

ACADEMIC YEAR (2022-2023)



J.K.K.MUNIRAJAH COLLEGE OF TECHNOLOGY
T.N.Palayam(po),Gobi(tk)-638506, Erode(dt).

**Metric
No 1.3.2**

S.No	Name of the course	course code	programme offering	Experiential learning			Number of students
				project work	field work	inplant training	
(2022-2023) Regulation-2021							
1	Advanced Data Structures and Algorithms	CP4151	MASTER OF COMPUTER SCIENCE AND ENGINEERING	✓			4
2	Database Practices	CP4152	MASTER OF COMPUTER SCIENCE AND ENGINEERING	✓			6
3	Network Technologies	CP4153	MASTER OF COMPUTER SCIENCE AND ENGINEERING	✓			5
4	Internet of Things	CP4291	MASTER OF COMPUTER SCIENCE AND ENGINEERING	✓			5
5	Machine Learning	CP4252	MASTER OF COMPUTER SCIENCE AND ENGINEERING	✓			6
6	Advanced Software Engineering	SE4151	MASTER OF COMPUTER SCIENCE AND ENGINEERING	✓			5
7	Security Practices	CP4391	MASTER OF COMPUTER SCIENCE AND ENGINEERING	✓			4
8	Project Work I	CP4311	MASTER OF COMPUTER SCIENCE AND ENGINEERING	✓			9
9	Project Work II	CP4411	MASTER OF COMPUTER SCIENCE AND ENGINEERING	✓			9
10	Cloud Computing Technologies	MP4251	MASTER OF COMPUTER SCIENCE AND ENGINEERING	✓			6

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COURSE OBJECTIVES:

- To learn the core fundamentals of system and web security concepts
- To have thorough understanding in these security concepts related to networks
- To deploy these security essentials in IT Sector
- To be exposed to the concepts of Cyber Security and cloud security
- To perform a detailed study of Privacy and Storage security and related issues

UNIT I SYSTEM SECURITY 9

Model of network security – Security attacks, services and mechanisms – OSI security architecture - A Cryptography primer- Intrusion detection system- Intrusion Prevention system - Security web applications-Case study:OWASP-Top10WebApplicationSecurityRisks.

UNIT II NETWORK SECURITY 9

Internet Security - Intranet security- Local Area Network Security - Wireless Network Security - Wireless Sensor Network Security- Cellular Network Security - Mobile security - IOT security - Case Study - Kali Linux.

UNIT III SECURITY MANAGEMENT 9

Information security essentials for IT Managers- Security Management System - Policy Driven System Management- IT Security - Online Identity and User Management System. Case study: Metasploit

UNIT IV CYBER SECURITY AND CLOUD SECURITY 9

Cyber Forensics- Disk Forensics – Network Forensics – Wireless Forensics – Database Forensics – Malware Forensics–Mobile Forensics–Email Forensics-Best security practices for automate Cloud infrastructure management – Establishing trust in IaaS, PaaS, and SaaS Cloud types. Case study: DVWA

UNIT V PRIVACY AND STORAGE SECURITY 9

Privacy on the Internet - Privacy Enhancing Technologies - Personal privacy Policies - Detection of Conflicts in security policies- privacy and security in environment monitoring systems. Storage Area Network Security - Storage Area Network Security Devices - Risk management - Physical Security Essentials.

COURSE OUTCOMES:

- CO1:** Understand the core fundamentals of system security
CO2: Apply these security concepts to wired and wireless networks
CO3: Implement and Manage these security essentials in IT Sector
CO4: Explain the concepts of Cyber Security and Cyber forensics
CO5: Be aware of Privacy and Storage security Issues.

TOTAL: 45 PERIODS**REFERENCES**

1. John R. Vacca, Computer and Information Security Handbook, Third Edition, Elsevier 2017
2. Michael E. Whitman, Herbert J. Mattord, Principles of Information Security, Seventh Edition, Cengage Learning, 2022

3. Richard E. Smith, Elementary Information Security, Third Edition, Jones and Bartlett Learning, 2019
4. Mayor, K.K. Mookhey, Jacopo Cervini, Fairuzan Roslan, Kevin Beaver, Metasploit Toolkit for Penetration Testing, Exploit Development and Vulnerability Research, Syngress publications, Elsevier, 2007. ISBN : 978-1-59749-074-0
5. John Sammons, "The Basics of Digital Forensics - The Primer for Getting Started in Digital Forensics", Syngress, 2012
6. Cory Altheide and Harlan Carvey, "Digital Forensics with Open Source Tools", 2011 Syngress, ISBN: 9781597495875.
7. Siani Pearson, George Yee "Privacy and Security for Cloud Computing" Computer Communications and Networks, Springer, 2013.



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COURSE OBJECTIVES:

- To gain expertise in Virtualization, Virtual Machines and deploy practical virtualization solution
- To understand the architecture, infrastructure and delivery models of cloud computing.
- To explore the roster of AWS services and illustrate the way to make applications in AWS
- To gain knowledge in the working of Windows Azure and Storage services offered by Windows Azure
- To develop the cloud application using various programming models of Hadoop and Aneka

UNIT I VIRTUALIZATION AND VIRTUALIZATION INFRASTRUCTURE 6

Basics of Virtual Machines - Process Virtual Machines – System Virtual Machines – Emulation – Interpretation – Binary Translation - Taxonomy of Virtual Machines. Virtualization – Management Virtualization – Hardware Maximization – Architectures – Virtualization Management – Storage Virtualization – Network Virtualization – Implementation levels of virtualization – virtualization structure – virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management – Virtualization for data center automation

UNIT II CLOUD PLATFORM ARCHITECTURE 12

Cloud Computing: Definition, Characteristics - Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything as a service: Infrastructure, platform, software - A Generic Cloud Architecture Design – Layered cloud Architectural Development – Architectural Design Challenges

UNIT III AWS CLOUD PLATFORM - IAAS 9

Amazon Web Services: AWS Infrastructure - AWS API - AWS Management Console - Setting up AWS Storage - Stretching out with Elastic Compute Cloud - Elastic Container Service for Kubernetes - AWS Developer Tools: AWS Code Commit, AWS Code Build, AWS Code Deploy, AWS Code Pipeline, AWS Code Star - AWS Management Tools: Cloud Watch, AWS Auto Scaling, AWS Control Tower, Cloud Formation, Cloud Trail, AWS License Manager

UNIT IV PAAS CLOUD PLATFORM 9

Windows Azure: Origin of Windows Azure, Features, The Fabric Controller – First Cloud APP in Windows Azure - Service Model and Managing Services: Definition and Configuration, Service runtime API - Windows Azure Developer Portal - Service Management API - Windows Azure Storage Characteristics - Storage Services - REST API - Blobs

UNIT V PROGRAMMING MODEL 9

Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job – Developing Map Reduce Applications - Design of Hadoop file system – Setting up Hadoop Cluster - Aneka: Cloud Application Platform, Thread Programming, Task Programming and Map-Reduce Programming in Aneka

COURSE OUTCOMES:

- CO1:** Employ the concepts of virtualization in the cloud computing
- CO2:** Identify the architecture, infrastructure and delivery models of cloud computing
- CO3:** Develop the Cloud Application in AWS platform
- CO4:** Apply the concepts of Windows Azure to design Cloud Application
- CO5:** Develop services using various Cloud computing programming models.

TOTAL: 45 PERIODS

REFERENCES

1. Bernard Golden, Amazon Web Service for Dummies, John Wiley & Sons, 2013.
2. Raoul Alongi, AWS: The Most Complete Guide to Amazon Web Service from Beginner to Advanced Level, Amazon Asia-Pacific Holdings Private Limited, 2019.
3. Sriram Krishnan, Programming: Windows Azure, O'Reilly, 2010.
4. Rajkumar Buyya, Christian Vacchiola, S. Thamarai Selvi, Mastering Cloud Computing, McGraw Hill Education (India) Pvt. Ltd., 2013.
5. Danielle Ruest, Nelson Ruest, —Virtualization: A Beginner's Guide, McGraw-Hill Osborne Media, 2009.
6. Jim Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
7. John W. Rittinghouse and James F. Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010
8. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.
9. Tom White, "Hadoop: The Definitive Guide", Yahoo Press, 2012.

COURSE OUTCOMES:

- CO1:** Identify various concepts of mobile programming that make it unique from programming for other platforms
- CO2:** Create, test and debug Android application by setting up Android development
- CO3:** Demonstrate methods in storing, sharing and retrieving data in Android applications
- CO4:** Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces
- CO5:** Create interactive applications in Android using databases with multiple activities including audio, video and notifications and deploy them in marketplace

TOTAL: 75 PERIODS

REFERENCES

1. Lauren Darcey and Shane Conder, "Android Wireless Application Development", Pearson Education, 2nd ed. (2011)
2. Google Developer Training, "Android Developer Fundamentals Course—Concept Reference", Google Developer Training Team, 2017.
3. Prasanth Kumar Pattnaik, Rajib Mall, "Fundamentals of Mobile Computing", PHI Learning Pvt. Ltd, New Delhi-2012
4. Reto Meier, "Professional Android 2 Application Development", Wiley India Pvt Ltd, 2010
5. Mark L. Murphy, "Beginning Android", Wiley India Pvt Ltd, 2009
6. Dawn Griffiths and David Griffiths, "Head First Android Development", 1st Edition, O'Reilly SPD Publishers, 2015. ISBN-13: 978-9352131341

7. Erik Hellman, "Android Programming—Pushing the Limits", 1st Edition, Wiley India Pvt Ltd, 2014. ISBN-13: 978-8126547197.
8. Bill Phillips, Chris Stewart and Kristin Marsicano, "Android Programming: The Big Nerd Ranch Guide", 4th Edition, Big Nerd Ranch Guides, 2019. ISBN-13: 978-0134706054



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CP4151

ADVANCED DATA STRUCTURES AND ALGORITHMS

LTPC
3003

COURSE OBJECTIVES:

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

UNIT I ROLE OF ALGORITHMS IN COMPUTING & COMPLEXITY ANALYSIS 9

Algorithms – Algorithms as a Technology -Time and Space complexity of algorithms- Asymptotic analysis- Average and worst-case analysis-Asymptotic notation-Importance of efficient algorithms- Program performance measurement - Recurrences: The Substitution Method – The Recursion-Tree Method-Data structures and algorithms.

UNIT II HIERARCHICAL DATA STRUCTURES 9

Binary Search Trees: Basics – Querying a Binary search tree – Insertion and Deletion- Red Black trees: Properties of Red-Black Trees – Rotations – Insertion – Deletion - B-Trees: Definition of B-trees – Basic operations on B-Trees – Deleting a key from a B-Tree-Heap – Heap Implementation – Disjoint Sets - Fibonacci Heaps: structure – Mergeable-heap operations- Decreasing a key and deleting a node- Bounding the maximum degree.

UNIT III GRAPHS 9

Elementary Graph Algorithms: Representations of Graphs – Breadth-First Search – Depth-First Search – Topological Sort – Strongly Connected Components- Minimum Spanning Trees: Growing a Minimum Spanning Tree – Kruskal and Prim- Single-Source Shortest Paths: The Bellman-Ford algorithm – Single-Source Shortest paths in Directed Acyclic Graphs – Dijkstra's Algorithm; Dynamic Programming - All-Pairs Shortest Paths: Shortest Paths and Matrix Multiplication – The Floyd-Warshall Algorithm

UNIT IV ALGORITHM DESIGN TECHNIQUES 9

Dynamic Programming: Matrix-Chain Multiplication – Elements of Dynamic Programming – Longest Common Subsequence- Greedy Algorithms: – Elements of the Greedy Strategy- An Activity-Selection Problem - Huffman Coding.

UNIT V NP COMPLETE AND NP HARD 9

NP-Completeness: Polynomial Time – Polynomial-Time Verification – NP-Completeness and Reducibility – NP-Completeness Proofs – NP-Complete Problems.

TOTAL: 45 PERIODS

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SUGGESTED ACTIVITIES:

1. Write an algorithm for Towers of Hanoi problem using recursion and analyze the complexity (No of disc-4)
2. Write any one real time application of hierarchical data structure
3. Write a program to implement Make_Set, Find_Set and Union functions for Disjoint Set Data Structure for a given undirected graph $G(V,E)$ using the linked list representation with simple implementation of Union operation
4. Find the minimum cost to reach last cell of the matrix from its first cell
5. Discuss about any NP completeness problem

COURSE OUTCOMES:

CO1: Design data structures and algorithms to solve computing problems.


CO2: Choose and implement efficient data structures and apply them to solve problems. **CO3:** Design algorithms using graph structure and various string-matching algorithms to solve real-life problems.

CO4: Design one's own algorithm for an unknown problem.

CO5: Apply suitable design strategy for problem solving.

REFERENCES

1. S. Sridhar, "Design and Analysis of Algorithms", Oxford University Press, 1st Edition, 2014.
2. Adam Drozdex, "Data Structures and Algorithms in C++", Cengage Learning, 4th Edition, 2013.
3. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, "Introduction to Algorithms", Prentice Hall of India, 3rd Edition, 2012.
4. Mark Allen Weiss, "Data Structures and Algorithms in C++", Pearson Education, 3rd Edition, 2009.
5. E. Horowitz, S. Sahni and S. Rajasekaran, "Fundamentals of Computer Algorithms", University Press, 2nd Edition, 2008.
6. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, Reprint 2006.


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COURSE OBJECTIVES

- Describe the fundamental elements of relational database management systems
- Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL.
- Understand query processing in a distributed database system
- Understand the basics of XML and create well-formed and valid XML documents.
- Distinguish the different types of NoSQL databases
- To understand the different models involved in database security and their applications in real time world to protect the database and information associated with them.

UNIT I RELATIONAL DATA MODEL

15

Entity Relationship Model – Relational Data Model – Mapping Entity Relationship Model to Relational Model – Relational Algebra – Structured Query Language – Database Normalization.

Suggested Activities:

Data Definition Language

- Create, Alter and Drop
- Enforce Primary Key, Foreign Key, Check, Unique and Not Null Constraints
- Creating Views

Data Manipulation Language

- Insert, Delete, Update
- Cartesian Product, Equi Join, Left Outer Join, Right Outer Join and Full Outer Join
- Aggregate Functions
- Set Operations
- Nested

Queries

Transaction Control Language

Language

- Commit, Rollback and Save Points

UNIT II DISTRIBUTED DATABASES, ACTIVE DATABASES AND OPEN DATABASE CONNECTIVITY

15

Distributed Database Architecture – Distributed Data Storage – Distributed Transactions – Distributed Query Processing – Distributed Transaction Management – Event Condition Action Model – Design and Implementation Issues for Active Databases – Open Database Connectivity.

Suggested Activities:

- Distributed Database Design and Implementation
- Row Level and Statement Level Triggers
- Accessing a Relational Database using PHP, Python and R

UNIT III XML DATABASES

15

Structured, Semistructured, and Unstructured Data—XML Hierarchical Data Model—XML Documents—DocumentTypeDefinition—XMLSchema—XMLDocumentsandDatabases— XMLQuerying—XPath—XQuery

SuggestedActivities:

- Creating XML Documents, Document Type Definition and XML Schema
- Using a Relational Database to store the XML documents as text
- Using a Relational Database to store the XML documents as data elements
- Creating or publishing customized XML documents from pre-existing relational databases
- Extracting XML Documents from Relational Databases
- XML Querying

UNITIV NOSQL DATABASES AND BIG DATA STORAGE SYSTEMS

15

NoSQL—Categories of NoSQL Systems—CAP Theorem—Document-Based NoSQL Systems and MongoDB – MongoDB Data Model – MongoDB Distributed Systems Characteristics – NoSQL Key-Value Stores – DynamoDB Overview – Voldemort Key-Value Distributed Data Store – Wide Column NoSQL Systems—Hbase Data Model—Hbase Crud Operations—Hbase Storage and Distributed System Concepts –NoSQL Graph Databases and Neo4j – Cypher Query Language of Neo4j—Big Data—MapReduce—Hadoop—YARN.

SuggestedActivities:

- Creating Databases using MongoDB, DynamoDB, Voldemort Key-Value Distributed Data Store Hbase and Neo4j. Writing simple queries to access databases created using MongoDB, DynamoDB, Voldemort Key-Value Distributed Data Store Hbase and Neo4j.

UNITV DATABASE SECURITY

15

Database Security Issues—Discretionary Access Control Based on Granting and Revoking Privileges –Mandatory Access Control and Role-Based Access Control for Multilevel Security – SQL Injection—Statistical Database Security—Flow Control—Encryption and Public Key Infrastructures—Preserving Data Privacy—Challenges to Maintaining Database Security— Database Survivability – Oracle Label-Based Security.

SuggestedActivities:

Implementing Access Control in Relational Databases

TOTAL: 75 PERIODS

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1: Convert the ER-model to relational tables, populate relational databases and formulate SQL queries on data.

CO2: Understand and write well-formed XML documents

CO3: Be able to apply methods and techniques for distributed query processing.

CO4: Design and implement secured database systems.

CO5: Use the data control, definition, and manipulation languages of the NoSQL databases

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REFERENCES:

1. R. Elmasri, S.B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education 2016.
2. Henry F. Korth, Abraham Silberschatz, S. Sudharshan, "Database System Concepts", Seventh Edition, McGraw Hill, 2019.
3. C.J. Date, A. Kannan, S. Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006
4. Raghu Ramakrishnan, Johannes Gehrke
"Database Management Systems", Fourth Edition, McGraw Hill Education, 2015.
5. Harrison, Guy, "Next Generation Databases, NoSQL and Big Data", First Edition, Apress publishers, 2015
6. Thomas Cannolly and Carolyn Begg, "Database Systems, A Practical Approach to Design, Implementation and Management", Sixth Edition, Pearson Education, 2015



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CP4153

NETWORK TECHNOLOGIES

LTPC
3003

COURSE OBJECTIVES:

- To understand the basic concepts of networks
- To explore various technologies in the wireless domain
- To study about 4G and 5G cellular networks
- To learn about Network Function Virtualization
- To understand the paradigm of Software defined networks

UNIT I NETWORKING CONCEPTS 9

Peer To Peer Vs Client-Server Networks. Network Devices. Network Terminology. Network Speeds. Network throughput, delay. Osi Model. Packets, Frames, And Headers. Collision And Broadcast Domains. LAN Vs WAN. Network Adapter. Hub. Switch. Router. Firewall, IP addressing.

UNIT II WIRELESS NETWORKS 9

Wireless access techniques- IEEE 802.11a, 802.11g, 802.11e, 802.11n/ac/ax/ay/ba/be, QoS – Bluetooth – Protocol Stack – Security – Profiles – zigbee

UNIT III MOBILE DATA NETWORKS 9

4G Networks and Composite Radio Environment – Protocol Boosters – Hybrid 4G Wireless Networks Protocols – Green Wireless Networks – Physical Layer and Multiple Access – Channel Modelling for 4G – Concepts of 5G – channel access – air interface – Cognitive Radio spectrum management – C-RAN architecture - Vehicular communications-protocol – Network slicing – MIMO, mmWave, Introduction to 6G.

UNIT IV SOFTWARE DEFINED NETWORKS 9

SDN Architecture. Characteristics of Software-Defined Networking. SDN- and NFV-Related Standards. SDN Data Plane. Data Plane Functions. Data Plane Protocols. OpenFlow Logical Network Device. Flow Table Structure. Flow Table Pipeline. The Use of Multiple Tables. Group Table. OpenFlow Protocol. SDN Control Plane Architecture. Control Plane Functions. Southbound Interface. Northbound Interface. Routing. ITU-T Model. OpenDaylight. OpenDaylight Architecture. OpenDaylight Helium. SDN Application Plane Architecture. Northbound Interface. Network Services Abstraction Layer. Network Applications. User Interface.

UNIT V NETWORK FUNCTIONS VIRTUALIZATION 9

Motivation-Virtual Machines –NFV benefits-requirements–architecture- NFV Infrastructure - Virtualized Network Functions-NFV Management and Orchestration-NFV Use Cases-NFV and SDN–Network virtualization –VLAN and VPN

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TOTAL:45 PERIODS

COURSE OUTCOMES:

CO1: Explain basic networking concepts

CO2: Compare different wireless networking protocols

CO3: Describe the developments in each generation of mobile data networks CO4:

Explain and develop SDN based applications

CO5: Explain the concepts of network function virtualization

SUGGESTED ACTIVITIES:

1. Execute various network utilities such as traceroute, pathping, ipconfig
2. Implement the Software Defined Networking using Mininet
3. Implement routing in Mininet
4. Install a virtual machine and study network virtualization
5. Simulate various network topologies in Network Simulator

REFERENCES

1. James Bernstein, "Networking made Easy", 2018. (UNIT1)
2. Houda Labiod, Costantinode Santis, Hossam Afifi "Wi-Fi, Bluetooth, Zigbee and WiMax", Springer 2007 (UNIT2)
3. Erik Dahlman, Stefan Parkvall, Johan Skold, 4G: LTE/LTE-Advanced for Mobile Broadband, Academic Press, 2013 (UNIT3)



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COURSE OBJECTIVES:

- To Understand the Architectural Overview of IoT
- To Understand the IoT Reference Architecture and Real World Design Constraints
- To Understand the various IoT levels
- To understand the basics of cloud architecture
- To gain experience in Raspberry Pi and experiments simple IoT application on it

UNIT I INTRODUCTION

9+6

Internet of Things- Domain Specific IoTs - IoT and M2M-Sensors for IoT Applications-Structure of IoT-IoT Map Device-IoT System Management with NETCONF-YANG

UNIT II IOT ARCHITECTURE, GENERATIONS AND PROTOCOLS

9+6

IETF architecture for IoT - IoT reference architecture -First Generation-Description & Characteristics-Advanced Generation - Description & Characteristics-Integrated IoT Sensors - Description & Characteristics

UNIT III IOT PROTOCOLS AND TECHNOLOGY

9+6

SCADA and RFID Protocols-BACnet Protocol-Zigbee Architecture-6LowPAN-CoAP-Wireless Sensor Structure-Energy Storage Module-Power Management Module-RF Module-Sensing Module

UNIT IV CLOUD ARCHITECTURE BASICS

9+6

The Cloud types; IaaS, PaaS, SaaS.-Development environments for service development; Amazon, Azure, Google App cloud platform in industry

UNIT V IOT PROJECTS ON RASPBERRY PI

9+6

Building IOT with RASPBERRY PI- Creating the sensor project - Preparing Raspberry Pi - Clayster libraries-Hardware Interacting with the hardware -Interfacing the hardware-Internal representation of sensor values - Persisting data - External representation of sensor values - Exporting sensor data

SUGGESTED ACTIVITIES:

1. Develop an application for LED Blink and Pattern using Arduino or Raspberry Pi
2. Develop an application for LED Pattern with Push Button Control using Arduino or Raspberry Pi
3. Develop an application for LM35 Temperature Sensor to display temperature values using arduino or Raspberry Pi
4. Develop an application for Forest fire detection end node using Raspberry Pi device and sensor
5. Develop an application for home intrusion detection web application
6. Develop an application for Smart parking application using python and Django for web application




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COURSE OUTCOMES:

- CO1:** Understand the various concepts of the IoT and their technologies
CO2: Develop the IoT application using different hardware platforms
CO3: Implement the various IoT Protocols
CO4: Understand the basic principles of cloud computing
CO5: Develop and deploy the IoT application into a cloud environment

TOTAL: 75 PERIODS**REFERENCES:**

1. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A hands-on approach, Universities Press, 2015
2. Dieter Uckelmann, Mark Harrison, Florian Michahelles (Eds), Architecting the Internet of Things, Springer, 2011
3. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015
4. Ovidiu Vermesan, Peter Friess, 'Internet of Things—From Research and Innovation to Market Deployment', River Publishers, 2014
5. N. Ida, Sensors, Actuators and Their Interfaces: A Multidisciplinary Introduction, 2nd Edition Scitech Publishers, 202014
6. Reese, G. (2009). Cloud Application Architectures: Building Applications and Infrastructure in the Cloud. Sebastopol, CA: O'Reilly Media, Inc. (2009)



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COURSE OBJECTIVES:

- To understand the concepts and mathematical foundations of machine learning and types of problems tackled by machine learning
- To explore the different supervised learning techniques including ensemble methods
- To learn different aspects of unsupervised learning and reinforcement learning
- To learn the role of probabilistic methods for machine learning
- To understand the basic concepts of neural networks and deep learning

UNIT I INTRODUCTION AND MATHEMATICAL FOUNDATIONS 9

What is Machine Learning? Need—History—Definitions—Applications-Advantages, Disadvantages & Challenges-Types of Machine Learning Problems—Mathematical Foundations- Linear Algebra & Analytical Geometry -Probability and Statistics- Bayesian Conditional Probability- Vector Calculus & Optimization-Decision Theory-Information theory

UNIT II SUPERVISED LEARNING 9

Introduction-Discriminative and Generative Models-Linear Regression-Least Squares-Under-fitting /Overfitting -Cross-Validation—Lasso Regression-Classification -Logistic Regression-Gradient Linear Models -Support Vector Machines -Kernel Methods -Instance based Methods - K-Nearest Neighbors - Tree based Methods -Decision Trees -ID3—CART - Ensemble Methods -Random Forest-Evaluation of Classification Algorithms

UNIT III UNSUPERVISED LEARNING AND REINFORCEMENT LEARNING 9

I
Introduction - Clustering Algorithms -K—Means—Hierarchical Clustering - Cluster Validity - Dimensionality Reduction -Principal Component Analysis—Recommendation Systems -EM algorithm.Reinforcement Learning—Elements-Model based Learning—Temporal Difference Learning


UNIT IV PROBABILISTIC METHODS FOR LEARNING 9

V
Introduction-Naïve Bayes Algorithm-Maximum Likelihood-Maximum A priori-Bayesian Belief Networks-Probabilistic Modelling of Problems-Inference in Bayesian Belief Networks—Probability Density Estimation - Sequence Models - Markov Models - Hidden Markov Models

UNIT V NEURAL NETWORKS AND DEEP LEARNING 9

Neural Networks—Biological Motivation-Perceptron—Multi-layer Perceptron—Feed Forward Network - Back Propagation-Activation and Loss Functions- Limitations of Machine Learning - Deep Learning— Convolution Neural Networks - Recurrent Neural Networks - Use cases

45 PERIODS**SUGGESTED ACTIVITIES:**


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1. Give an example from our daily life for each type of machine learning problem
2. Study at least 3 Tools available for Machine Learning and discuss pros & cons of each
3. Take an example of a classification problem. Draw different decision trees for the example and explain the pros and cons of each decision variable at each level of the tree
4. Outline 10 machine learning applications in healthcare
5. Give 5 examples where sequential models are suitable.
6. Give at least 5 recent applications of CNN

PRACTICAL EXERCISES:

30 PERIODS

1. Implement a Linear Regression with a Real Dataset (<https://www.kaggle.com/harrywang/housing>). Experiment with different features in building a model. Tune the model's hyperparameters.
2. Implement a binary classification model. That is, answers a binary question such as "Are houses in this neighborhood above a certain price?" (use data from exercise 1). Modify the classification threshold and determine how that modification influences the model. Experiment with different classification metrics to determine your model's effectiveness.
3. Classification with Nearest Neighbors. In this question, you will use the scikit-learn's KNN classifier to classify real vs. fake news headlines. The aim of this question is for you to read the scikit-learn API and get comfortable with training/validation splits. Use California Housing Dataset
4. In this exercise, you'll experiment with validation sets and test sets using the dataset. Split a training set into a smaller training set and a validation set. Analyze deltas between training set and validation set results. Test the trained model with a test set to determine whether your trained model is overfitting. Detect and fix a common training problem.
5. Implement the k-means algorithm using <https://archive.ics.uci.edu/ml/datasets/Codon+usage+dataset>
6. Implement the Naïve Bayes Classifier using <https://archive.ics.uci.edu/ml/datasets/Gait+Classification+dataset>
7. Project-(in Pairs) Your project must implement one or more machine learning algorithms and apply them to some data.
 - a. Your project may be a comparison of several existing algorithms, or it may propose a new algorithm in which case you still must compare it to at least one other approach.
 - b. You can either pick a project of your own design, or you can choose from the set of pre-defined projects.
 - c. You are free to use any third-party ideas or code that you wish as long as it is publicly available.
 - d. You must properly provide references to any work that is not your own in the write-up.
 - e. Project proposal You must turn in a brief project proposal. Your project proposal should describe the idea behind your project. You should also briefly describe software you will need to write, and papers (2-3) you plan to read.



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List of Projects (datasets available)

1. Sentiment Analysis of Product Reviews
2. Stock Prediction
3. Sales Forecasting
4. Music Recommendation
5. Handwriting Digit Classification
6. Fake News Detection
7. Sports Prediction
8. Object Detection
9. Disease Prediction

COURSE OUTCOMES:

Upon the completion of course, students will be able to

CO1: Understand and outline problems for each type of machine learning

CO2: Design a Decision tree and Random forest for an application

CO3: Implement Probabilistic Discriminative and Generative algorithms for an application and analyze the results.


CO4: Use a tool to implement typical Clustering algorithms for different types of applications.

CO5: Design and implement an HMM for a Sequence Model type of application and identify applications suitable for different types of Machine Learning with suitable justification.

TOTAL: 75 PERIODS

REFERENCES

1. Stephen Marsland, "Machine Learning: An Algorithmic Perspective", Chapman & Hall/CRC, 2nd Edition, 2014.
2. Kevin Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012
3. Ethem Alpaydin, "Introduction to Machine Learning", Third Edition, Adaptive Computation and Machine Learning Series, MIT Press, 2014
4. Tom M Mitchell, "Machine Learning", McGraw Hill Education, 2013.
5. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", First Edition, Cambridge University Press, 2012.
6. Shai Shalev-Shwartz and Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press, 2015
7. Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2007.
8. Hal Daumé III, "A Course in Machine Learning", 2017 (freely available online)
9. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning", Springer, 2009 (freely available online)
10. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems 2nd Edition", O'Reilly, (2017)


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COURSE OBJECTIVES:

- To understand the rationale for software development process models
- To understand why the architectural design of software is important;
- To understand the five important dimensions of dependability, namely, availability, reliability, safety, security, and resilience.
- To understand the basic notions of a web service, web service standards, and service-oriented architecture;
- To understand the different stages of testing from testing during development of a software system

UNIT I SOFTWARE PROCESS & MODELING 9

Prescriptive Process Models – Agility and Process – Scrum – XP – Kanban – DevOps – Prototype Construction – Prototype Evaluation – Prototype Evolution – Modelling – Principles – Requirements Engineering – Scenario-based Modelling – Class-based Modelling – Functional Modelling – Behavioural Modelling.

UNIT II SOFTWARE DESIGN 9

Design Concepts – Design Model – Software Architecture – Architectural Styles – Architectural Design – Component-Level Design – User Experience Design – Design for Mobility – Pattern-Based Design.

UNIT III SYSTEM DEPENDABILITY AND SECURITY 9

Dependable Systems – Dependability Properties – Sociotechnical Systems – Redundancy and Diversity – Dependable Processes – Formal Methods and Dependability – Reliability Engineering – Availability and Reliability – Reliability Requirements – Fault-tolerant Architectures – Programming for Reliability – Reliability Measurement – Safety Engineering – Safety-critical Systems – Safety Requirements – Safety Engineering Processes – Safety Cases – Security Engineering – Security and Dependability – Safety and Organizations – Security Requirements – Secure System Design – Security Testing and Assurance – Resilience Engineering – Cybersecurity – Sociotechnical Resilience – Resilient Systems Design.

UNIT IV SERVICE-ORIENTED SOFTWARE ENGINEERING, SYSTEMS ENGINEERING AND REAL-TIME SOFTWARE ENGINEERING 9

Service-oriented Architecture – RESTful Services – Service Engineering – Service Composition – Systems Engineering – Sociotechnical Systems – Conceptual Design – System Procurement – System Development – System Operation and Evolution – Real-time Software Engineering – Embedded System Design – Architectural Patterns for Real-time Software – Timing Analysis – Real-time Operating Systems.

UNIT V SOFTWARE TESTING AND SOFTWARE CONFIGURATION MANAGEMENT 9

Software Testing Strategy – Unit Testing – Integration Testing – Validation Testing – System

Testing—Debugging—White-Box Testing—Basis Path Testing—Control Structure Testing—Black-Box Testing—Software Configuration Management (SCM)—SCM Repository—SCM Process – Configuration Management for Web and Mobile Apps.

SUGGESTED ACTIVITIES

1. Comparatively analysing different Agile methodologies.
2. Describing the scenarios where 'Scrum' and 'Kanban' are used.
3. Mapping the data flow into suitable software architecture.
4. Developing behavioural representations for a class or component.
5. Implementing simple applications as RESTful service.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The Students will be able to

CO1: Identify appropriate process models based on the Project requirements

CO2: Understand the importance of having a good Software Architecture.


CO3: Understand the five important dimensions of dependability, namely, availability, reliability, safety, security, and resilience.

CO4: Understand the basic notions of a web service, web service standards, and service-oriented architecture;

CO5: Be familiar with various levels of Software testing

REFERENCES:

1. Software Engineering: A Practitioner's Approach, 9th Edition. Roger Pressman and Bruce Maxim, McGraw-Hill 2019.
2. Software Engineering, 10th Edition, Ian Sommerville, Pearson Education Asia 2016.
3. Software Architecture In Practice, 3rd Edition, Len Bass, Paul Clements and Rick Kazman, Pearson India 2018
4. An integrated approach to Software Engineering, 3rd Edition, Pankaj Jalote, Narosa Publishing House, 2018
5. Fundamentals of Software Engineering, 5th Edition, Rajib Mall, PHI Learning Private Ltd, 2018


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