO DATA MINING
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
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 divisible 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

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  L T P C 3 0 0 3

UNIT I  INTRODUCTION
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

UNIT III DETECTING AND MINING COMMUNITIES

UNIT IV VISUALIZATION OF SOCIAL NETWORKS

UNIT V APPLICATIONS

TOTAL: 45 PERIODS

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

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CP3079 USER INTERFACE DESIGN

UNIT I INTRODUCTION 9

UNIT II INTERACTION DESIGN 9

UNIT III ADVANCED INTERACTION DESIGN 9
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 9

UNIT V FORMAL MODELS, TOOLS, CASE STUDIES 9
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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CP3081 VISUALIZATION TECHNIQUES

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

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**


**UNIT IV**

**PYTHON LIBRARIES FOR DATA WRANGLING**


**UNIT V**

**DATA VISUALIZATION**


**TOTAL: 45 PERIODS**

**REFERENCES**

4. Matthew O. Ward, George Grinstein, Daniel Keim, “Interactive Data Visualization:

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 9

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
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

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  L T P C
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UNIT I  AGILE METHODOLOGY
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
UNIT I  MORPHOLOGY AND PART-OF SPEECH PROCESSING

UNIT II  SPEECH PROCESSING

UNIT III  SYNTAX ANALYSIS

UNIT IV  SEMANTIC AND PRAGMATIC INTERPRETATION
UNIT V APPLICATIONS


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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UNIT I QUANTUM MECHANICS AND QUANTUM COMPUTATION 9

UNIT II QUANTUM COMPUTERS AND ALGORITHMS 9
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 9
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 9

UNIT V ENTROPY AND INFORMATION THEORY 9
Entropy : Shannon Entropy, Basic properties of entropy, Von Neumann entropy, Strong subadditivity, 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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**CP3066**  
**GPU COMPUTING**  
**L T P C**  
**3 0 0 3**

**UNIT I GPU ARCHITECTURE**

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

**UNIT III PROGRAMMING ISSUES**

**UNIT IV OPENCL BASICS**

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

**TOTAL: 45 PERIODS**

**REFERENCES**
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
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UNIT I INTRODUCTION TO DEVOPS 9

UNIT II SECURITY IN DEVOPS 9

UNIT III INTRODUCTION TO MICROSERVICES 9
Microservices – Reasons for using Microservices – 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.

TOTAL: 45 PERIODS
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.

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

TOTAL: 75 PERIODS
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 BIOINFORMATICS  L T P C
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UNIT I  INTRODUCTION
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 DATA MINING IN BIOINFORMATICS
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  GRAPHS

UNIT IV  PHYLOGENETICS AND MODELS OF EVOLUTION
Introduction to Phylogenetics, Jukes Cantor and Kimura Models of Evolution, Distance and Character based methods for phylogenetic tree construction: Unweighted Pair Group Method of Arithmetic Averages, Neighbour joining Trees, Maximum Likelihood Trees, Ultra metric and Min ultra metric trees, Parsimonious trees, Additive trees, Assessing there liability of phylogenetic trees-Bootstrapping.

UNIT V  MICROARRAY ANALYSIS
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 phylogenetics tree construction and its evolutions

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CP3069 MIXED REALITY 3 0 0 3

UNIT I INTRODUCTION
UNIT II  
MR COMPUTING ARCHITECTURE

UNIT III  
MR MODELING

UNIT IV  
MR PROGRAMMING

UNIT V  
APPLICATIONS

TOTAL: 45 PERIODS

REFERENCES

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 3 0 0 3

UNIT I CYBER-PHYSICAL SYSTEMS

UNIT II CPS - FEEDBACK SYSTEMS

UNIT III CPS - HITL

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.

TOTAL: 45 PERIODS

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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