Rajiv Gandhi ProudyogikiVishwavidyalaya Bhopal
M.Tech (IoT)
Second Semester Syllabus
MTIO 201-IoT ARCHITECTURE AND PROTOCOLS

Course Objectives:
The objective of this course is to make students learn about the architecture, Components and various protocols of IoT.

Unit I
IoT definition, Characteristics, IoT conceptual and architectural framework, Physical and logical design of IoT, IoT enablers, Modern day IoT applications, M2M communications, IoT vs M2M, IoT vs WoT, IoT reference architecture, IoT Network configurations, IoT LAN, IoT WAN, IoT Node, IoT Gateway, IoT Proxy

Unit II
Basics of IoT Networking, IoT Components, Functional components of IoT, IoT service oriented architecture, IoT challenges, 6LowPAN, IEEE 802.15.4, RFID Features, RFID working principle and applications, NFC (Near Field communication), Bluetooth, Wireless Sensor Networks and its Applications

Unit III
IoT Data Link Layer & Network Layer Protocols: PHY/MAC Layer(3GPP MTC, IEEE 802.11, IEEE 802.15), Wireless HART,ZWave,Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4,IPv6, 6LoWPAN, 6TiSCH,ND, DHCP, ICMP, RPL, CORPL, CARP

Unit IV
IoT Transport & Session Layer Protocols: Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS) – Session Layer-HTTP, CoAP, CoAP message types, CoAP Request-Response model, XMPP, AMQP, MQTT, MQTT methods and components, MQTT communication, topics and applications, SMQTT

Unit V
IoT Service Layer Protocols & Security Protocols: Service Layer -oneM2M, ETSI M2M, OMA, BBF – Security in IoT Protocols – MAC802.15.4 , 6LoWPAN, RPL, Application Layer
IoT Platforms, Arduino, Raspberry Pi Board, Other IoT Platforms; Data Analytics for IoT, Cloud for IoT, Cloud storage models & communication APIs, IoT case studies

Reference Books:

1. Vijay Madisetti, ArshdeepBahga, “Ïnternet of Things, A Hands on Approach”, University Press
2. Dr. SRN Reddy, RachitThukral and Manasi Mishra, “Introduction to Internet of Things: A practical Approach”, ETI Labs
3. Pethuru Raj and Anupama C. Raman, “The Internet of Things: Enabling Technologies, Platforms, and Use Cases”, CRC Press
4. Jeeva Jose, “Internet of Things”, Khanna Publishing House, Delhi
5. Adrian McEwen, “Designing the Internet of Things”, Wiley
6. Raj Kamal, “Internet of Things: Architecture and Design”, McGraw Hill
7. CunoPfister, “Getting Started with the Internet of Things”, O Reilly Media

8. Daniel Minoli, “Building the Internet of Things with IPv6 and MIPv6: The EvolvingWorld of M2M Communications”, ISBN: 978-1-118-47347-4, Willy Publications ,2016
9. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand,StamatisKarnouskos, David Boyle, “From Machine-to-Machine to the Internet ofThings: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2015
10. Bernd Scholz-Reiter, Florian Michahelles, “Architecting the Internet of Things”,ISBN 978-3-642- 19156-5 e-ISBN 978-3-642-19157-2, Springer, 2016

Course Outcomes:

On successful completion of this course the students will be able to-

1. Understand the concepts of IoT Architecture
2. Apply knowledge of IoT Networking and its components to design IoT-based systems
3. Understand data link layer and network layer protocols of IoT
4. Use the knowledge of IoT transport and session layer protocols in various applications of IoT
5. Design IoT-based systems for real-world problems

MTIO 202-SECURITY IN IOT

Course Objectives:

The objective of this course is to make students to learn how cyber security for the IoT works along with key technical details, process flows, definitions of terms and practical examples.

UNIT I

Fundamentals of encryption for cyber security: Cryptography – Need and the Mathematical basics- History of cryptography, symmetric ciphers, block ciphers, DES – AES. Public-key cryptography: RSA, Diffie-Hellman Algorithm, Elliptic Curve Cryptosystems, Algebraic structure, Triple Data Encryption Algorithm (TDEA) Block cipher

UNIT II

IoT security framework : IOT security frame work, Security in hardware, Bootprocess, OS & Kernel, application, run time environment and containers. Need and methods of Edge Security, Network Security: Internet, Intranet, LAN, Wireless Networks, Wireless cellular networks, Cellular Networks and VOIP.

UNIT III

Elementary blocks of IoT Security & Models for Identity Management: Vulnerability of IoT and elementary blocks of IoT Security, Threat modeling – Key elements. Identity management Models and Identity management in IoT, Approaches using User-centric, Device-centric and Hybrid.

UNIT IV

Identity Management and Trust Establishment: Trust management lifecycle, Identity and Trust, Web of trust models. Establishment: Cryptosystems – Mutual establishment phases – Comparison on security analysis. Identity management framework
Access Control in IoT and light weight cryptography: Capability-based access control schemes, Concepts, identity-based and identity-driven, Light weight cryptography, need and methods, IoT use cases

UNIT V

Security and Digital Identity in Cloud Computing: **S**ecurity, Digital identity management in cloud, Classical solutions, alternative solutions, Management of privacy and personal data in Cloud; Cyber Crimes, Hackers and Forensics: Cyber Crimes and Laws – Hackers – Dealing with the rise tide of Cyber Crimes – Cyber Forensics and incident Response – Network Forensics

Reference Books:

1. John R. Vacca, “Computer and Information Security Handbook”, Elsevier, 2013.
2. Parikshit Narendra Mahalle , Poonam N. Railkar, “Identity Management for Internet of Things”, River Publishers, 2015.
3. William Stallings, “Cryptography and Network security: Principles and Practice”, 5th Edition, 2014, Pearson Education, India.

4. Maryline Laurent, Samia Bouzefrane, “Digital Identity Management”, Elsevier, 2015.
5. Joseph Migga Kizza, “Computer Network Security”, Springer, 2005.
6. Christof Paar and Jan Pelzl, “Understanding Cryptography – A Textbook for Students and Practitioners”, Springer, 2014.
7. Behrouz A.Forouzan : Cryptography & Network Security – The McGraw Hill Company, 2007.
8. Charlie Kaufman, Radia Perlman, Mike Speciner, Network Security: “Private Communication in a public World”, PTR Prentice Hall, Second Edition, 2002.
9. Alasdair Gilchrist, “IoT security Issues”, Oreilly publications, 2017.

Course Outcomes:

On successful completion of this course the students will be able to-

1. Design and implement cryptography algorithms
2. Solve network security problems in various networks
3. Build security systems using elementary blocks
4. Build Trustable cloud based IoT systems
5. Solve IoT security problems using light weight cryptography and appreciate the need for cyber security laws and methods.

MTIO 203-WIRELESS SENSOR NETWORKS

Course Objectives:

The objective of this course is to make students to understand the basic WSN technology and supporting protocols.

Unit I

Overview of Wireless Sensor Networks: Network Characteristics, Network Applications, Network Design Objectives, Network Design Challenges, Technological Background : MEMS Technology , Wireless Communication Technology , Hardware and Software Platforms, Wireless Sensor Network Standards, Introduction, Network Architectures for Wireless Sensor Networks, Classifications of Wireless Sensor Networks, Protocol Stack for Wireless Sensor Networks.

Unit II

Fundamental MAC Protocols, MAC Design for Wireless Sensor Networks, MAC Protocols for Wireless Sensor Networks: Contention-Based Protocols, Contention-Free Protocols, Hybrid Protocols. Introduction, Fundamentals and Challenges, Taxonomy of Routing and Data Dissemination Protocols, Overview of Routing and Data Dissemination Protocols: Location-Aided Protocols, Layered and In-Network Processing-Based Protocols, Data-Centric Protocols, Multipath-Based Protocols, Mobility-Based Protocols, QoS Based Protocols, Heterogeneity-Based Protocols.

Unit III

Wireless Sensor Network Architectures and Overview of Node Clustering Structures, Query Processing in Wireless Sensor Networks, Data Aggregation in Wireless Sensor Networks, Node Localization: Concepts and Challenges of Node Localization Technologies, Ranging Techniques for Wireless Sensor Networks, Wireless Localization Algorithms, Wireless Sensor Node Localization.

Unit IV

Need for Energy Efficiency and Power Control in Wireless Sensor Networks, Passive Power Conservation Mechanisms: Physical-Layer Power Conservation Mechanisms, MAC Layer Power Conservation Mechanisms, Higher Layer Power Conservation Mechanisms, and Active Power Conservation Mechanisms: MAC Layer Mechanisms, Network Layer Mechanisms, Transport Layer Mechanisms.

Unit V

Fundamentals of Network Security, Challenges of Security in Wireless Sensor Networks, Security Attacks in Sensor Networks, Protocols and Mechanisms for Security, IEEE 802.15.4 and ZigBee Security .

Reference Books:

1. Wireless Sensor Networks A Networking Perspective, Jun Zheng & Abbas Jamalipour, a john Wiley & sons, Inc., publication .
2. Wireless sensor networks Technology, Protocols, and Applications , kazem sohraby, daniel minoli, taieb znati , John Wiley & sons, Inc., publication .
3. Fundamentals of wireless sensor networks theory and practice, Waltenegus Dargie, Christian Poellabauer, John Wiley and Sons, Ltd., Publication.

Course Outcomes:

On successful completion of this course the students will be able to-

1. Explain the basic concepts of wireless sensor networks, sensing, computing and communication tasks
2. Demonstrate knowledge of MAC protocols and routing protocols developed for WSN

3. Describe and explain radio standards and communication protocols adopted in wireless sensor networks
4. Be able to carry out simple analysis and planning of WSNs
5. To develop wireless sensor systems for different applications

MTIO 204 (A) -MOBILE APPLICATION DEVELOPMENT

Course Objectives:
The objective of this course is to make students to understand basic concepts of mobile application development.

UNIT I

Overview of Mobile App Development: Mobile Applications, A formula for designing engaging applications, Unique challenges for development of engaging applications, Enterprise mobile development, Mobile App Development Lifecycle Overview

UNIT II

Importance of Design, App Design issues and considerations, Scope of Design in Mobile App Development, Design Principles and Guidelines, Some Design Methods, Factors for choosing mobile app, Mobile App Architectural Components, Mobile App Flow, Mobile App Deployment Considerations

UNIT III

Building Mobile Apps Powered by Enterprise Backend, Connecting the Mobile App with Enterprise IT Services and Data, Types of IT Backend to Integrate from Mobile Apps, Type of API Protocols, Security Integration, Mobile Devices Security Considerations, Secured Data Store and Synchronization, Enterprise Mobile Application Management and Device Management, Special Challenges in Managing Mobile Applications and Devices

UNIT IV

Quality, Cost of Quality, Automated versus Manual Testing, Preproduction versus Post release, Automated Mobile App Testing Considerations, Monetizing Apps, Publishing Apps

UNIT V

The Android Operating System, Working of Android Apps, Programming languages used for developing Android Apps, Android Studio, Emulators, General Procedure for developing an App

Reference Books:

1. Leigh Williamson, Roland Barcia, Omkar Chandgadkar, Ashish Mathur, Soma Ray, Darrell Schrag, Roger Snook, Jianjun Zhang, " Enterprise Class Mobile Application Development", IBM Press Pearson plc, 2016
2. Jakob Iversen Michael Eierman, "Learning Mobile App Development", Pearson Education, 2014
3. J. Paul Cardle, "Android App Development in Android Studio", Manchester Academic Publishers

Course Outcomes:
On successful completion of this course the students will be able to-

1. Understand the entire lifecycle involved in mobile app development
2. Design a mobile app
3. Understand Security considerations in mobile app development
4. Know about the range of techniques available for testing of Mobile Apps and understand when one approach is better than the others.
5. Follow general procedure for developing an App

MTIO 204 (B)Blockchain Technology

Course Objectives:
The objective of this course is to provide conceptual understanding of how block chain technology can be used to innovate and improve business processes.

Unit I Introduction: Overview of Block chain, Public Ledgers, Bitcoin, Smart Contracts, Block in a Block chain, Transactions, Distributed Consensus, Public vs Private Block chain, Understanding Cryptocurrency to Block chain, Permissioned Model of Block chain, Overview of Security aspects of Block chain; Basic Crypto Primitives: Cryptographic Hash Function, Properties of a hash function, Hash pointer and Merkle tree, Digital Signature, Public Key Cryptography, A basic cryptocurrency

Unit II Understanding Block chain with Crypto currency: Bitcoin and Block chain: Creation of coins, Payments and double spending, Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay.
Working with Consensus in Bitcoin**:** Distributed consensus in open environments, Consensus in a Bitcoin network, Proof of Work (PoW) – basic introduction, HashCash PoW, Bitcoin PoW, Attacks on PoW and the monopoly problem, Proof of Stake, Proof of Burn and Proof of Elapsed Time, The life of a Bitcoin Miner, Mining Difficulty, Mining Pool

Unit III Understanding Block chain for Enterprises: Permissioned Block chain: Permissioned model and use cases, Design issues for Permissioned block chains, Execute contracts, State machine replication, Overview of Consensus models for permissioned block chain- Distributed consensus in closed environment, Paxos, RAFT Consensus, Byzantine general problem, Byzantine fault tolerant system, Lamport-Shostak-Pease BFT Algorithm, BFT over Asynchronous systems.

Unit IV Enterprise application of Block chain: Cross border payments, Know Your Customer (KYC), Food Security, Mortgage over Block chain, Block chain enabled Trade, We Trade – Trade Finance Network, Supply Chain Financing, and Identity on Block chain

Unit V Block chain application development: Hyperledger Fabric- Architecture, Identities and Policies, Membership and Access Control, Channels, Transaction Validation, Writing smart contract using Hyperledger Fabric, Writing smart contract using Ethereum, Overview of Ripple and Corda

References:

1. Melanie Swan, “Block Chain: Blueprint for a New Economy”, O’Reilly, 2015
2. Josh Thompsons, “Block Chain: The Block Chain for Beginners- Guide to Block chain Technology and Leveraging Block Chain Programming”
3. Daniel Drescher, “Block Chain Basics”, Apress; 1stedition, 2017
4. Anshul Kaushik, “Block Chain and Crypto Currencies”, Khanna Publishing House, Delhi.
5. Imran Bashir, “Mastering Block Chain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained”, Packt Publishing
6. Ritesh Modi, “Solidity Programming Essentials: A Beginner’s Guide to Build Smart Contracts for Ethereum and Block Chain”, Packt Publishing
7. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O’Dowd, Venkatraman Ramakrishna, “Hands-On Block Chain with Hyperledger: Building Decentralized Applications with Hyperledger Fabric and Composer”, Import, 2018

Course Outcomes:

After the completion of this course, the students will be able to:

1. Understand block chain technology
2. Acquire knowledge of cryptocurrencies
3. Develop block chain based solutions and write smart contract using Hyperledger Fabric and Ethereum frameworks
4. Build and deploy block chain application for on premise and cloud based architecture
5. Integrate ideas from various domains and implement them using block chain technology in different perspectives

MTIO 204 (C)CLOUD AND FOG COMPUTING

Course Objectives:

The objective of this course is to discuss cloud and fog computing as an increasingly viable means of achieving enhanced monitoring and control of industrial processes, differentiate between Cloud and edge-fog computing and what role the two technologies will increasingly play in process control and automation.

UNIT I

Cloud Computing Fundamentals: Motivation for Cloud Computing, Defining Cloud Computing, Principles of Cloud Computing , Five Essential Characteristics, Cloud Ecosystem, Requirements for Cloud Services, Cloud Applications, Benefits and Drawbacks, Cloud Architecture, Network Connectivity in Cloud Computing, Managing the Cloud, Migrating Application to Cloud

UNIT II

Cloud Deployment Models: Private Cloud, Public Cloud, Community Cloud, Hybrid Cloud; Cloud Service Models: Infrastructure as a Service, Platform as a Service, Software as a Service, Their characteristics, Suitability, Pros and Cons, Cloud Service Providers

UNIT III

Technological Drivers of Cloud Computing: Virtualization, Approaches in Virtualization, Hypervisor and Its Role, Types of Virtualization; Memory and Storage Technologies, Networking Technologies, Web 2.0 and Web 3.0, Agile SDLC for Cloud Computing, Programming Models for Cloud Computing

UNIT IV

Security in Cloud Computing: Security Aspects, Data Security, Virtualization Security, Network Security, Security Issues in Cloud Service Models, Audit and Compliance, Data Protection in the Cloud, Cloud Security as a Service; Advanced Concepts in Cloud Computing: Intercloud, Cloud Management, Mobile Cloud, Cloud Governance, Green Cloud, Cloud Analytics

UNIT V

Introduction to Fog Computing, Difference between cloud computing and fog computing, Fog Computing benefits and drawbacks, Applications of Fog computing, Role of Fog computing in Internet of Things, Need for Fog computation, Fog data processing layers.

Reference Books:

1. K. Chandrasekaran, “Essentials of Cloud Computing”, CRC Press, 2015
2. Arshdeep Bahga, Vijay Madisetti, “Cloud Computing: A Hands-on Approach”, 2013.
3. Rajkumar Buyya, James Broberg, Andrzej Goscinski, “Cloud Computing: Principles and Paradigms”, Wiley
4. Rajkumar Buyya, Satish Narayana Srirama, “ Fog and Edge Computing: Principles and Paradigms”, Wiley
5. Assad Abbas, Samee U. Khan, Albert Y. Zomaya “Fog Computing: Theory and Practice”, Wiley, 2020

Course Outcomes:
On successful completion of this course the students will be able to-

1. Articulate the main concepts, key technologies, strengths, and limitations of cloud computing
2. Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.
3. Have understanding of the Technological Drivers of Cloud Computing
4. Explain the core issues of cloud computing such as security, privacy, and interoperability and provide the appropriate cloud computing solutions and recommendations according to the applications used.
5. Attempt to generate new ideas and innovations in cloud computing and Fog computing.

MTIO 205 (A) PYTHON FOR IoT

Course Objectives:

The objective of this course is to equip students with Python programming skills to develop useful IoT (Internet of Things) applications.

UNIT I

Python Concepts, Data Structures, Classes, Interpreter – Program Execution – Statements – Expressions – Flow Controls – Functions - Numeric Types – Sequences - Strings, Tuples, Lists and - Class Definition – Constructors – Inheritance – Overloading – Text & Binary Files - Reading and Writing

UNIT II

Data Wrangling, Combining and Merging Data Sets – Reshaping and Pivoting – Data Transformation – String Manipulation, Regular Expressions

UNIT III

Data Aggregation, Group Operations, Time series & Web Scrapping, Group By Mechanics – Data Aggregation – GroupWise Operations and Transformations – Pivot Tables and Cross Tabulations – Date and Time Date Type tools – Time Series Basics – Data Ranges, Frequencies and Shifting. Data Acquisition by Scraping web applications –Submitting a form - Fetching web pages – Downloading web pages through form submission – CSS Selectors

UNIT IV

Visualization in Python, Matplot lib package – Plotting Graphs – Controlling Graph – Adding Text – More Graph Types – Getting and setting values – Patches

UNIT V

Implementation using Raspberry Pi, Working with Raspberry Pi 3 Model - Installing OS and Designing Systems using Raspberry pi - Configuring Raspberry Pi for VNC Connection - Getting introduced to Linux OS Basic Linux commands and uses - Getting Started with Python - Interface sensor and Actuator with Raspberry Pi

Reference Books:

1. Mark Lutz, “Learning Python”, O'Reilly Media, 5th Edition, 2016.
2. White, “Hadoop: The Definitive Guide”, Third Edition - O’Reilly, 2012.
3. Brandon Rhodes and John Goerzen, “Foundations of Python Network Programming: The Comprehensive Guide to Building Network Applications with Python”, Apress, Second Edition, 2016

Course Outcomes:

On successful completion of this course the students will be able to-

1. Interpret the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements.
2. Determine the methods to create and manipulate Python programs by utilizing the data structures like lists, dictionaries, tuples and sets.

3. Develop Python programs
4. Plot data using appropriate Python visualization libraries
5. Develop intelligent IoT devices using Python

MTIO 205 (B) BIG DATA ANALYTICS FOR IOT

Course Objectives:
The objective of this course is to introduce big data technology platforms and how these can be applied to IoT data.

UNIT I

Introducing IoT Analytics: Types of Data Sources, Understanding Big Data, Applications of Big Data Analytics, IoT Data and Big Data, Defining IoT Analytics, Challenges of IoT Analytics, IoT Analytics Lifecycle and Techniques

UNIT II

IoT, Cloud and Big Data Integration for IoT Analytics: Cloud-based IoT Platform, Requirements of IoT Big Data Analytics Platform, Functional Architecture, Data Analytics for the IoT, Characteristics of IoT Generated Data, Data Analytic Techniques and Technologies, Data Collection Using Low-power, Long-range Radios, IoT Analytics for the cloud

UNIT III

Searching the Internet of Things: A Search Architecture for Social and Physical Sensors, Local Event Retrieval, Using Sensor Metadata Streams to Identify Topics of Local Events in the City, Venue Recommendation, Development Tools for IoT Analytics Applications; IoT Analytics as a Service: Architecture for IoT Analytics-as-a-Service, Sensing-as-a-Service, Scheduling, Metering and Service Delivery, Sensing-as-a-Service Example, From Sensing-as-a-Service to IoT-Analytics- as-a-Service

UNIT IV

Data Science for IoT Analytics: Machine Learning, Feature Engineering with IoT Data, Validation Methods, Bias, Variance, Comparing different Models to find the Best fit, Anomaly Detection, Forecasting, Deep Learning with IoT data; Strategies to organize data for Analytics; The Economics of IoT Analytics: Cost Considerations for IoT Analytics

UNIT V

IoT Analytics Applications and Case Studies: Data Analytics in Smart Buildings, Internet-of-Things Analytics for Smart Cities, Ethical IoT

Reference Books:

1. John Soldatos, “Building Blocks for IoT Analytics”, River Publishers, 2017
2. Andrew Minteer, “Analytics for the Internet of Things”, Packt Publishing, 2017

Course Outcomes:
On successful completion of this course the students will be able to-

1. Understand IoT Analytics Lifecycle and Techniques
2. Know the characteristics of IoT Generated Data
3. Use development tools for IoT Analytics Applications
4. Learn Machine Learning for IoT data
5. Understand IoT Data Analytics applications

MTIO 205 (C) SDN AND NFV FOR IOT

Course Objectives:

The objective of this course is to develop understanding of the two most important network technologies that will transform networks operated by Carrier Service Providers: Software Defined Networking (SDN) and Network Functions Virtualization (NFV).

UNIT I

Software Defined Networks: Background and Motivation, Evolving Network Requirements, The SDN Approach, SDN Architecture, SDN- and NFV-Related Standards

UNIT II

SDN Data Plane and OpenFlow: SDN Data Plane Functions and Protocols, OpenFlow Logical Network Device, OpenFlow Protocol; SDN Control Plane: SDN Control Plane Architecture, ITU-T Model, OpenDaylight, REST, Cooperation and Coordination Among Controllers; SDN Application Plane: SDN Application Plane Architecture, Network Services Abstraction Layer, Traffic Engineering, Measurement and Monitoring, Security, Data Center Networking, Information-Centric Networking

UNIT III

Network Functions Virtualization: Concepts and Architecture, Background and Motivation for NFV, Virtual Machines, NFV Concepts, NFV Benefits and Requirements, NFV Reference Architecture; NFV Functionality: NFV Infrastructure, Virtualized Network Functions, NFV Management and Orchestration, NFV Use Cases, SDN and NFV; Network Virtualization: Virtual LANs, OpenFlow VLAN Support, Virtual Private Networks, Network Virtualization, Software-Defined Infrastructure

UNIT IV

Defining And Supporting User Needs: Quality of Service, QoS Architectural Framework, Integrated Services Architecture, Differentiated Services, Service Level Agreements, IP Performance Metrics, OpenFlow QoS Support; QoE: User Quality of Experience: QoE, Service Failures Due to Inadequate QoE Considerations, Definition of Quality of Experience, Factors Influencing QoE, Measurements of QoE, Applications of QoE

UNIT V

Security: Security Requirements, SDN Security, NFV Security, Cloud Security, IoT Security

Reference Books:

1. William Stallings, “Foundations of Modern Networking”, Pearson Education, 2016
2. Paul Goransson, “Software Defined Networks A Comprehensive Approach”, Morgan Kaufmann, Elsevier
3. Thomas D. Nadeau, Ken Gray, “Software Defined Networks”, O’Reilly
4. Guy Pujolle, “Software Networks”, Wiley

Course Outcomes:

On successful completion of this course the students will be able to-

1. Have knowledge of SDN concepts and technology

2. Know about the application areas that can be supported by SDN and provides a number of examples of SDN applications
3. Discuss NFV concepts, technology, and applications, as well as network virtualization
4. Understand quality of service (QoS) and quality of experience (QoE) to determine customer needs and network design responses to those needs
5. Analyse the security issues that have emerged with the evolution of SDN and NFV