SRI INDU INSTITUTE OF ENGINEERING AND TECHNOLOGY

(An Autonomous Institution)

B.Tech. in COMPUTER SCIENCE AND ENGINEERING (IOT)
COURSE STRUCTURE, III YEAR & IV YEAR SYLLABUS

(BR22 Regulations)

Applicable from Academic Year: 2022-23 BATCH

IV YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	CS710PC	Operating Systems forIoT	3	0	0	3
2	CS711PC	IoT Networks	2	0	0	2
3		Professional Elective-III	3	0	0	3
4		Professional Elective-IV	3	0	0	3
5		Open Elective-II	3	0	0	3
6	MBA701HS	Professional Practice, Law & Ethics	0	0	4	2
7		Professional Elective-III Lab	0	0	2	1
8	CS713PC	ProjectStage-I	0	0	6	3
		Total	**14**	**0**	**12**	**20**

IV YEAR II SEMESTER

S.No.	Course Code	CourseTitle	L	T	P	Credits
1		Professional Elective-V	3	0	0	3
2		Professional Elective–VI	3	0	0	3
3		Open Elective–III	3	0	0	3
4	CS801PC	ProjectStage–II including Seminar	0	0	22	11
		Total	**9**	**0**	**22**	**20**

***MC – Satisfactory/Unsatisfactory**

Professional Elective – III

CS764PE	Mobile Application Development
CS777PE	Software Testing Methodologies
CS778PE	Cloud Computing and Virtualization
CS779PE	Artificial Intelligence
CS780PE	Lightweight Cryptography

Professional Elective – III LAB

CS734PE	Mobile Application Development Lab
CS736PE	Software Testing Methodologies Lab
CS737PE	Cloud Computing and Virtualization Lab
CS738PE	Artificial Intelligence Lab
CS739PE	Lightweight Cryptography Lab

 # Courses in PE - III and PE - III Lab must be in 1-1 correspondence.

Professional Elective – IV

CS765PE	Quantum Computing
CS781PE	Wireless Ad-Hoc Networks
CS782PE	Augmented Reality& Virtual Reality
CS783PE	IoT Automation
CS745PE	Ad-hoc& Sensor Networks

Professional Elective – V

CS865PE	Embedded Software Design
CS866PE	5G&IoTTechnologies
CS859PE	Cognitive Computing
CS842PE	Distributed Systems
CS867PE	Edge Computing

Professional Elective – VI

CS868PE	Industrial IoT
CS869PE	Fog Computing
EC825PE	Smart Sensor Technologies
CS871PE	Digital Forensics
CS863PE	Block chain Technology

Open Electives (OE–II)

CS798OE	IOT AUTOMATION
CS795OE	AI APPLICATIONS

Open Electives (OE–III)

CS888OE	IOT SECURITY
CS889OE	INDUSTRIAL IOT

OPERATING SYSTEMS FOR IOT

(Course code: CS710PC)

B.Tech. IV Year I Sem. L T P C
3 0 0 3

Course Objective:

- To learn various issue in the selection of Operating system for Internet of Things.

Course Outcomes:

- Revise the concepts of operating systems basics
- Learn best suitable architectures for CPU
- Understand software architectures for middleware
- Learn embedded operating systems
- Use embedded operating system for IoT

UNIT - I

Selection of OS: No OS and Strictly Polling, Co-routines, Interrupts, A Small Real-time Kernel, A nonpreemptive Operating System, Full OS, Open Source, GNU licensing and Linux, OS constructs

Selection of CPU: Overview, CPU Core, CPU Architecture, Word-Size, MMU – Memory Managed Unit, RAM, Cache, EEPROM and Flash, FPU – Floating Point Unit, DSP, Crypto-Engine

UNIT- II

Software Architecture: Design for Performance, Layers, Object Model, Case: CANOpen, Message Passing, Middleware

UNIT- III

Introduction to Embedded OS: Definitions of Embedded systems, embedded OS

History of Embedded OS: VRTX, The uc/os story, Wind-River, Threadx

Open-source Embedded Operating System: Open-source and Embedded Operating System,

Thoughts on Embedded system open-source software, Customize own Linux, Montavista and Embedded Linux

UNIT – IV

Embedded Linux OS: Real-Time Technologies in Embedded Linux, Improve clock precision, dynamic power management in embedded linux

Embedded OS in mobile phones: Mobile phones: Symbian OS, open-source Mobile phone os, android and its competitors

Embedded Operating Applications: Embedded communication products development, Embedded Linux in communication devices, Embedded linux for next generation of communication devices, Montavista Embedded linux

Wearable Devices and Embedded OS: Wearable Device, OS on wearable devices

UNIT- V

Internet of things OS: IoT os, Drive into the IOT OS, IoT operating systems, Huawei LiteOS, Comparison of Operating Systems

Embedded Technology and IoT: Microcontroller Unit, MCU powers the development of IoT, Edge computing in IOT, IoT cloud platform, IoT OS, RISC-V

TEXT BOOKS:

1. KLAUS ELK: Embedded software for IoT, De Gruyter; 3rd edition
2. Allan He and Lingyuan He: Embedded Operating System, History and Future in the Internet ofThings, Elektor Publication

REFERENCE BOOKS:

1. Jim cooling, Real-time Operating Systems Book 2 - The Practice: Using STM Cube, FreeRTOS and the STM32 Discovery Board (Engineering of Real-Time Embedded Systems) Jim cooling,ISBN-10:1973409933, ISBN-13:978-1973409939
2. Charles Bell, MicroPython for the Internet of Things, A Beginner's Guide to Programming with Python on Microcontrollers, Apress, ISBN-13 (pbk): 978-1-4842-3122-7, ISBN-13 (electronic): 978-1-4842-3123-4
3. Charles bell Windows 10 for the Internet of Things 1st Edition, Apress, ISBN-13 (pbk): 978-1-4842-2107-5 ISBN-13, (electronic): 978-1-4842-2108-2.

IOT NETWORKS
(Course code: CS711PC)

B.Tech. IV Year I Sem. L T P C
3 0 0 3

Prerequisites: Computer Networks.

Course Objectives

- In this course, learners will be going to learn about various network technologies designed for the implementation of the Internet of Things (IoT) applications

Course Outcomes:

- Understand various IoT challenges
- Learn communication models to access sensor data from IoT devices
- Learn challenges encountered while deploying IP
- Learn application protocols for IoT networks

UNIT - I

Introduction to IoT: IoT and Degitization, IoT impact, Convergence of IT and OT, IoT challenges

Smart Objects: The "Things" in IoT: Sensors, Actuators and Smart Objects, Sensors Networks

UNIT - II

IoT Network Architecture and Design: Drivers behind New Network Architectures, Comparing IoT Architectures, A simplified architectures, The core to Functional stack, IoT Data Management and computing stack

UNIT - III

Connecting Smart Objects: Communications Criteria, IoT Access Technologies

UNIT - IV

IP as the IoT Network Layer: The Business Case for IP, The Need for Optimization, Optimizing IP for IoT, Profiles and Compliances

UNIT - V

Application Protocols for IoT: The Transport Layer, IoT Application Transport Methods

TEXT BOOK:

1. David Hanes, Gonzalo, Patrick, Rob Barton, Jarome: IoT fundamentals Networking Technologies, Protocols, and usecase for the Internet of Things.

REFERENCE BOOKS:

1. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications ,2016
2. N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers, 2014.

MOBILE APPLICATION DEVELOPMENT (Professional Elective – III)
(Course code: CS764PE)

B.Tech. IV Year I Sem. L T P C
3 0 0 3

Prerequisites

1. Acquaintance with JAVA programming
2. A Course on DBMS

Course Objectives

- To demonstrate their understanding of the fundamentals of Android operating systems
- To improves their skills of using Android software development tools
- To demonstrate their ability to develop software with reasonable complexity on mobile platform
- To demonstrate their ability to deploy software to mobile devices
- To demonstrate their ability to debug programs running on mobile devices

Course Outcomes

- Understand the working of Android OS Practically.
- Develop Android user interfaces
- Develop, deploy and maintain the Android Applications.

UNIT - I

Introduction to Android Operating System: Android OS design and Features – Android development framework, SDK features, Installing and running applications on Android Studio, Creating AVDs, Types of Android applications, Best practices in Android programming, Android tools Android application components – Android Manifest file, Externalizing resources like values, themes, layouts, Menus etc, Resources for different

devices and languages, Runtime Configuration Changes Android Application Lifecycle – Activities, Activity lifecycle, activity states, monitoring state changes

UNIT - II

Android User Interface: Measurements – Device and pixel density independent measuring unit – s Layouts – Linear, Relative, Grid and Table Layouts User Interface (UI) Components –Editable and non-editable TextViews, Buttons, Radio and Toggle Buttons, Checkboxes, Spinners, Dialog and pickers Event Handling – Handling clicks or changes of various UI components Fragments – Creating fragments, Lifecycle of fragments, Fragment states, Adding fragments to Activity, adding, removing and replacing fragments with fragment transactions, interfacing between fragments and Activities, Multi-screen Activities

UNIT - III

Intents and Broadcasts: Intent – Using intents to launch Activities, Explicitly starting new Activity, Implicit Intents, Passing data to Intents, Getting results from Activities, Native Actions, using Intent to dial a number or to send SMS Broadcast Receivers – Using Intent filters to service implicit Intents, Resolving Intent filters, finding and using Intents received within an Activity Notifications – Creating and Displaying notifications, Displaying Toasts

UNIT - IV

Persistent Storage: Files – Using application specific folders and files, creating files, reading data from files, listing contents of a directory Shared Preferences – Creating shared preferences, saving and retrieving data using Shared Preference

UNIT - V

Database – Introduction to SQLite database, creating and opening a database, creating tables, inserting retrieving and etindelg data, Registering Content Providers, Using content Providers (insert, delete,

retrieve and update).

TEXT BOOK:

1. Professional Android 4 Application Development, Reto Meier, Wiley India, (Wrox), 2012.

REFERENCE BOOKS:

1. Android Application Development for Java Programmers, James C Sheusi, CengageLearning,2013.
2. Beginning Android 4 Application Development, Wei-Meng Lee, Wiley India (Wrox), 2013.

SOFTWARE TESTING METHODOLOGIES (Professional Elective – III)

(Course code: CS777PE)

B.Tech. IV Year I Sem. L T P C
3 0 0 3

Prerequisites

1. Software Engineering

Course Objectives

- To provide knowledge of the concepts in software testing such as testing process, criteria, strategies, and methodologies.
- To develop skills in software test automation and management using the latest tools.

Course Outcomes:

- Understand purpose of testing and path testing
- Understand strategies in data flow testing and domain testing
- Develop logic-based test strategies
- Understand graph matrices and its applications
- Implement test cases using any testing automation tool

UNIT - I

Introduction: Purpose of testing, Dichotomies, model for testing, consequences of bugs, taxonomy of bugs Flow graphs and Path testing: Basics concepts of path testing, predicates, path predicates and achievable paths, path sensitizing, path instrumentation, application of path testing.

UNIT - II

Transaction Flow Testing: transaction flows, transaction flow testing techniques.

Data Flow testing: Basics of data flow testing, strategies in data flow testing, application of data flow testing.

Domain Testing: domains and paths, Nice & ugly domains, domain testing, domains and interfaces testing, domain and interface testing, domains and testability.

UNIT - III

Paths, Path products and Regular expressions: path products & path expression, reduction procedure, applications, regular expressions & flow anomaly detection.

Logic Based Testing: overview, decision tables, path expressions, kv charts, specifications.

UNIT - IV

State, State Graphs and Transition testing: state graphs, good & bad state graphs,state testing, Testability tips.

UNIT - V

Graph Matrices and Application: Motivational overview, matrix of graph, relations, power of a matrix, node reduction algorithm, building tools. (Student should be given an exposure to a tool like Jmeter/selenium/soapUI/Catalon).

TEXT BOOKS:

1. Software Testing techniques - Baris Beizer, Dreamtech, second edition.
2. Software Testing Tools – Dr. K. V. K. K. Prasad, Dreamtech.

REFERENCE BOOKS:

1. The craft of software testing - Brian Marick, Pearson Education.
2. Software Testing Techniques – SPD(Oreille)
3. Software Testing in the Real World – Edward Kit, Pearson.
4. Effective methods of Software Testing, Perry, John Wiley.
5. Art of Software Testing – Meyers, John Wiley.

CLOUD COMPUTING AND VIRTUALIZATION (Professional Elective – III)

(Course code: CS778PE)

B.Tech. IV Year I Sem. L T P C
3 0 0 3

Course Objectives:

- Guiding design principles for Cloud Computing
- Understand the concepts of virtualization for cloud computing.

Course Outcomes:

- Understand the concepts of cloud computing.
- Explore several services provided by cloud.
- Understand different types of virtualizations.

UNIT - I

Live Virtual Concept in Cloud Environment

Live Migration, Issues with Migration, Research on Live Migration, Total Migration Time, Graph Partitioning

Live Virtual Machine Migration in Cloud

Introduction, Business Challenge, Virtual Machine Migration, Virtualization System, Live Virtual Machine Migration,

Attacks and Policies in Cloud Computing and Live Migration Introduction to Cloud Computing, Common Types of Attacks and Policies

UNIT - II

Live Migration Security in Cloud

Cloud Security and Security Appliances, VMM in Clouds and Security Concerns, Software-Defined Networking, Distributed Messaging System, Customized Testbed for Testing Migration Security in Cloud, A Case Study and Other Use Cases, Solution for Secure Live Migration

Detecting and Preventing Data Migrations to the Cloud

Protecting Data Moving to the Cloud, Application Security, Virtualization, Virtual Machine Guest Hardening, Security as a Service

UNIT - III

Dynamic Load Balancing Based on Live Migration

Introduction, Classification of Load Balancing Techniques, Policy Engine, Load Balancing Algorithm, Resource Load Balancing, Load Balancers in Virtual Infrastructure, Manageme Software, VMware Distributed Resource Scheduler,

Live Migration in Cloud Data Center

Definition of Data Center, Data Center Traffic Characteristics, Traffic Engineering for Data Centers, Energy Efficiency in Cloud Data Centers, Major Cause of Energy Waste, Power Measurement and Modeling in Cloud, Power Measurement Techniques, Power Saving Policies in Cloud

UNIT - IV

Trusted VM-vTPM Live Migration Protocol in Clouds Trusted Computing, TPM Operations, TPM Applications and Extensions, TPM Use Cases, State of the Art in Public Cloud Computing Security, Launch and Migration of Virtual Machines, Trusted VM Launch and Migration Protocol

Lightweight Live Migration

Introduction, VM Checkpointing, Enhanced VM Live Migration, VM Checkpointing Mechanisms, Lightweight Live Migration for Solo VM, Lightweight Checkpointing, Storage-Adaptive Live Migration

UNIT - V

Virtual Machine Mobility with Self-Migration

Checkpoints and Mobility, Manual and Seamless Mobility, Fine-and Coarse-Grained Mobility Models, Migration Freeze Time, Device Drivers, Self-Migration

Different Approaches for Live Migration

Virtualization, Types of Live Migration, Live VM Migration Types, Hybrid Live Migration, Reliable Hybrid Live Migration

TEXT BOOK:

1. Cloud Computing and Virtualization, Dac-Nhuong Le, Raghvendra Kumar, Gia Nhu Nguyen, Jyotir Moy Chatterjee, Wiley.

REFERENCE BOOKS:

1. T. Erl, R. Puttini, Z. Mahmood, Cloud Computing: Concepts, Technology & Architecture, Prentice Hall, 2013.
2. Balwinder Singh Sodh, IIT Ropar, Topics in virtualization and cloud computing.
3. T. Mather, S. Kumaraswamy, S. Latif, Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, O'Reilly Series, 2009.
4. Controlling data in the cloud: outsourcing computation without outsourcing control. In Proceedings of the 2009 ACM workshop on Cloud computing security (CCSW '09). ACM, New York, NY, USA, 85-90, 2009

ARTIFICIAL INTELLIGENCE (Professional Elective – III)

(Course code: CS779PE)

B.Tech. IV Year I Sem. L T P C
3 0 0 3

Prerequisites:

1. Programming for problem solving, Data Structures.

Course Objectives:

- To learn the distinction between optimal reasoning Vs. human like reasoning
- To understand the concepts of state space representation, exhaustive search, heuristic search together with the time and space complexities.
- To learn different knowledge representation techniques.
- To understand the applications of AI, namely game playing, theorem proving, and machine learning.

Course Outcomes:

- Understand search strategies and intelligent agents
- Understand different adversarial search techniques
- Apply propositional logic, predicate logic for knowledge representation
- Apply AI techniques to solve problems of game playing, and machine learning.

UNIT - I

Introduction to AI, Intelligent Agents, problem-Solving Agents, Searching for Solutions,

UninformedSearch Strategies: Breadth-first search, Uniform cost search, Depth-first search, Iterative deepeningDepth-first search, Bidirectional search, Informed (Heuristic) Search Strategies: Greedy best-firstsearch, A* search, Heuristic Functions, Beyond Classical Search: Hill-climbing search, Simulated annealing search, Local Search in Continuous Spaces

UNIT - II

Problem Solving by Search-II and Propositional Logic

Adversarial Search: Games, Optimal Decisions in Games, Alpha–Beta Pruning, Imperfect Real-Time Decisions. Constraint Satisfaction Problems: Defining Constraint Satisfaction Problems, Constraint Propagation, Backtracking Search for CSPs, Local Search for CSPs, The Structure of Problems. Propositional Logic: Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic, Propositional Theorem Proving: Inference and proofs, Proof by resolution, Horn clauses and definite clauses, Forward and backward chaining, Effective Propositional Model Checking, Agents Based on Propositional Logic.

UNIT - III

Logic and Knowledge Representation

First-Order Logic: Representation, Syntax and Semantics of First-Order Logic, Using First-Order Logic, Knowledge Engineering in First-Order Logic.

Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution.

UNIT - IV

Knowledge Representation: Ontological Engineering, Categories and Objects, Events. Mental Events and Mental Objects, Reasoning Systems for Categories, Reasoning with Default Information.

Classical Planning: Definition of Classical Planning, Algorithms for Planning with State-Space Search, Planning Graphs, other Classical Planning Approaches, Analysis of Planning approaches.

UNIT - V

Uncertain knowledge and Learning Uncertainty: Acting under Uncertainty, Basic Probability

Notation, Inference Using Full Joint Distributions, Independence, Bayes' Rule and Its Use

Probabilistic Reasoning: Representing Knowledge in an Uncertain Domain, The Semantics

of Bayesian Networks, Efficient Representation of Conditional Distributions, Approximate Inference in Bayesian Networks, Relational and First-Order Probability, Other Approaches to Uncertain Reasoning; Dempster-Shafer theory.

TEXT BOOK:

1. Artificial Intelligence: A Modern Approach, Third Edition, Stuart Russell and Peter Norvig, Pearson Education.

REFERENCE BOOKS:

1. Artificial Intelligence, 3rd Edn, E. Rich and K. Knight (TMH).
2. Artificial Intelligence, 3rd Edn., Patrick Henry Winston, Pearson Education.
3. Artificial Intelligence, Shivani Goel, Pearson Education.
4. Artificial Intelligence and Expert systems – Patterson, Pearson Education.

LIGHTWEIGHT CRYPTOGRAPHY (Professional Elective – III)

(Course code: CS780PE)

B.Tech. IV Year I Sem. L T P C
3 0 0 3

Prerequisites:

- Undergraduate-level knowledge of Network Security.

Course Objectives:

- Acquire a comprehensive understanding of Lightweight Cryptography and its implications for enhancing security in RFID tags.
- Implement both proactive and defensive strategies to mitigate potential threats, attacks, and intrusions effectively.

Course Outcomes:

- Learn cryptographic-based solutions as well as methods for detecting and preventing attacks and intrusions.
- Comprehend the security and privacy challenges associated with radio frequency identification (RFID) systems.
- Gain insight into various approaches for both attacking and defending industrial systems.

UNIT - I

New Trends in Cryptography

Security requirements, mechanisms, Modern Cryptography, symmetric key algorithms, asymmetric key algorithms, hash function, lightweight cryptography, lightweight algorithms- SIMON, SPECK, PRESENT, HIGHT, CAMELLA, TEA.

UNIT - II

RFID Technology: RFID basics, Coupling techniques Tags & smart labels Readers, writers & printers, RFID antennas Frequency bands & spectrum Security Standards.

Anti-counterfeiting and RFID: Anti-Counterfeiting and Supply Chain Security, Networked RFID Systems, PC Network Architecture, A Security Primer.

UNIT - III

Security and Privacy Current Status: Addressing Insecurities and Violations of Privacy, RFID Tag, Vulnerabilities in RFID Systems, From Identification to Authentication, A Review of RFID Product Authentication Techniques.

Network-Based Solutions: EPC System for a Safe & Secure Supply Chain and How it is Applied, The Potential of RFID and NFC in Anti-Counter feiting, Improving the Safety and Security of the Pharmaceutical Supply Chain.

UNIT - IV

Cryptographic Solutions: Product Specific Security Based on RFID Technology, Strengthening the Security of Machine, Readable Documents, Enhancing Security of Class IGeneration2 RFID against Traceability And Cloning.

UNIT - V

Low-cost Cryptographic Solutions: A Random Number Generator for Application in RFID Tags, A Low-Cost Solution to Cloning and Authentication Based on a Light weight Primitive, Lightweight Cryptography for Low-Cost RFID.

TEXT BOOK:

1. Networked RFID Systems and Lightweight Cryptography by Peter H. Cole· Damith C. Ranasinghe 3rd edition, Springer Publication 2010.

2. New Frontiers in Cryptography Quantum, Blockchain, Lightweight, Chaotic and DNA By Khaled Salah Mohamed, 2020.

REFERENCE BOOKS:

1. RFID Security and Privacy by YingjiuLi, Robert H. Deng.
2. RFID HANDBOOK by Klaus Finkenzeller, Third edition Wiley Publications.

QUANTUM COMPUTING (Professional Elective – IV)

(Course code: CS765PE)

B.Tech. IV Year I Sem. L T P C
3 0 0 3

Course Objectives:

- To introduce the fundamentals of quantum computing.
- The problem-solving approach using finite dimensional mathematics.

Course Outcomes:

- Understand basics of quantum computing.
- Understand physical implementation of Qubit.
- Understand Quantum algorithms and their implementation.
- Understand The Impact of Quantum Computing on Cryptography.

UNIT - I

History of Quantum Computing: Importance of Mathematics, Physics and Biology. Introduction to Quantum Computing: Bits Vs Qubits, Classical Vs Quantum logical

operations

UNIT - II

Background Mathematics: Basics of Linear Algebra, Hilbert space, Probabilities and measurements. Background Physics: Paul's exclusion Principle, Superposition, Entanglement and super-symmetry, density operators and correlation, basics of quantum mechanics, Measurements in bases other than computational basis. Background Biology: Basic concepts of Genomics and Proteomics (Central Dogma)

UNIT - III

Qubit: Physical implementations of Qubit. Qubit as a quantum unit of information. The Bloch sphere Quantum Circuits: single qubit gates, multiple qubit gates, designing the quantum circuits. Bell states.

UNIT - IV

Quantum Algorithms: Classical computation on quantum computers. Relationship between quantum and classical complexity classes. Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor's factorization algorithm, Grover's search algorithm.

UNIT - V

Noise and error correction: Graph states and codes, Quantum error correction, fault-tolerant computation. Quantum Information and Cryptography: Comparison between classical and quantum information theory. Quantum Cryptography, Quantum teleportation

TEXT BOOK:

1. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge.

REFERENCE BOOKS:

1. Quantum Computing for Computer Scientists by Noson S. Yanofsky and Mirco A. Mannucci
2. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol.I: Basic Concepts, Vol II.
3. Basic Tools and Special Topics, World Scientific. Pittenger A. O., An Introduction to Quantum Computing Algorithms.

WIRELESS AD-HOC NETWORKS (Professional Elective – IV)

(Course code: CS781PE)

B.Tech. IV Year I Sem. L T P C
3 0 0 3

Prerequisite: Computer Networks

Course Objectives:

- To study the fundamentals of wireless Ad-Hoc Networks.
- To study the operation and performance of various Ad Hoc wireless network protocols.
- To study the architecture and protocols of Wireless sensor networks.

Course Outcomes:

- Understand the basics of wireless Ad-hoc networks.
- Understand design, operation and the performance of MAC layer protocols of wireless Ad Hoc networks.
- Understand design, operation and the performance of routing protocol of wireless Ad Hoc network.

- Understand design, operation and the performance of transport layer protocol of wireless Ad Hoc networks.
- Understand sensor network Architecture, and to distinguish between protocols used in Adhoc wireless networks and wireless sensor networks.

UNIT - I

Wireless LANs and PANs: Introduction, Fundamentals of WLANS, IEEE 802.11 Standards, HIPERLAN Standard, Bluetooth, Home RF.

AD-Hoc Wireless Networks: Introduction, Issues in Ad Hoc Wireless Networks.

UNIT - II

MAC Protocols: Introduction, Issues in Designing a MAC protocol for Ad Hoc Wireless Networks, Design goals of a MAC Protocol for Ad Hoc Wireless Networks, Classifications of MAC Protocols, Contention - Based Protocols, Contention - Based Protocols with reservation Mechanisms, Contention – Based MAC Protocols with Scheduling Mechanisms, MAC Protocols that use Directional Antennas, Other MAC Protocols.

UNIT - III

Routing Protocols: Introduction, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classification of Routing Protocols, Table –Driven Routing Protocols, On – Demand Routing Protocols, Hybrid Routing Protocols, Routing Protocols with Efficient Flooding Mechanisms, Hierarchical Routing Protocols, Power – Aware Routing Protocols.

UNIT - IV

Transport Layer Protocols: Introduction, Issues in Designing a Transport Layer Protocol for Ad Hoc Wireless Networks, Design Goals of a Transport Layer Protocol for Ad Hoc Wireless Networks, Classification of Transport Layer Solutions, TCP Over Ad Hoc Wireless Networks, Other Transport Layer Protocol for Ad Hoc Wireless Networks.

UNIT - V

Wireless Sensor Networks: Introduction, Sensor Network Architecture, Data Dissemination, Data Gathering, MAC Protocols for Sensor Networks, Location Discovery, Quality of a Sensor Network, Evolving Standards, Other Issues.

TEXT BOOKS:

1. Ad Hoc Wireless Networks: Architectures and Protocols - C. Siva Ram Murthy and B. S. Manoj, 2004, PHI.
2. Wireless Ad- hoc and Sensor Networks: Protocols, Performance and Control – Jagannathan Sarangapani, CRC Press.

REFERENCE BOOKS:

1. Ad- Hoc Mobile Wireless Networks: Protocols & Systems, C.K. Toh, 1st Ed. Pearson Education.
2. Wireless Sensor Networks - C. S. Raghavendra, Krishna M. Sivalingam, 2004, Springer.

AUGMENTED REALITY & VIRTUAL REALITY (Professional Elective - IV)
(Course code: CS782PE)

B.Tech. IV Year I Sem. L T P C
3 0 0 3

Course Objectives:

- Provide a foundation to the fast-growing field of AR and make the students aware of the various AR concepts.
- To give historical and modern overviews and perspectives on virtual reality. It describes the fundamentals of sensation, perception, technical and engineering aspects of virtual reality systems.

Course Outcomes:

- Describe how AR systems work and list the applications of AR.
- Understand the software architectures of AR.

- Understand the Visual perception and rendering in VR
- Understand the interaction, auditory perception and rendering in VR

UNIT - I

Introduction to Augmented Reality: Augmented Reality - Defining augmented reality, history of augmented reality, Examples, Related fields

Displays: Multimodal Displays, Visual Perception, Requirements and Characteristics, Spatial Display Model, Visual Displays

Tracking: Tracking, Calibration, and Registration, Coordinate Systems, Characteristics of Tracking Technology, Stationary Tracking Systems, Mobile Sensors

UNIT - II

Computer Vision for Augmented Reality: Marker Tracking, Multiple-Camera Infrared Tracking, Natural Feature Tracking by Detection, Outdoor Tracking.

Interaction: Output Modalities, Input Modalities, Tangible Interfaces, Virtual User Interfaces on Real Surfaces, Augmented Paper, Multi-view Interfaces, Haptic Interaction

Software Architectures: AR Application Requirements, Software Engineering Requirements, Distributed Object Systems, Dataflow, Scene Graphs

UNIT - III

Introduction to Virtual Reality: Defining Virtual Reality, History of VR, Human Physiology and Perception

The Geometry of Virtual Worlds: Geometric Models, Axis-Angle Representations of Rotation, Viewing Transformations

Light and Optics: Basic Behavior of Light, Lenses, Optical Aberrations, The Human Eye, Cameras, Displays

UNIT - IV

The Physiology of Human Vision: From the Cornea to Photoreceptors, From Photoreceptors to the Visual Cortex, Eye Movements, Implications for VR

Visual Perception: Visual Perception - Perception of Depth, Perception of Motion, Perception of Color

Visual Rendering: Visual Rendering -Ray Tracing and Shading Models, Rasterization,

Correcting Optical Distortions, Improving Latency and Frame Rates, Immersive Photos and Videos

UNIT - V

Motion in Real and Virtual Worlds: Velocities and Accelerations, The Vestibular System, Physics in the Virtual World, Mismatched Motion and Vection

Interaction: Motor Programs and Remapping, Locomotion, Social Interaction

Audio: The Physics of Sound, The Physiology of Human Hearing, Auditory Perception, Auditory Rendering

TEXT BOOKS:

1. Augmented Reality: Principles & Practice by Schmalstieg/Hollerer, Pearson Education India;First edition (12 October 2016),ISBN-10: 9332578494.
2. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016.

REFERENCE BOOKS:

1. Allan Fowler-AR Game Development‖, 1st Edition, A press Publications, 2018, ISBN 978- 1484236178
2. Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002
3. Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig, William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009
4. Designing for Mixed Reality, Kharis O'Connell Published by O'Reilly Media, Inc., 2016, ISBN: 9781491962381
5. Sanni Siltanen- Theory and applications of marker-based augmented reality. Julkaisija –Utgivare Publisher. 2012. ISBN 978-951-38-7449-0
6. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005.

IOT AUTOMATION (Professional Elective - IV)

(Course code: CS783PE)

B.Tech. IV Year I Sem. L T P C

3 0 0 3

Course Objectives:

- While the promise of the Industrial Internet of Things (IIoT) brings many new business prospects, it also presents significant challenges ranging from technology architectural choices to security concerns.
- Students acquire the upcoming Industrial IoT: Roadmap to the Connected World Course offersimportant insights on overcoming the challenges and thrive in this exciting space.

Course Outcomes:

- Discover key IIoT concepts including identification, sensors, localization, wireless protocols, data storage and security.

- Explore IoT technologies, architectures, standards, and regulation.
- Realize the value created by collecting, communicating, coordinating, and leveraging the data from connected devices.
- Examine technological developments that will likely shape the industrial landscape in the future.
- Understand how to develop and implement own IoT technologies, solutions, and applications.

UNIT - I

Introduction & Architecture: Introduction of IIoT and the connected, The difference between IoT and IIoT, Architecture IIoT, IOT node, Challenges of IIOT, Fundamentals of Control System, introductions, components, closed loop & open loop system.

UNIT - II

IIOT Components: Introduction to Sensors, Types of sensors, working principle of basic Sensors - Ultrasonic Sensor, IR sensor, MQ2, Temperature and Humidity Sensors (DHT-11). Digital switch, Electro Mechanical switches.

UNIT - III

Communication Technologies of IIoT: Communication Protocols: IEEE 802.15.4, ZigBee, Z Wave, Bluetooth, BLE, NFC, RFID Industry standards communication technology (LoRAWAN, OPC UA, MQTT), connecting into existing Modbus and Profibus technology, wireless network communication.

UNIT - IV

Visualization and Data Types of IIoT: Front-end EDGE devices, Enterprise data for IIoT, Emerging descriptive data standards for IIoT, Cloud database, Cloud computing, Fog or Edge computing. Connecting an Arduino/Raspberry pi to the Web: Introduction, setting up the Arduino/Raspberry pi development environment, Options for Internet connectivity with Arduino, Configuring your Arduino/Raspberry pi board for the IoT.

UNIT - V

Retrieving Data: Extraction from Web: Grabbing the content from a web page, Sending data

on the web, Troubleshooting basic Arduino issues, Types of IoT interaction, Machine to Machine interaction (M2M).

Control & Supervisory Level of Automation: Programmable logic controller (PLC), Real-time control system, Supervisory Control & Data Acquisition (SCADA). HMI in an automation process, ERP & MES.

TEXT BOOKS:

1. The Internet of Things in the Industrial Sector, Mahmood, Zaigham (Ed.) (Springer Publication)
2. Industrial Internet of Things: Cyber manufacturing System, Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer Publication).
3. Industrial IoT Challenges, Design Principles, Applications, and Security by Ismail Butun (editor).

REFERENCE BOOK:

1. Jerker Delsing, IoT Automation: Arrowhead Framework, CRC Press.

AD HOC & SENSOR NETWORKS (Professional Elective – IV)
(Course code: CS745PE)

B.Tech. IV Year I Sem. L T P C
3 0 0 3

Prerequisites

- Computer Networks
- Distributed Systems
- Mobile Computing

Course Objectives

- To understand the challenges of routing in ad-hoc and sensor networks
- To understand various broadcast, mutlicast and geocasting protocols in ad hoc and

sensor networks

- To understand basics of Wireless sensors, and Lower Layer Issues and Upper Layer Issues of WSN

Course Outcomes

- Understand the concepts of sensor networks and applications
- Understand and compare the MAC and routing protocols for adhoc networks
- Understand the transport protocols of sensor networks

UNIT - I

Introduction to Ad Hoc Networks

Characteristics of MANETs, Applications of MANETs and Challenges of MANETs.

Routing in MANETs Criteria for classification, Taxonomy of MANET routing algorithms, Topology-based routing algorithms- Proactive: DSDV, WRP; Reactive: DSR, AODV, TORA; Hybrid: ZRP; Position- based routing algorithms- Location Services-DREAM, Quorum-based, GLS; Forwarding Strategies, Greedy Packet, Restricted Directional Flooding-DREAM, LAR; Other routing algorithms-QoS Routing, CEDAR.

UNIT - II

Data Transmission

Broadcast Storm Problem, Rebroadcasting Schemes-Simple-flooding, Probability-based Methods, Areabased Methods, Neighbour Knowledge-based: SBA, Multipoint Relaying, AHBP. Multicasting: Tree-based: AMRIS, MAODV; Mesh-based: ODMRP, CAMP; Hybrid: AMRoute, MCEDAR.

UNIT - III

Geocasting

Data-transmission Oriented-LBM; Route Creation Oriented-GeoTORA, MGR.

TCP over Ad Hoc TCP protocol overview, TCP and MANETs, Solutions for TCP over Ad hoc

UNIT - IV

Basics of Wireless Sensors and Lower Layer Issues-Applications, Classification of sensor networks, Architecture of sensor network, Physical layer, MAC layer, Link layer, Routing Layer.

UNIT - V

Upper Layer Issues of WSN

Transport layer, High-level application layer support, Adapting to the inherent dynamic nature of WSNs.

TEXT BOOKS

1. Ad Hoc and Sensor Networks – Theory and Applications, Carlos Corderio Dharma P.Aggarwal, World Scientific Publications, March 2006, ISBN – 981-256-681-3
2. Wireless Sensor Networks: An Information Processing Approach, Feng Zhao, Leonidas Guibas, Elsevier Science, ISBN – 978-1-55860-914-3 (Morgan Kauffman)

REFERENCE BOOKS:

1. C. Siva Ram Murthy, B.S. Manoj Ad Hoc Wireless Networks: Architectures and Protocols.
2. Taieb Znati Kazem Sohraby, Daniel Minoli, Wireless Sensor Networks: Technology, Protocols and Applications, Wiley.

IOT AUTOMATION (Open Elective –II)
(Course code: CS798OE)

B.Tech. IV Year I Sem. L T P C
3 0 0 3

Course Objectives:

- While the promise of the Industrial Internet of Things (IIoT) brings many new business prospects, it also presents significant challenges ranging from technology architectural choices to security concerns.
- Students acquire the upcoming Industrial IoT: Roadmap to the Connected World Course offers important insights on overcoming the challenges and thrive in this exciting space.

Course Outcomes:

- Discover key IIoT concepts including identification, sensors, localization, wireless

protocols, data storage and security.

- Explore IoT technologies, architectures, standards, and regulation.
- Realize the value created by collecting, communicating, coordinating, and leveraging the data from connected devices.
- Examine technological developments that will likely shape the industrial landscape in the future.
- Understand how to develop and implement own IoT technologies, solutions, and applications.

UNIT - I

Introduction & Architecture: Introduction of IIoT and the connected, The difference between IoT and IIoT, Architecture IIoT, IOT node, Challenges of IIOT, Fundamentals of Control System, introductions, components, closed loop & open loop system.

UNIT - II

IIOT Components: Introduction to Sensors, Types of sensors, working principle of basic Sensors - Ultrasonic Sensor, IR sensor, MQ2, Temperature and Humidity Sensors (DHT-11). Digital switch, Electro Mechanical switches.

UNIT - III

Communication Technologies of IIoT: Communication Protocols: IEEE 802.15.4, ZigBee, Z Wave, Bluetooth, BLE, NFC, RFID Industry standards communication technology (LoRAWAN, OPC UA, MQTT), connecting into existing Modbus and Profibus technology, wireless network communication.

UNIT - IV

Visualization and Data Types of IIoT: Front-end EDGE devices, Enterprise data for IIoT, Emerging descriptive data standards for IIoT, Cloud database, Cloud computing, Fog or Edge computing. Connecting an Arduino/Raspberry pi to the Web: Introduction, setting up the Arduino/Raspberry pi development environment, Options for Internet connectivity with Arduino, Configuring your Arduino/Raspberry pi board for the IoT.

UNIT - V

Retrieving Data: Extraction from Web: Grabbing the content from a web page, Sending data on the web, Troubleshooting basic Arduino issues, Types of IoT interaction, Machine to Machine interaction (M2M).

Control & Supervisory Level of Automation: Programmable logic controller (PLC), Real-time control system, Supervisory Control & Data Acquisition (SCADA). HMI in an automation process, ERP & MES.

TEXT BOOKS:

1. The Internet of Things in the Industrial Sector, Mahmood, Zaigham (Ed.) (Springer Publication)
2. Industrial Internet of Things: Cyber manufacturing System, Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer Publication).
3. Industrial IoT Challenges, Design Principles, Applications, and Security by Ismail Butun (editor).

REFERENCE BOOK:

1. Jerker Delsing, IoT Automation: Arrowhead Framework, CRC Press.

AI APPLICATIONS (Open Elective - II)
(Course code: CS795OE)

B.Tech. IV Year I Sem. L T P C
3 0 0 3

Prerequisites:

- Fundamentals of AI

Course Objectives:

- To give deep knowledge of AI and how AI can be applied in various fields to make life easy.

Course Outcomes:

- Correlate AI and solutions to modern problems.
- Use of AI in business applications
- Application of AI in manufacturing automation
- Use of AI in streaming of data and Network applications

UNIT - I

Alibaba: Using Artificial Intelligence To Power The Retail And Business-To-Business Services Of The Future

Amazon: Using Deep Learning To Drive Business Performance

UNIT - II

McDonald's: Using Robots And Artificial Intelligence To Automate Processes

Walmart: Using Artificial Intelligence To Keep Shelves Stacked And Customers Happy

UNIT - III

LinkedIn: Using Artificial Intelligence To Solve The Skills Crisis

Netflix: Using Artificial Intelligence To Give Us A Better TV Experience

UNIT - IV

Salesforce: How Artificial Intelligence Helps Businesses Understand Their Customers

Uber: Using Artificial Intelligence To Do Everything

UNIT - V

Siemens: Using Artificial Intelligence And Analytics To Build The Internet Of Trains

Tesla: Using Artificial Intelligence To Build Intelligent Cars

TEXT BOOK:

1. Artificial Intelligence in Practice: How 50 Successful Companies Used AI and Machine Learning to Solve Problems, Bernard Marr, Matt Ward, Wiley.

PROFESSIONAL PRACTICE, LAW & ETHICS

(Course code: MBA701HS)

B.Tech. IV Year I Sem. L T P C
2 0 0 2

Course Objectives:

- Understand the types of roles they are expected to play in the society as practitioners of the engineering profession.
- To develop some ideas of the legal and practical aspects of their profession.

Course Outcome:

- Practice ethics and rule of the land in their profession
- Follow the principles and elements of legal contracts
- Able to resolve disputes pertaining to arbitration, reconciliation
- Aware of intellectual property loss

UNIT - I

Professional Practice and Ethics: Definition of Ethics, Professional Ethics - Engineering Ethics, Personal Ethics; Code of Ethics - Profession, Professionalism, Professional Responsibility, Conflict of Interest, Gift Vs Bribery, Environmental breaches, Negligence, Deficiencies in state-of-the-art; Vigil Mechanism, Whistle blowing, protected disclosures. Introduction to GST- Various Roles of Various Stake holders

UNIT - II

Law of Contract: Nature of Contract and Essential elements of valid contract, Offer and Acceptance, Consideration, Capacity to contract and Free Consent, Legality of Object. Unlawful and illegal agreements, Contingent Contracts, Performance and discharge of Contracts, Remedies for breach of contract. Contracts-II: Indemnity and guarantee, Contract of Agency, Sale of goods Act -1930: General Principles, Conditions & Warranties, Performance of Contract of Sale.

UNIT - III

Arbitration, Conciliation and ADR (Alternative Dispute Resolution) system: Arbitration – meaning, scope and types – distinction between laws of 1940 and 1996; UNCITRAL model law – Arbitration and expert determination; Extent of judicial intervention; International commercial arbitration;

UNIT - IV

Arbitration agreements – essential and kinds, validity, reference and interim measures by court; Arbitration tribunal – appointment, challenge, jurisdiction of arbitral tribunal, powers, grounds of challenge, procedure and court assistance; Distinction between conciliation, negotiation, mediation and arbitration, confidentiality, resort to judicial proceedings, costs; Dispute Resolution Boards; Lok Adalats.

UNIT - V

Law relating to Intellectual property: Introduction – meaning of intellectual property, main

forms of IP, Copyright, Trademarks, Patents and Designs, Secrets; Law relating to Copyright in India including Historical evolution of Copy Rights Act, 1957, Meaning of copyright – computer programs, Ownership of copyrights and assignment, Criteria of infringement, Piracy in Internet – Remedies and procedures in India; Law relating to Patents under Patents Act, 1970

TEXT BOOKS:

1. Professional Ethics: R. Subramanian, Oxford University Press, 2015.
2. Ravinder Kaur, Legal Aspects of Business, 4e, Cengage Learning, 2016.

REFERENCE BOOKS:

1. Wadhera (2004), Intellectual Property Rights, Universal Law Publishing Co.
2. T. Ramappa (2010), Intellectual Property Rights Law in India, Asia Law House.
3. O.P. Malhotra, Law of Industrial Disputes, N.M. Tripathi Publishers.

MOBILE APPLICATION DEVELOPMENT LAB (Professional Elective – III)

(Course code: CS734PE)

B.Tech. IV Year I Sem. L T P C
0 0 2 1

Course Objectives:

- To learn how to develop Applications in an android environment.
- To learn how to develop user interface applications.

- To learn how to develop URL related applications.

Course Outcomes:

- Understand the working of Android OS Practically.
- Develop user interfaces.
- Develop, deploy and maintain the Android Applications.

List of Experiments:

1. Create an Android application that shows Hello + name of the user and run it on an emulator. (b) Create an application that takes the name from a text box and shows hello message along with the name entered in the text box, when the user clicks the OK button.
2. Create a screen that has input boxes for User Name, Password, Address, Gender (radio buttons for male and female), Age (numeric), Date of Birth (Datepicker), State (Spinner) and a Submit button. On clicking the submit button, print all the data below the Submit Button. Use (a) Linear Layout (b) Relative Layout and (c) Grid Layout or Table Layout.
3. Develop an application that shows names as a list and on selecting a name it should show the details of the candidate on the next screen with a "Back" button. If the screen is rotated to landscape mode (width greater than height), then the screen should show list on left fragment and details on the right fragment instead of the second screen with the back button. Use Fragment transactions and Rotation event listeners.
4. Develop an application that uses a menu with 3 options for dialing a number, opening a website and to send an SMS. On selecting an option, the appropriate action should be invoked using intents.
5. Develop an application that inserts some notifications into Notification area and whenever a notification is inserted, it should show a toast with details of the notification.
6. Create an application that uses a text file to store usernames and passwords (tab separated fields and one record per line). When the user submits a login name and password through a screen, the details should be verified with the text file data and if

they match, show a dialog saying that login is successful. Otherwise, show the dialog with a Login Failed message.

7. Create a user registration application that stores the user details in a database table.
8. Create a database and a user table where the details of login names and passwords are stored. Insert some names and passwords initially. Now the login details entered by the user should be verified with the database and an appropriate dialog should be shown to the user.
9. Create an admin application for the user table, which shows all records as a list and the admin can select any record for edit or modify. The results should be reflected in the table.
10. Develop an application that shows all contacts of the phone along with details like name, phone number, mobile number etc.
11. Create an application that saves user information like name, age, gender etc. in shared preference and retrieves them when the program restarts.
12. Create an alarm that rings every Sunday at 8:00 AM. Modify it to use a time picker to set alarm time.

TEXT BOOKS:

1. Professional Android 4 Application Development, Reto Meier, Wiley India, (Wrox), 2012
2. Android Application Development for Java Programmers, James C Sheusi, Cengage Learning, 2013

REFERENCE BOOK:

1. Beginning Android 4 Application Development, Wei-Meng Lee, Wiley India (Wrox), 2013

SOFTWARE TESTING METHODOLOGIES LAB (Professional Elective – III)

(Course code: CS736PE)

B.Tech. IV Year I Sem. L T P C
0 0 2 1

Prerequisites

- A basic knowledge of programming.

Course Objectives

- To provide knowledge of software testing methods.
- To develop skills in automation of software testing and software test automation management using the latest tools.

Course Outcomes

- Design and develop the best test strategies in accordance with the development model.
- Design and develop GUI, Bitmap and database checkpoints
- Develop database checkpoints for different checks
- Perform batch testing with and without parameter passing

List of Experiments

1. Recording in context sensitive mode and analog mode
2. GUI checkpoint for single property
3. GUI checkpoint for single object/window
4. GUI checkpoint for multiple objects
5.
   a. Bitmap checkpoint for object/window
   b. Bitmap checkpoint for screen area
6. Database checkpoint for Default check
7. Database checkpoint for custom check
8. Database checkpoint for runtime record check
9.

a. Data driven test for dynamic test data submission

b. Data driven test through flat files

c. Data driven test through front grids

d. Data driven test through excel test

10

a. Batch testing without parameter passing

b. Batch testing with parameter passing

11. Data driven batch

12. Silent mode test execution without any interruption

13. Test case for calculator in windows application

TEXT BOOKS

1. Software Testing techniques, Baris Beizer, 2nd Edition, Dreamtech.

2. Software Testing Tools, Dr. K.V.K.K. Prasad, Dreamtech.

REFERENCE BOOKS

1. The craft of software testing, Brian Marick, Pearson Education.

2. Software Testing Techniques – SPD(Oreille)

3. Software Testing in the Real World, Edward Kit, Pearson.

4. Effective methods of Software Testing, Perry, John Wiley.

5. Art of Software Testing, Meyers, John Wiley.

CLOUD COMPUTING AND VIRTUALIZATION LAB (Professional Elective – III)

(Course code: CS737PE)

B.Tech. IV Year I Sem. L T P C
0 0 2 1

Course Objectives:

- Guiding design principles for Cloud Computing.
- Understand the concepts of virtualization for cloud computing.

Course Outcomes:

- Understand the concepts of cloud computing.
- Explore several services provided by cloud.
- Understand different types of virtualizations.

List of Experiments:

1. Install Oracle Virtual box and create two VMs on your laptop.
2. Install Turbo C in guest OS and execute C program.
3. Test ping command to test the communication between the guest OS and Host OS
4. Install Hadoop single node setup.
5. Hopkinson‘s test on DC shunt machines
6. Develop hadoop application to count no of characters, no of words and each character frequency.
7. Develop hadoop application to process given data and produce results such as finding the year of maximum usage, year of minimum usage.
8. Develop hadoop application to process given data and produce results such as how many female and male students in both schools the results should be in following format.

   GP-F #number

   GP-M #numbers

   MS-F #number

   MS-M #number

9. Establish an AWS account. Use the AWS Management Console to launch an EC2 instance and connect to it.
10. Design a protocol and use Simple Queue Service (SQS)to implement the barrier
11. Synchronization after the first phase
12. Use the Zookeeper to implement the coordination model in Problem 10.
13. Develop a Hello World application using Google App Engine
14. Develop a Guestbook Application using Google App Engine
15. Develop a Windows Azure Hello World application using.
16. Create a Mashup using Yahoo! Pipes.

TEXT BOOKS:

1. Cloud Computing and Virtualization, Dac-Nhuong Le, Raghvendra Kumar, Gia Nhu Nguyen, Jyotir Moy Chatterjee, Wiley.
2. T. Erl, R. Puttini, Z. Mahmood, Cloud Computing: Concepts, Technology & Architecture, Prentice Hall, 2013.

REFERENCE BOOKS:

1. Balwinder Singh Sodh, IIT Ropar, Topics in virtualization and cloud computing.
2. T. Mather, S. Kumaraswamy, S. Latif, Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, O'Reilly Series, 2009.
3. Controlling data in the cloud: outsourcing computation without outsourcing control. In Proceedings of the 2009 ACM workshop on Cloud computing security (CCSW '09). ACM, New York, NY, USA, 85-90, 2009

ARTIFICIAL INTELLIGENCE LAB (Professional Elective – III)

(Course code: CS738PE)

B.Tech. IV Year I Sem. L T P C
0 0 2 1

Course Objectives:

- Become familiar with basic principles of AI toward problem solving, knowledge representation, and learning.

Course Outcomes:

- Apply basic principles of AI in solutions that require problem solving, knowledge representation, and learning.

LIST OF EXPERIMENTS

Write a Program to Implement the following using Python.

1. Breadth First Search
2. Depth First Search
3. Tic-Tac-Toe game
4. 8-Puzzle problem
5. Water-Jug problem
6. Travelling Salesman Problem
7. Tower of Hanoi
8. Monkey Banana Problem
9. Alpha-Beta Pruning
10. 8-Queens Problem

TEXT BOOK:

1. Artificial Intelligence a Modern Approach, Third Edition, Stuart Russell and Peter Norvig, Pearson Education.

REFERENCE BOOKS:

1. Artificial Intelligence, 3rd Edn, E. Rich and K. Knight (TMH)
2. Artificial Intelligence, 3rd Edn., Patrick Henny Winston, Pearson Education.
3. Artificial Intelligence, Shivani Goel, Pearson Education.

LIGHTWEIGHT CRYPTOGRAPHY LAB (Professional Elective – III)

(Course code: CS739PE)

B.Tech. IV Year I Sem. L T P C
0 0 2 1

Course Objectives:

- Acquire understanding of Lightweight Cryptography and its correlation with advancing security in RFID tags.
- Implement proactive and defensive strategies to effectively thwart potential threats, attacks, and intrusions.

Course Outcomes:

- Ability to learn cryptographic-based solutions, attacks, and intrusions.
- Understand security and privacy issues in radio frequency identification (RFID) systems.
- Understanding multiple ways to attack and defend industrial systems.

List of Experiments:

1. Set up a basic RFID system, exploring its components such as RFID tags and readers (Requirement: Arduino).
2. Implement the Lightweight Cryptographic Algorithm “PRESENT”.
3. Implement the Lightweight Cryptographic Algorithm “SIMON”.
4. Implement the Lightweight Cryptographic Algorithm “SPECK”.
5. Implement the Tiny Encryption Algorithm (TEA).
6. Implement the Scalable Encryption Algorithm (SEA).
7. Implement AES for RFID systems to encrypt data stored on tags and the communication between tags and readers.
8. Implement the RSA algorithm for RFID tags.
9. Implement ECC (Elliptic Curve Cryptography).
10. Algorithm for implementing the elliptic group operation and elliptic curve protocols

which influence the performance of ECC.

11. Implement a simple Electronic Product Code (EPC) system.
12. Implement a hash function for RFID tag data.
13. Implement a simple random number generator suitable for use in RFID tags.

TEXT BOOK:

1. Networked RFID Systems and Lightweight Cryptography by Peter H. Cole · Damith C. Ranasinghe First edition, Springer publication 2008.

REFERENCE BOOKS:

1. RFID Security and Privacy by YingjiuLi, Robert H. Deng

2. RFID HANDBOOK by Klaus Finkenzeller, Third edition Wiley Publications

EMBEDDED SOFTWARE DESIGN (Professional Elective – V)

(Course code: CS865PE)

B.Tech. IV Year II Sem. L T P C
3 0 0 3

Course Objectives:

- Knowledge on fundamental concepts of real time embedded systems and applications

Course Outcomes:

- Understand requirements for real time software design method for embedded systems
- Understand and analyze overview of Real-Time Software Design Method for Embedded Systems
- Discussion on State Machines for Real-Time Embedded Systems with examples
- Understand the importance of software architectural Patterns for Real-Time Embedded Systems

UNIT - I

Introduction - The Challenge, Real-Time Embedded Systems and Applications, Characteristics of Real- Time Embedded Systems, Distributed Real-Time Embedded Systems, Cyber-Physical Systems, Requirements for Real-Time Software Design Method for Embedded Systems, COMET/RTE: A Real- Time Software Design Method for Embedded Systems, Visual Modeling Languages: UML, SysML, and MARTE.

Real-Time Software Design and Architecture Concepts - Object-Oriented Concepts, Information Hiding,Inheritance, Active and Passive Objects, Concurrent Processing, Cooperation between Concurrent Tasks, Information Hiding Applied to Access Synchronization, Runtime Support for Real-Time Concurrent Processing, Task Scheduling, Software Architecture and Components.

UNIT - II

Overview of Real-Time Software Design Method for Embedded Systems - COMET/RTE System and Software Life Cycle model, Phases in COMET/RTE Life Cycle model. Structural Modeling for Real-Time Embedded Systems with SysML and UML - Static Modeling Concepts, Categorization of Blocks and Classes using Stereotypes, Structural

Modeling of the Problem Domain with SysML, Structural Modeling of the System Context, Hardware/Software Boundary Modeling, Structural Modeling of the Software System Context, Defining Hardware/Software Interfaces, System Deployment Modeling. Use Case Modeling for Real-Time Embedded Systems.

UNIT - III

State Machines for Real-Time Embedded Systems- State Machines and examples, Events and Guard Conditions, Actions, Hierarchical State Machines, Cooperating State Machines, Inherited State Machines, Developing State Machines from Use Cases.

Object and Class Structuring for Real-Time Embedded Software- Object and Class Structuring Criteria, Object and Class Structuring Categories, Object Behavior and Patterns, Boundary Classes and Objects, Entity Classes and Objects, Control Classes and Objects, Application Logic Classes and Objects.

Dynamic Interaction Modeling for Real-Time Embedded Software - Object Interaction Modeling, Message Sequence Description, Approach for Dynamic Interaction Modeling, Stateless Dynamic Interaction Modeling, State Dependent Dynamic Interaction Modeling. Modeling: Microwave Oven System.

UNIT - IV

Software Architectures for Real-Time Embedded Systems- Overview of Software Architectures, Multiple Views of a Software Architecture, Transition from Analysis to Design, Separation of Concerns in Subsystem Design, Subsystem Structuring Criteria, Decisions about Message Communication between Subsystems.

Software Architectural Patterns for Real-Time Embedded Systems - Software Design Patterns, Layered Software Architectural Patterns, Control Patterns for Real-Time Software Architectures, Client/Service Software Architectural Patterns, Basic Software Architectural Communication Patterns, Software Architectural Broker Patterns, Group Message Communication Patterns.

UNIT - V

Component-Based Software Architectures for Real-Time Embedded Systems- Concepts for Component-Based Software Architectures, Designing Distributed Component-Based Software Architectures, Component Interface Design, Designing Composite Components, Component Structuring Criteria, Design of Service Components, Distribution of Data, Software Deployment, Design of Software Connectors. Concurrent Real-Time Software Task Design -

Concurrent Task Structuring Issues, Categorizing Concurrent Tasks, I/O Task Structuring Criteria, Internal Task Structuring Criteria, Task Priority Criteria, Task Clustering Criteria, Design Restructuring by Using Task Inversion, Developing the Task Architecture, Task Communication and Synchronization, Task Interface and Task Behavior Specifications.

TEXT BOOK:

1. Real-Time Software Design for Embedded Systems by Hassan Gomaa.

REFERENCE BOOK:

1. K. Shibu, Introduction to Embedded Systems, McGraw Hill Education.

5G & IOT TECHNOLOGIES (Professional Elective – V)

(Course code: CS866PE)

B.Tech. IV Year II Sem. L T P C
3 0 0 3

Course Objectives:

- Students will be explored to the interconnection and integration of the physical world and the cyber space. They are also able to design & develop IOT Devices.

Course Outcomes:

- Understand 5G and 5G Broadband Wireless Communications
- Understand 5G wireless Propagation Channels
- Understand the application areas of IOT
- Realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks
- Understand building blocks of Internet of Things and characteristics

UNIT - I

Overview of 5G Broadband Wireless Communications: Mobile communications generations: from 1G to 4G, Rationale of 5G - requirements, Standardization activities.

UNIT - II

The 5G wireless Propagation Channels: Channel model requirements, Propagation scenarios and challenges in the 5G modeling, Channel Models for mmWave, MIMO Systems.

UNIT - III

Introduction to Internet of Things –Definition and Characteristics of IoT, Physical Design of IoT – IoT Protocols, IoT communication models, Iot Communication APIs, IoT enabled Technologies – Wireless Sensor Networks, Cloud Computing, Big data analytics,

Communication protocols, Embedded Systems, IoT Levels and Templates, Domain Specific IoTs – Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle.

UNIT - IV

IoT and M2M – Software defined networks, network function virtualization, difference between SDN and NFV for IoT, Basics of IoT System Management with NETCOZF, YANGNETCONF, YANG, SNMP NETOPEER

UNIT - V

IoT Physical Devices and Endpoints - Introduction to Raspberry PI - Interfaces (serial, SPI, I2C). Programming – Python program with Raspberry PI with focus of interfacing external gadgets, controlling output, reading input from pins.

TEXT BOOKS:

1. Afif Osseiran, Jose. F. Monserrat, Patrick Marsch, "Fundamentals of 5G Mobile Networks", Cambridge University Press.
2. Arshdeep Bahga and Vijay Madisetti, "Internet of Things - A Hands-on Approach", Universities Press, 2015, ISBN: 9788173719547

REFERENCE BOOKS:

1. Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks", John Wiley & Sons.
2. Amitabha Ghosh and Rapeepat Ratasuk "Essentials of LTE and LTE-A", Cambridge University Press
3. Athanasios G. Kanatos, Konstantina S. Nikita, Panagiotis Mathiopoulos, "New Directions in Wireless Communication Systems from Mobile to 5G", CRC Press.
4. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759.

COGNITIVE COMPUTING (Professional Elective – V)

(Course code: CS859PE)

B.Tech. IV Year II Sem. L T P C
3 0 0 3

Prerequisites: Probability Theory.

Course Objectives:

- To provide an understanding of the central challenges in realizing aspects of human cognition.
- To provide a basic exposition to the goals and methods of human cognition.
- To develop algorithms that use AI and machine learning along with human interaction and feedback to help humans make choices/decisions.
- To support human reasoning by evaluating data in context and presenting relevant findings along with the evidence that justifies the answers.

Course Outcomes:

- Understand cognitive computing
- Plan and use the primary tools associated with cognitive computing.
- Plan and execute a project that leverages cognitive computing.
- Understand and develop the business implications of cognitive computing.

UNIT - I

Introduction to Cognitive Science: Understanding Cognition, IBM's Watson, Design for

Human Cognition, Augmented Intelligence, Cognition Modeling Paradigms: Declarative/ logic-based computational cognitive modeling, connectionist models of cognition, Bayesian models of cognition, a dynamical systems approach to cognition.

UNIT - II

Cognitive Models of memory and language, computational models of episodic and semantic memory, modeling psycholinguistics.

UNIT - III

Cognitive Modeling: modeling the interaction of language, memory and learning, Modeling select aspects of cognition classical models of rationality, symbolic reasoning and decision making.

UNIT - IV

Formal models of inductive generalization, causality, categorization and similarity, the role of analogy in problem solving, Cognitive Development Child concept acquisition. Cognition and Artificial cognitive architectures such as ACT-R, SOAR, OpenCog, CopyCat, Memory Networks.

UNIT - V

DeepQA Architecture, Unstructured Information Management Architecture (UIMA), Structured Knowledge, Business Implications, Building Cognitive Applications, Application of Cognitive Computing and Systems.

TEXT BOOK:

1. The Cambridge Handbook of Computational Psychology by Ron Sun (ed.), Cambridge University Press.

REFERENCE BOOKS:

1. Judith S. Hurwitz, Marcia Kaufman, Adrian Bowles Cognitive Computing and Big Data Analytics, Wiley
2. Vijay V Raghavan, Venkat N. Gudivada, Venu Govindaraju, Cognitive Computing: Theory and Applications: Volume 35 (Handbook of Statistics), North Hollan.

DISTRIBUTED SYSTEMS (Professional Elective - V)

(Course code: CS842PE)

B.Tech. IV Year II Sem. L T P C
3 0 0 3

Prerequisites:

1. A course on "Operating Systems".
2. A course on "Computer Organization & Architecture".

Course Objectives:

- To provide an insight into Distributed systems.
- To introduce concepts related to Peer to Peer Systems, Transactions and Concurrency control, Security and Distributed shared memory.

Course Outcomes:

- Understand Transactions and Concurrency control.
- Understand distributed shared memory.
- Design a protocol for a given distributed application.

UNIT - I

Characterization of Distributed Systems: Examples of Distributed systems, Resource sharing and web, challenges

System models: Architectural and Fundamental models, Networking and Internetworking, Interprocess Communication

Distributed objects and Remote Invocation: Communication between distributed objects, RPC, Events and notifications, Case study-Java RMI.

UNIT - II

Operating System Support- OS layer, Protection, Processes and Threads, Communication and Invocation, Operating system architecture.

Distributed File Systems-Introduction, File Service architecture.

UNIT - III

Peer to Peer Systems– Napster and its legacy, Peer to Peer middleware

Time and Global States-Introduction, Clocks, events and Process states, Synchronizing physical clocks, logical time and logical clocks, global states, distributed debugging. **Coordination and Agreement**- Distributed mutual exclusion, Elections, Multicast communication, consensus and related problems.

UNIT - IV

Transactions and Concurrency Control- Introduction, Transactions, Nested Transactions, Locks, Optimistic concurrency control, Timestamp ordering.

Distributed Transactions-Introduction, Flat and Nested Distributed Transactions, Atomic commit protocols, Concurrency control in distributed transactions

Distributed deadlocks: Transaction recovery.

UNIT - V

Replication: Introduction, System model and group communication, Fault tolerant services, Transactions with replicated data.

Distributed shared memory: Design and Implementation issues, Consistency models.

TEXT BOOKS:

1. Distributed Systems Concepts and Design, G Coulouris, J Dollimore and T Kindberg, Fourth Edition, Pearson Education.
2. Distributed Systems, S. Ghosh, Chapman & Hall/CRC, Taylor & Francis Group, 2010.

REFERENCE BOOKS:

1. Distributed Systems – Principles and Paradigms, A.S. Tanenbaum and M.V. Steen, Pearson Education.

2. Distributed Computing, Principles, Algorithms and Systems, Ajay D. Kshemakalyani and Mukesh Singhal, Cambridge, rp 2010.

EDGE COMPUTING (Professional Elective - V)
(Course code: CS867PE)

B.Tech. IV Year II Sem. L T P C
3 0 0 3

Course Objectives:

- Knowledge on how edge computing and Internet of Things (IoT) can be used as a way to meet application demands in intelligent IoT systems

Course Outcomes:

- Understand use of the IoT architecture with its entities and protocols, from the IoT devices
- Security and privacy issues related to the area of edge computing and IoT
- Understand the RaspberryPi architecture and its components
- Work with RaspberryPi components and evaluate its performance.

UNIT - I

IoT and Edge Computing Definition and Use Cases

Introduction to Edge Computing Scenario's and Use cases - Edge computing purpose and definition, Edge computing use cases, Edge computing hardware architectures.

UNIT - II

Edge platforms, Edge vs Fog Computing, Communication Models - Edge, Fog and M2M, IoT

Architecture and Core IoT Modules-A connected ecosystem, IoT versus machine-to-machine versus, SCADA, The value of a network and Metcalfe's and Beckstrom's laws

UNIT - III

IoT and edge architecture, Role of an architect, Understanding Implementations with examples-Example use case and deployment, Case study – Telemedicine palliative care, Requirements, Implementation, Use case retrospective.

UNIT - IV

Implementation of Microcomputer RaspberryPi and device Interfacing, Edge to Cloud Protocols- Protocols, MQTT, MQTT publish-subscribe, MQTT architecture details, MQTT state transitions, MQTT packet structure, MQTT data types, MQTT communication formats

UNIT - V

Edge computing with RaspberryPi, Industrial and Commercial IoT and Edge, Edge computing and solutions.

TEXT BOOKS:

1. IoT and Edge Computing for Architects - Second Edition, by Perry Lea, Publisher: Packt Publishing, 2020, ISBN: 9781839214806
2. Raspberry Pi Cookbook, 3rd Edition, by Simon Monk, Publisher: O'Reilly Media, Inc., 2019, ISBN: 978149204322.

REFERENCE BOOKS:

1. Fog and Edge Computing: Principles and Paradigms by Rajkumar Buyya, Satish Narayana Srirama, wiley publication, 2019, ISBN: 9781119524984.
2. David Jensen, “Beginning Azure IoT Edge Computing: Extending the Cloud to the Intelligent Edge, MICROSOFT AZURE

INDUSTRIAL IOT (Professional Elective - VI)

(Course code: CS868PE)

B.Tech. IV Year II Sem.

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Course Objectives:

- To provide students with a good depth of knowledge of Designing Industrial IOT Systems for various applications.

Course Outcomes:

- Identify the Key opportunities and benefits in Industrial IoT
- Apply virtual network to demonstrate the use of Cloud in Industrial IoT
- Analyze industrial IoT Three tier topology and data management system
- Summarize Legacy Industrial and Modern Communication Protocols
- Describe Middleware Architecture, LoRaWAN- and Augmented reality

UNIT - I

Introduction To Industrial Internet And Use-Cases: Industrial Internet- Key IIoT Technologies- Innovation and the IIoT -Key Opportunities and Benefits -The Digital and Human Workforce – Logistics and the Industrial Internet- IOT Innovations in Retail.

UNIT - II

The Technical And Business Innovators Of The Industrial Internet: Cyber Physical Systems (CPS) – IP Mobility – Network Virtualization - SDN (Software Defined Networks)- The Cloud and Fog – Role of Big Data in IIOT - Role of Machine learning and AI in IIOT

UNIT - III

IIOT Reference Architecture: Industrial Internet Architecture Framework (IIAF) - Industrial Internet Viewpoints -. Architectural Topology: The Three-Tier Topology- Key System Characteristics- Data Management- Advanced data analytics.

UNIT - IV

Protocols for Industrial Internet Systems: Legacy Industrial Protocols - Modern Communication Protocols-Proximity Network Communication Protocols- Wireless Communication Technologies- Gateways: industrial gateways - CoAP (Constrained Application Protocol)- NFC.

UNIT - V

Middleware Software Patterns and IIOT Platforms: Publish/Subscribe Pattern: MQTT, XMPP, AMQP, DDS- Middleware Architecture- SigFox- LoRaWAN Augmented reality- Real-World Smart Factories

Application of IIOT: Case study: Health monitoring, Iot smart city, Smart irrigation, Robot surveillance.

TEXT BOOKS:

1. Gilchrist, Alasdair, “Industry 4.0 The Industrial Internet of Things”, Apress, 2017.
2. Zaigham Mahmood, “The Internet of Things in the Industrial Sector: Security and Device connectivity, smart environments and Industry 4.0 (Springer), 2019.

REFERENCE BOOKS:

1. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat “Industrial Internet of Things: Cyber manufacturing Systems” (Springer), 2017.
2. Industrial IoT Challenges, Design Principles, Applications, and Security by Ismail Butun (editor)
3. Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”,

1st Edition, VPT, 2014.

4. Michahelles, "Architecting the Internet of Things", ISBN 978-3- 642-19156-5 e-ISBN 978-3-642- 19157-2, Springer
5. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 20132 Cuno Pfister, Getting Started with the Internet of Things, O "Reilly Media, 2011, ISBN: 978-1-4493-9357-1

E-BOOKS

1. https://www.apress.com/gp/book/9781484220467

FOG COMPUTING (Professional Elective –VI)
(Course code: CS869PE)

B.Tech. IV Year II Sem. L T P C
3 0 0 3

Course Objectives:

- Overview of Fog Computing and its architecture, challenges and applications in different contexts.

Course Outcomes:

- Familiar with the concepts of Fog.
- Understand the architecture and its components and working of components and its performance.
- Explore Fog on security, multimedia and smart data.
- Model the fog computing scenario.

UNIT - I

Introduction to Fog Computing: Fog Computing, Characteristics, Application Scenarios, Issues and challenges.

Fog Computing Architecture: Communication and Network Model, Programming Models, Fog Architecture for smart cities, healthcare and vehicles.

Fog Computing Communication Technologies: Introduction, IEEE 802.11, 4G, 5G standards, WPAN, Short-Range Technologies, LPWAN and other medium and Long-Range Technologies.

UNIT - II

Management and Orchestration of Network Slices in 5G, Fog, Edge, and Clouds: Introduction, Background, Network Slicing in 5G, Network Slicing in Software-Defined Clouds, Network Slicing Management in Edge and Fog, Middleware for Fog and Edge Computing, Need for Fog and Edge Computing Middleware, Clusters for Lightweight Edge Clouds, IoT Integration, Security Management for Edge Cloud Architectures.

Fog Computing Realization for Big Data Analytics: Introduction to Big Data Analytics, Data Analytics in the Fog, Prototypes and Evaluation.

UNIT - III

Fog computing requirements when applied to IoT: Scalability, Interoperability, Fog-IoT architectural model, Challenges on IoT Stack Model via TCP/IP Architecture, Data Management, filtering, Event Management, Device Management, cloudification, virtualization, security and privacy issues. Integrating IoT, Fog, Cloud Infrastructures: Methodology, Integrated C2F2T Literature by Modeling Technique by Use-Case Scenarios, Integrated C2F2T Literature by Metrics.

UNIT - IV

Exploiting Fog Computing in Health Monitoring: An Architecture of a Health Monitoring IoT Based System with Fog Computing, Fog Computing Services in Smart E-Health Gateways, Discussion of Connected Components.

Fog Computing Model for Evolving Smart Transportation Applications: Introduction, Data-Driven Intelligent Transportation Systems, Fog Computing for Smart Transportation Applications Case Study: Intelligent Traffic Lights Management (ITLM) System

UNIT - V

Software Defined Networking and application in Fog Computing: Open Flow Protocol, Open Flow Switch, SDN in Fog Computing, Home Network using SDN.

Security and Privacy issues: Trust and privacy issues in IoT Network, web Semantics and trust Management for Fog Computing, Machine Learning based security in Fog Computing, Cyber- Physical Energy Systems over Fog Computing.

TEXT BOOKS:

1. Fog Computing: Theory and Practice by Assad Abbas, Samee U. Khan, Albert Y. Zomaya
2. Fog and Edge Computing: Principles and Paradigms (Wiley Series on Parallel and Distributed Computing) by Rajkumar Buyya and Satish Narayana Srirama
3. Amir Vahid Dastjerdi and Rajkumar Buyya, ―Fog Computing: Helping the Internet of Things Realize its Potential, University of Melbourne.

REFERENCE BOOKS:

1. Flavio Bonomi, Rodolfo Milito, Jiang Zhu, Sateesh Addepalli, ―Fog Computing and Its Role in the Internet of Things, MCC'12, August 17, 2012, Helsinki, Finland. Copyright 2012 ACM 978- 1-4503-1519-7/12/08... $15.00.
2. Shanhe Yi, Cheng Li, Qun Li, ―A Survey of Fog Computing: Concepts, Applications and Issues, Mobidata' 15, ACM 978-1-4503-3524-9/15/06, DOI: 10.1145/2757384.2757397, June 21, 2015, Hangzhou, China.
3. Amir M. Rahmani, Pasi Liljeberg, Preden, Axel Jantsch, ―Fog Computing in the Internet of Things - Intelligence at the Edge, Springer International Publishing, 2018.
4. Ivan Stojmenovic, Sheng Wen, "The Fog Computing Paradigm: Scenarios and Security Issues", Proceedings, Federated Conference on Computer Science and Information Systems,pp. 1–8, 2014.

SMART SENSOR TECHNOLOGIES (Professional Elective - VI)

(Course code: EC825PE

B.Tech. IV Year II Sem. L T P C
3 0 0 3

Course Objectives:

- Obtain knowledge on sensors, sensors with microcontrollers and their applications

Course Outcomes:

- Analyze the sensors available in IoT based on application requirements and the Sensing methods
- Create a Real-time application by choosing appropriate sensors for temperature monitoring.
- Interfacing different types of Sensors with MCU
- Infer Wireless Sensing, RF Sensing and RF MEMS

- Design a real-time application for landslide monitoring and hazard mitigation

UNIT - I

Basics of Sensors: Introduction- Sensor Vs Transducer, Nature of Sensors, Sensor Output Characteristics, Sensing Technologies, Digital Output Sensors.

UNIT - II

Application Specific Sensors: Occupancy and motion detectors: ultrasonic – microwave capacitive detectors- optical presence sensor, Light Detectors: Photo diodes – phototransistor – photoresistor- CCD and CMOS image sensors, Temperature Sensors: thermos-resistive sensors – thermoelectric contact sensor

UNIT - III

Sensor With Microcontroller: Introduction, Amplification and Signal Conditioning, Integrated Signal Conditioning, Digital Conversion, MCU Control, MCUs for Sensor Interface, Techniques and Systems Considerations, Sensor Integration

UNIT - IV

Wireless Sensing: Wireless Data and Communications, Wireless Sensing Networks, Industrial Wireless Sensing Networks, RF Sensing, Telemetry, RF MEMS, Complete System Consideration.

UNIT - V

Smart Applications and System Requirements: Automotive Applications, Industrial (Robotic) Applications, Consumer Applications, Future Sensor Plus Semiconductor Capabilities, Future System Requirements.

TEXT BOOKS:

1. Frank, Randy, “Understanding smart sensors”, Artech House integrated microsystems series, 3rd Edition, 2013.
2. Jacob Fraden, “Handbook of Modern Sensors: Physics, Designs, and Applications”, 5th Edition, Springer, 2016

REFERENCE BOOKS:

1. Vlasios Tsiatsis, Stamatis Karnouskos, Jan Holler, David Boyle, Catherine Mulligan, "Internet of Things: Technologies and Applications for a New Age of Intelligence", Academic Press, 16-Nov- 2018.

2. Henry Leung, Subhas Chandra Mukhopadhyay, "Intelligent Environmental Sensing", Springer, 22-Jan-2015.

E BOOKS

1. https://www.sciencedirect.com/topics/engineering/smart-sensors

1. https://www.azosensors.com/article.aspx?ArticleID=1289

DIGITAL FORENSICS (Professional Elective –VI)

(Course code: CS871PE)

B.Tech. IV Year II Sem. L T P C
3 0 0 3

Course Objectives:

- Understanding the history and evolution of digital forensics.
- Describe various types of cybercrimes.
- Prepare students for forensics readiness plan.

Course Outcomes:

- Interpret and appropriately apply the laws and procedures associated with identifying, acquiring, examining, and presenting digital evidence.
- Create a method for gathering, assessing, and applying new and existing legislation and industry trends specific to the practice of digital forensics.

UNIT - I

Computer Forensics Fundamentals: Introduction to Computer Forensics: Use of Computer Forensics in Law Enforcement, Computer Forensics Assistance to Human Resources/Employment Proceedings, Computer Forensics Services, Benefits of Professional Forensics Methodology, Steps taken by Computer Forensics Specialists.

Types of Computer Forensics Technology: Types of Military Computer Forensic Technology, Types of Law Enforcement, Computer Forensic Technology, Types of Business Computer Forensic Technology.

Computer Forensics Evidence and Capture: Data Recovery Defined, Data Back-up and Recovery, The Role of Back-up in Data Recovery, The Data-Recovery Solution.

UNIT - II

Evidence Collection and Data Seizure: Why Collect Evidence? Collection Options, Obstacles, Types of Evidence, The Rules of Evidence, Volatile Evidence, General Procedure, Collection and Archiving, Methods of Collection, Artifacts, Collection Steps, Controlling Contamination: The Chain of Custody.

Duplication and Preservation of Digital Evidence: Preserving the Digital Crime Scene, Computer Evidence Processing Steps, Legal Aspects of Collecting and Preserving Computer Forensic Evidence.

Computer Image Verification and Authentication: Special Needs of Evidential Authentication, Practical Consideration, Practical Implementation.

UNIT - III

Computer Forensics analysis and validation: Determining what data to collect and analyze,validating forensic data, addressing data-hiding techniques, and performing remote acquisitions.

Network Forensics: Network forensics overview, Performing live acquisitions, Developing standard procedures for network forensics, using network tools, Examining the honeynet project.

Processing Crime and Incident Scenes: Identifying digital evidence, Collecting evidence in privatesector incident scenes, Processing law enforcement crime scenes, Preparing for a search, Securing a computer incident or crime scene, Seizing digital evidence at the scene, Storing digital evidence, Obtaining a digital hash, reviewing a case.

UNIT - IV

Current Computer Forensic Tools: Evaluating computer forensic tool needs, Computer Forensics Software Tools, Computer Forensics Hardware Tools, Validating and Testing Forensics Software.

E-Mail Investigations: Exploring the role of e-mail in the investigation, Exploring the roles of the client and server in email, Investigating e-mail crimes and violations, Understanding e- mail servers, Using specialized e-mail forensic tools. Cell phone and mobile device forensics: Understanding mobile device forensics, Understanding acquisition procedures for cell phones and mobile devices.

UNIT – V

Working with Windows and DOS Systems: Understanding file systems, exploring Microsoft File Structures, Examining NTFS disks, Understanding whole disk encryption, windows registry, Microsoft startup tasks, MS-DOS startup tasks, Virtual Machines.

TEXT BOOKS:

1. Computer Forensics, Computer Crime Investigation by John R. Vacca, Firewall Media, New Delhi.
2. Computer Forensics and Investigations by Nelson, Phillips Enfinger, Steuart, CENGAGE Learning.

REFERENCE BOOKS:

1. Real Digital Forensics by Keith J. Jones, Richard Bejtiich, Curtis W. Rose, Addison-Wesley Pearson Education
2. Forensic Compiling, A Practitioners Guide by Tony Sammes and Brian Jenkinson, Springer International edition.
3. Computer Evidence Collection & Presentation by Christopher L.T. Brown, Firewall Media.
4. Homeland Security, Techniques & Technologies by Jesus Mena, Firewall Media.
5. Software Forensics Collecting Evidence from the Scene of a Digital Crime by Robert M. Slade, TMH 2005
6. Windows Forensics by Chad Steel, Wiley India Edition.

BLOCKCHAIN TECHNOLOGY (Professional Elective – VI)

(Course code: CS863PE)

B.Tech. IV Year II Sem. L T P C
3 0 0 3

Prerequisites:

1. Knowledge in information security and applied cryptography.
2. Knowledge in Computer Networks

Course Objectives:

- To learn the fundamentals of Blockchain and various types of block chain and consensus mechanisms.
- To understand the public block chain system, Private block chain system and consortium blockchain.
- Able to know the security issues of blockchain technology.

Course Outcomes:

- Understanding concepts behind crypto currency

- Applications of smart contracts in decentralized application development
- Understand frameworks related to public, private and hybrid blockchain
- Create blockchain for different application case studies

UNIT - I

Fundamentals of Blockchain: Introduction, Origin of Blockchain, Blockchain Solution, Components of Blockchain, Block in a Blockchain, The Technology and the Future. Blockchain Types and Consensus Mechanism: Introduction, Decentralization and Distribution, Types of Blockchain, Consensus Protocol.

Cryptocurrency – Bitcoin, Altcoin and Token: Introduction, Bitcoin and the Cryptocurrency, Cryptocurrency Basics, Types of Cryptocurrencies, Cryptocurrency Usage.

UNIT - II

Public Blockchain System: Introduction, Public Blockchain, Popular Public Blockchains, The Bitcoin Blockchain, Ethereum Blockchain.

Smart Contracts: Introduction, Smart Contract, Characteristics of a Smart Contract, Types of Smart Contracts, Types of Oracles, Smart Contracts in Ethereum, Smart Contracts in Industry.

UNIT - III

Private Blockchain System: Introduction, Key Characteristics of Private Blockchain, Need of Private Blockchain, Private Blockchain Examples, Private Blockchain and Open Source, E- commerce SiteExample, Various Commands (Instructions) in E-commerce Blockchain, Smart Contract in Private Environment, State Machine, Different Algorithms of Permissioned Blockchain, Byzantine Fault, Multichain.

Consortium Blockchain: Introduction, Key Characteristics of Consortium Blockchain, Need of Consortium Blockchain, Hyperledger Platform, Overview of Ripple, Overview of Corda. Initial Coin Offering: Introduction, Blockchain Fundraising Methods, Launching an ICO, Investing in an ICO, Pros and Cons of Initial Coin Offering, Successful Initial Coin Offerings, Evolution of ICO, ICO Platforms.

UNIT - IV

Security in Blockchain: Introduction, Security Aspects in Bitcoin, Security and Privacy

Challenges of Blockchain in General, Performance and Scalability, Identity Management and Authentication, Regulatory Compliance and Assurance, Safeguarding Blockchain Smart Contract (DApp), Security Aspects in Hyperledger Fabric.

Applications of Blockchain: Introduction, Blockchain in Banking and Finance, Blockchain in Education, Blockchain in Energy, Blockchain in Healthcare, Blockchain in Real-estate, Blockchain In Supply Chain, The Blockchain and IoT. Limitations and Challenges of Blockchain.

UNIT - V

Blockchain Case Studies: Case Study 1 – Retail, Case Study 2 – Banking and Financial Services, Case Study 3 – Healthcare, Case Study 4 – Energy and Utilities.

Blockchain Platform using Python: Introduction, Learn How to Use Python Online Editor, Basic Programming Using Python, Python Packages for Blockchain.

Blockchain platform using Hyperledger Fabric: Introduction, Components of Hyper ledger Fabric Network, Chain codes from Developer.ibm.com, Blockchain Application Using Fabric Java SDK.

TEXT BOOK:

1. "Blockchain Technology", Chandramouli Subramanian, Asha A. George, Abhilasj K A and Meena Karthikeyan, Universities Press.

REFERENCE BOOKS:

1. Michael Juntao Yuan, Building Blockchain Apps, Pearson, India.
2. Blockchain Blueprint for Economy, Melanie Swan, SPD O'reilly.
3. Blockchain for Business, Jai Singh Arun, Jerry Cuomo, Nitin Gaur, Pearson.

IOT SECURITY (Open Elective - III)

(Course code: CS888OE)

B.Tech. IV Year II Sem. L T P C
3 0 0 3

Course Objectives:

- Understand the various attacks and importance of Security aspects in IoT
- Understand the techniques, protocols and security towards Gaming models
- Understand security and privacy challenges of IoT
- Understand the application of block chain technology for IoT Security

Course Outcomes:

- Incorporate the best practices learnt to identify the attacks and mitigate the same

- Adopt the right security techniques and protocols during the design of IoT products
- Assimilate and apply the skills learnt on ciphers and block chains when appropriate
- Describe the essential components of IoT
- Find appropriate security/privacy solutions for IoT

UNIT - I

Fundamentals of IoT and Security and its need, Prevent Unauthorized Access to Sensor Data, Block ciphers, Introduction to Blockchain, Introduction of IoT devices, IoT Security Requirements, M2M Security, Message integrity Modeling faults and adversaries Difference among IoT devices, computers,and embedded devices.

UNIT - II

IoT and cyber-physical systems RFID Security, Authenticated encryption Byzantine Generals problem sensors and actuators in IoT, IoT security (vulnerabilities, attacks, and countermeasures), Cyber Physical Object Security, Hash functions Consensus algorithms and their scalability problems Accelerometer, photoresistor, buttons

UNIT - III

Security engineering for IoT development Hardware Security, Merkle trees and Elliptic curves digital signatures, verifiable random functions, Zero-knowledge systems motor, LED, vibrator, IoT security lifecycle, Front-end System Privacy Protection, Management, Secure IoT Databases, Public-key crypto (PKI), blockchain, the challenges, and solutions, analog signal vs. digital signal

UNIT - IV

Data Privacy Networking Function Security Trees signature algorithms proof of work, Proof of stake, Networking in IoT Device/User Authentication in IoT IoT Networking Protocols, Crypto-currencies, alternatives to Bitcoin consensus, Bitcoin scripting language and their use Real-time communication

UNIT - V

Introduction to Authentication Techniques, Secure IoT Lower Layers, Bitcoin P2P network, Ethereum and Smart Contracts, Bandwidth efficiency, Data Trustworthiness in IoT, Secure IoT Higher Layers, Distributed consensus, Smart Contract Languages and verification challenges, Data analytics in IoT - simple data analyzing methods

TEXT BOOKS:

1. B. Russell and D. Van Duren, "Practical Internet of Things Security," Packt Publishing, 2016.
2. Fei HU, "Security and Privacy Internet of Things (IoTs): Models, Algorithms and Implementations", CRC Press, 2016
3. Narayanan et al., "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction," Princeton University Press, 2016.

REFERENCE BOOKS:

1. A. Antonopoulos, "Mastering Bitcoin: Unlocking Digital Crypto currencies," O'Reilly, 2014.
2. T. Alpcan and T. Basar, "Network Security: A Decision and Game-theoretic Approach," Cambridge University Press, 2011.
3. Security and the IoT ecosystem, KPMG International, 2015.
4. Internet of Things: IoT Governance, Privacy and Security Issues" European Research Cluster.
5. Ollie Whitehouse, "Security of Things: An Implementers' Guide to Cyber-Security for Internet of Things Devices and Beyond", NCC Group, 2014.
6. Josh Thompson, 'Blockchain: The Blockchain for Beginnings, Guide to Blockchain Technology and Blockchain Programming', Create Space Independent Publishing Platform, 2017.

INDUSTRIAL IOT (Open Elective - III)
(Course code: CS889OE)

B.Tech. IV Year II Sem. L T P C
3 0 0 3

Course Objectives:

- To provide students with a good depth of knowledge of Designing Industrial IOT Systems for various applications.

Course Outcomes:

- Identify the Key opportunities and benefits in Industrial IoT

- Apply virtual network to demonstrate the use of Cloud in Industrial IoT
- Analyze industrial IoT Three tier topology and data management system
- Summarize Legacy Industrial and Modern Communication Protocols
- Describe Middleware Architecture, LoRaWAN- and Augmented reality

UNIT - I

Introduction To Industrial Internet And Use-Cases: Industrial Internet- Key IIoT Technologies- Innovation and the IIoT -Key Opportunities and Benefits -The Digital and Human Workforce – Logistics and the Industrial Internet- IOT Innovations in Retail.

UNIT - II

The Technical And Business Innovators Of The Industrial Internet: Cyber Physical Systems (CPS) – IP Mobility – Network Virtualization - SDN (Software Defined Networks)- The Cloud and Fog – Role of Big Data in IIOT - Role of Machine learning and AI in IIOT

UNIT - III

IIOT Reference Architecture: Industrial Internet Architecture Framework (IIAF) - Industrial Internet Viewpoints -. Architectural Topology: The Three-Tier Topology- Key System Characteristics- Data Management- Advanced data analytics.

UNIT - IV

Protocols for Industrial Internet Systems: Legacy Industrial Protocols - Modern Communication Protocols-Proximity Network Communication Protocols- Wireless Communication Technologies-Gateways: industrial gateways - CoAP (Constrained Application Protocol)- NFC.

UNIT - V

Middleware Software Patterns and IIOT Platforms: Publish/Subscribe Pattern: MQTT, XMPP, AMQP, DDS- Middleware Architecture- SigFox- LoRaWAN Augmented reality- Real-World Smart Factories

Application of IIOT: Case study: Health monitoring, Iot smart city, Smart irrigation, Robot surveillance.

TEXT BOOKS:

1. Gilchrist, Alasdair, "Industry 4.0 The Industrial Internet of Things", Apress, 2017.
2. Zaigham Mahmood, "The Internet of Things in the Industrial Sector: Security and Device connectivity, smart environments and Industry 4.0 (Springer), 2019.

REFERENCE BOOKS:

1. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat "Industrial Internet of Things: Cyber manufacturing Systems" (Springer), 2017.
2. Industrial IoT Challenges, Design Principles, Applications, and Security by Ismail Butun (editor)
3. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.
4. Michahelles, "Architecting the Internet of Things", ISBN 978-3- 642-19156-5 e-ISBN 978-3-642- 19157-2, Springer
5. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 20132 Cuno Pfister, Getting Started with the Internet of Things, O "Reilly Media, 2011, ISBN: 978-1-4493-9357-1

E-BOOKS

https://www.apress.com/gp/book/9781484220467