PONDICHERRY UNIVERSITY
DEPARTMENT OF COMPUTER SCIENCE

REGULATIONS AND SYLLABUS

Master of Technology
(Network & Information Security)

(For CBSC System in Pondicherry University)
(Effective from the academic year 2018-2019)

Eligibility for Admission


OR

M.Sc in Computer Science/ Information Technology/ Software Engineering with a minimum of 55% marks.

OR

MCA with Bachelors degree in Computer science/ Computer Applications/ Mathematics/ Statistics/ Physics/ Electronics/ Applied Science with a minimum of 55% marks in each degree.

Duration of the Course

The course duration shall normally be of two years duration spread over four semesters. The maximum duration to complete the course shall be 4 years.

Medium

The medium of instruction shall be English.

Passing Minimum

Passing Eligibility & Classification for the award of the Degree are as per the Choice Based Credit System norms of Pondicherry University.
PONDICHERRY UNIVERSITY
DEPARTMENT OF COMPUTER SCIENCE

Master of Technology
(Network & Information Security)

COURSE STRUCTURE

<table>
<thead>
<tr>
<th>Course Category</th>
<th>Notation</th>
<th>Number of Credits</th>
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<tbody>
<tr>
<td>Core Courses</td>
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<td>Supportive Hard Core</td>
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# M.Tech(NIS) CURRICULUM

## FIRST SEMESTER

<table>
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<tr>
<th>S.No.</th>
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<td>Mathematics for Network Engineering</td>
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<td>2</td>
<td>CSNS612</td>
<td>Principles of Modern Cryptography</td>
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<td>3</td>
<td>CSNS613</td>
<td>Operating Systems: Administration And Security</td>
<td>H</td>
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<td>4</td>
<td>CSNS614</td>
<td>Network Management</td>
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<td>CSNS615</td>
<td>Foundations of modern networking</td>
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## SECOND SEMESTER

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<td>3</td>
<td>CSNS623</td>
<td>Distributed Systems and Security</td>
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<td>4</td>
<td>CSNS624</td>
<td>Network Protocols</td>
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<td>CSNS625</td>
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## THIRD SEMESTER

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<td>2</td>
<td>CSNS712</td>
<td>Information Security Managementand Standards</td>
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## FOURTH SEMESTER

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<td>Project Work Phase – 2</td>
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<td>CSNS722</td>
<td>Project Report &amp; Viva Voce</td>
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*In case of failure due to lack of attendance or minimum internal marks, the course has to be repeated in the subsequent semester and only after successful completion, CSNS 721 and CSNS 722 could be credited. If failure is due to external marks only, the course can be credited along with CSNS 721 and CSNS 722.
LIST OF DOMAIN SPECIFIC ELECTIVES (15 Credits)

Note: All Course Codes are to be preceded with ‘CSNS ’

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<td>Cloud Storage infrastructure</td>
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<td>Converged networks</td>
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<td>CSNS815</td>
<td>Enterprise storage systems</td>
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<td>Data center virtualization</td>
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<td>Pattern Recognition techniques in Cyber crime</td>
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<td>CSNS824</td>
<td>Cyber Laws and Security Policies</td>
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<td>CSNS825</td>
<td>Information Security and Risk Management</td>
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<td>Intrusion Detection Systems and Firewall</td>
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<td>Multimedia Security &amp; forensics</td>
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<td>CSNS832</td>
<td>Cloud Orchestration and NFV</td>
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<td>CSNS842</td>
<td>IoT Architecture and Protocols</td>
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<td>CSNS843</td>
<td>Embedded Systems</td>
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<td>CSNS844</td>
<td>Privacy and Security in IoT</td>
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<td>CSNS845</td>
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<td>CSNS846</td>
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<td>CSNS847</td>
<td>Wireless Sensor Protocols and Programming</td>
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<td>Radio network planning &amp; optimization</td>
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<td>CSNS852</td>
<td>Advanced Wireless Networks</td>
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<td>Mobile Communication Networks</td>
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<td>CSNS855</td>
<td>Advanced Mobile Computing</td>
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<td>CSNS856</td>
<td>High Speed Networks</td>
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M.Tech (NIS)  
First Semester
Pre-requisite:
- Basic knowledge on discrete mathematics – basic set theory and proof techniques, mathematic induction, graphs, relations, functions, and logic.

Objectives:
- To develop the ability to use the concepts of Special Functions for solving problems on Networks.
- To analyse the Graph Theory algorithms and understand its applications in Networks.
- To impart knowledge on Numerical Methods that will come in handy to solve numerically the problems that arise in engineering. This will also serve as a precursor for future research.
- To acquire skills in analysing Queuing Models.

Module-I: 9 hrs
Graph Theory Introduction: Introduction to Graphs - Paths - Cycles - And Trails - Vertex Degrees and Counting - Directed Graphs - Trees and Distance: Basic Properties - Spanning Trees and Enumeration - Optimization and Trees.

Module-II: 9 hrs

Module-III: 9 hrs

Module-IV: 9 hrs

Module-V: 9 hrs
Queueing Theory: Markovian queuing models - Little's formula - Multi-server queues - M/G/1 Queues - Pollaczek - Khintchine formula - Applications in Networks.

Text Book(s):
Reference Book(s):

Pre-requisite:
- Basic knowledge Of Mathematics, Algorithms, Computer Networks

Objectives:
- To gain knowledge about the mathematics of the cryptographic algorithms
- To get an insight into the working of different existing cryptographic algorithms
- To get an insight into the working of Authentication Mechanisms and Key Management

Module-I: 9 hrs

Module-II: 9 hrs
Traditional Symmetric Key Ciphers: Mathematics of Symmetric Key Cryptography – Algebraic Structures - Introduction to Modern Symmetric Key Ciphers- DES, Blowfish, IDEA, AES, RC5, - Modes of operation of Modern Symmetric Key Ciphers

Module-III: 9 hrs
Mathematics of Asymmetric Key Cryptography: Primes, Primality Testing, Factorization, Chinese Remainder Theorem, Quadratic Congruence - Asymmetric Key Cryptography – RSA, ElGamal Cryptosystem, Elliptic Curve Cryptosystem, Public Key Infrastructure and Digital Certificates

Module-IV: 9 hrs

Module-V: 9 hrs

Text Book(s):

**Reference Book(s):**


CSNS613: OPERATING SYSTEMS: ADMINISTRATION AND SECURITY

L T P C
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Pre-requisite:
- Familiar with basic hardware and software aspects of computer systems organization.

Objectives:
- Become knowledgeable in the concepts of various functions of operating systems
- Gain hands-on experience in the basic administration of a Linux system.
- Understand the concepts of securing operating systems.

Module-I: 9 hrs


Module-II: 9 hrs


Module-III: 9 hrs


Module-IV: 9 hrs

Linux Administration and Other Services: Open source operating system- Linux Kernel architecture- User administration in Linux- Services offered by Linux OS- Configuration of email service, web service, DNS in Linux- Syntactical Interpretation of various files related to different services in Linux

Module-V: 9 hrs


**Text Book(s):**

**Reference Book(s):**
Pre-requisite:
- Introduction to Computer Networks and Data Structure

Objectives:
- The purpose of the course is to provide the technical understanding and managerial view of network operations so that the heterogeneous architectures can easily be handled
- Students will gain an understanding of SNMP protocol and its roles in providing information about network devices to a management station.

Module-I: 9 hrs

Hands on: - Using NS2/NS3/WireShark practice Packet Capturing during web page requests and reply - Investigate the packets for protocols, the values of the header fields and the packet sizes.

Module-II: 9 hrs

Hands On-1. Explore the features of network monitoring software (Eg. WireShark) like Filters, Flow Graphs (TCP), Statistics, and Protocol Hierarchies.

Hands On-2. Create files on Web Server – Try accessing the files from a remote machine - Capture the packets and observe the log file. (Same can be done for Folders on the Web Server and observe the log)

Module-III: 9 hrs

Hands On - Install any open source NMS in the system (Like OpenNMS) and explore OAMP.

Module-IV: 9 hrs

**Hands On:** Design a Network with 1 router, 2 Switches, Server (PDC) and 3 to 4 clients - Establish communication between the devices - Create the rules in the router to drop/restrict the packets between nodes - Monitor the network activity

**Module-V:** 9 hrs


**Text Book(s):**
3. Simple Network Management Protocol (SNMP) 5.2.11, Ericsson AB, 2018

**Reference Book(s):**
5. https://ns2projects.org/ns2-simulator-free-download/
8. https://www.gambitcomm.com/site/gambit3.shtml?gclid=CjwKCAjw-8nbBRBnEiwAqWt1zYy_Tw_mWayq1fSDDfeoSIZurFwDvQHmWM44NNYVXKnOKNfEidynDROcWkQAvD_BwE

**Available Journals for Network Management:**
4. https://dl.acm.org/citation.cfm?id=J332
Pre-requisite:
• Networking Basics: OSI Model, TCP, UDP, TCP/IP

Objectives:
• Understand the principles behind the Modern Network approaches such as SDN NFV and IoT
• Ability to analyse Data Center topologies and virtualized environment
• Understand the data traversal over virtualized environment for IoT
• Design algorithms for virtualization over multi-tenant environments

Module-I: 9 hrs

Module-II: 9 hrs

Module-III: 9 hrs
Virtualization: Background and Motivation for NFV - Virtual Machines - NFV Concepts - NFV Reference Architecture - NFV Infrastructure - Virtualized Network Functions - NFV Management and Orchestration - NFV Use Cases - SDN and NFV

Module-IV: 9 hrs

Module-V: 9 hrs

Text Book(s):
Reference Book(s):

1. *Network Function virtualization with a touch of SDN* by Paresh Shah, Syed Farrukh Hassan, Rajendra Chayapathi

M.Tech (NIS)

Second Semester
Pre-requisite:
- Basic understanding of linear programming.

Objectives:
- Be familiar with resource management techniques.
- Learn to solve problems in linear programming and Integer programming.
- Be exposed to CPM and PERT.

Module-I: 9 hrs

Module-II: 9 hrs

Module-III: 9 hrs
Integer Programming: Cutting plan algorithm – Branch and bound methods, Multistage (Dynamic) programming.

Module-IV: 9 hrs

Module-V: 9 hrs
Object Scheduling: Network diagram representation – Critical path method – Time charts and resource leveling – PERT.

Text Book(s):

Reference Book(s):
CSNS622: NETWORK SECURITY

Pre-requisite:
- Good understanding of the basics of TCP/IP.

Objectives:
- What is Network Security and why it is important.
- To know application and network layer security
- To provide knowledge on wireless and mobile security

Module-I: 9 hrs
Introduction: Introduction to Security in Networks – Characteristics of Networks – Intrusion – Kinds of security breaches – Plan of attack - Points of vulnerability – Methods of defense – Control measures – Effectiveness of controls

Module-II: 9 hrs

Module-III: 9 hrs

Module-IV: 9 hrs

Module-V: 9 hrs

Text Book(s):
Reference Book(s):

CSNS623: DISTRIBUTED SYSTEMS AND SECURITY

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**Pre-requisite:**
- Good knowledge of network security and introduction to threats.

**Objectives:**
- Become knowledgeable in the concepts of distributed systems and security
- Get the exposure to Threats and Vulnerabilities.
- To acquire knowledge on Host level and service level solutions

**Module-I:**

**Module-II:**

**Module-III:**

**Module-IV:**

**Module-V:**
Text Book(s):

Reference Book(s):
CSNS624: NETWORK PROTOCOLS

Pre-requisite:
- Basic understanding of computer networking and cryptography.

Objectives:
- To have exposure on various protocols.
- Gain knowledge on various ISO protocols.
- Be exposed to various wireless protocols

Module-I: 9 hrs


Module-II: 9 hrs


Module-III: 9 hrs


Module-IV: 9 hrs


Module-V: 9 hrs

Text Book(s):

Reference Book(s):
CSNS625: WIRELESS COMMUNICATION NETWORKS

Pre-requisite:
- Good understanding of the basics in networking.

Objectives:
- To study about wireless LAN standards and it’s important.
- To provide knowledge on Bluetooth and WAP
- To know about satellite communication

Module-I: 9 hrs


Module-II: 9 hrs

Wireless LAN Standards: Evolution of IEEE 802.11- Introduction to IEEE 802.11 -General Description- Medium Access Control (MAC) for the IEEE 802.11 -WLANs Physical Layer for IEEE 802.11 -WLANs; Radio systems -IR Systems Applications

Module-III: 9 hrs


Module-IV: 9 hrs


Module-V: 9 hrs


Text Book(s):
Reference Book(s):

M.Tech (NIS)

Third Semester
CSNS712: INFORMATION SECURITY MANAGEMENT AND STANDARDS

Pre-requisite:
- Familiarity with basic principles of information security.

Objectives:
- Understand the management aspects of information security.
- To Discuss about Security life cycle and planning
- Demonstrate various security standardizations, for example, ISO/IEC 27002.

Module-I: 9 hrs

Module-II: 9 hrs

Module-III: 9 hrs

Module-IV: 9 hrs

Module-V: 9 hrs


Text Book(s):

Reference Book(s):
M.Tech (NIS)

Fourth Semester
M.Tech (NIS)

ELECTIVES
(15 Credits)
CLOUD
COMPUTING
Pre-requisite:
- Basic concepts of Operating Systems (how they work and operate at a high level): Windows, Linux and a bit of basic concepts about them.

Objectives:
- Analyse the components of cloud computing showing how business agility in an organization can be created
- Evaluate the deployment of web services from cloud architecture
- Critique the consistency of services deployed from a cloud architecture
- Critically analyse case studies to derive the best practice model to apply when developing and deploying cloud based applications

Module-I: 9 hrs

Module-II: 9 hrs

Module-III: 9 hrs

Module-IV: 9 hrs

Module-V: 9 hrs
Text Book(s):
2. Gautam Shroff, Enterprise Cloud Computing Technology Architecture Applications
3. Toby Velte, Anthony Velte, Robert Elsenpeter, Cloud Computing, A Practical Approach

Reference Book(s):
1. Dimitris N. Chorafas, Cloud Computing Strategies
Pre-requisite:
- Basic knowledge on virtualization.

Objectives:
- Critically appraise the opportunities and challenges of information management
- Evaluate information storage management design in a cloud environment
- Analyse the role technology plays in the design of a storage solution in a cloud architecture
- Investigate how a global storage solution can be optimized so that it can be delivered successfully from the cloud
- Analyse how best to provide reliable access to information both locally and remotely using storage technologies

Module-I: 9 hrs


Module-II: 9 hrs


Module-III: 9 hrs

Measurements and Data Footprint Reduction: Getting Started - Making Sense of Metrics and Measurements - Different Metrics for Different Audiences - Key Performance Indicators

**Module-IV:**

**Storage Services and Connectivity:** Tiered Storage - Storage Reliability, Availability, and Serviceability (RAS) - Aligning Storage Technology and Media to Application Needs - Storage Services and Functionalities - Storage System Architectures - Storage Virtualization and Virtual Storage - Common Storage Questions - Virtual Servers - Inside Virtual Servers and Virtual Machines - Virtual Desktop Infrastructure - Cloud and Virtual Servers - Can and Should All Servers or Desktops Be Virtualized? - Virtualization Beyond Consolidation: Enabling IT Agility - Common Virtualization Questions - Connectivity: Networking with Your Servers and Storage - Networking Challenges - I/O and Networking Bits and Bytes, Decoding Encoding - I/O and Networking Fundamentals - Server (Physical, Virtual and Cloud) Topics - I/O and Networking Devices - Converged and Unified Networking - Local Networking (DAS, SANs, and LANs) - Enabling Distance (MANs and WANs) - Cloud, Virtualization, and Management Topics - Configuring for Reliability, Availability, and Serviceability (RAS) - Common Networking Questions.

**Module-V:**


**Text Book(s):**
1. Greg Schulz 2011, *Cloud and Virtual Data Storage Networking*
2. Marty Poniatowski, *Foundations of Green IT*
3. EMC, *Information Storage and Management: Storing, Managing, and Protecting*

**Reference Book(s):**
1. Volker Herminghaus, Albrecht Scriba., *Storage Management in Data Centers*
2. Klaus Schmidti, *High Availability and Disaster Recovery*
Pre-requisite:

- Familiarity with Information security.

Objectives:

- Compare modern security concepts as they are applied to cloud computing
- Assess the security of virtual systems
- Evaluate the security issues related to multi-tenancy
- Appraise compliance issues that arise from cloud computing

Module-I: 9 hrs


Module-II: 9 hrs

Data Classification and Security: Data Inventory and Discovery - Jurisdictional Requirements - Data Rights Management - Cloud Data Life Cycle - Cloud Storage - Cloud Data Security Foundational Strategies - Security in the Cloud - Virtualization - Cloud Attack Surface - Disaster Recovery (DR)

Module-III: 9 hrs


Module-IV: 9 hrs


Module-V: 9 hrs


Text Book(s):

1. Brian T. O'Hara, Certified Cloud Security Professional
2. Ronald L. Krutz, Russell Dean Vines, Cloud Security
3. John Rittinghouse, James Ransome, Cloud Computing
4. J.R. ("Vic") Winkler, Securing the Cloud

**Reference Book(s):**
2. VMware Security Hardening Guide
4. NIST Guidelines on Security and Privacy in Public Cloud Computing
5. NIST Guide to Security for Full Virtualization Technologies
6. NIST The NIST Definition of Cloud Computing
7. William Hau, Rudolph Araujo et al How Virtualization Affects PCI DSS
8. Chenxi Wang Compliance with Clouds: Caveat Emptor
CSNS814: CONVERGED NETWORKS

Pre-requisite:
- Knowledge of basic networking concepts, routing protocols and IP addressing mechanisms.

Objectives:
- Implement applications enabled by a multi-service convergent network
- Explain how real-time traffic is prioritized and carried within a data network.
- Engineer networks suitable for voice, multicast traffic and high-speed switched Internet based networks

Module-I: 9 hrs

Module-II: 9 hrs

Module-III: 9 hrs

Module-IV: 9 hrs

Module-V: 9 hrs

Text Book(s):
2. Connecting Networks v6 Companion Guide, Cisco Networking Academy
4. CVOICE 8.0: Implementing Cisco Unified Communications Voice over IP and QoS
Reference Book(s):
2. Christina Hattingh, Darryl Sladden, ATM ZakariaSwapan 2010, SIP Trunking, Cisco Press
3. Website: Cisco Systems Inc. 2006, Voice/Data Integration Technologies
CSNS815: ENTERPRISE STORAGE SYSTEMS

Pre-requisite:
- Understanding of key concepts related to cloud computing.

Objectives:
- Evaluate various storage classifications and technologies.
- Analyse storage architectures, processes, components and how they relate to virtualization.

Module-I: 9 hrs

**Storage Systems:** Data Classification, Storage Evolution and Data Center infrastructure- Host components, Connectivity, Storage, and Protocols. Components of a disk drive, physical disk and factors affecting disk drive performance - RAID level performance and availability considerations - Components and benefits of an intelligent storage system.

Module-II: 9 hrs

**Storage Networking Technologies:** Direct-Attached Storage (DAS) architecture, Storage Area Network (SAN) attributes components, topologies, connectivity options and zoning. FC protocol stack, addressing, flow control, and classes of service. Networked Attached Storage (NAS) components, protocols, IP Storage Area Network (IP SAN) iSCSI, FCIP and FCoE architecture. Content Addressed Storage (CAS) elements, storage, and retrieval processes.

Module-III: 9 hrs

**Virtualization:** Block-level and file-level storage virtualization technology, virtual provisioning and cloud computing.

Module-IV: 9 hrs

**Business Continuity:** Business Continuity measurement, terminologies, and planning. Backup designs, architecture, topologies, and technologies in SAN and NAS environments - Local and Remote replication using host and array-based replication technologies such as Synchronous and Asynchronous methods.

Module-V: 9 hrs

**Storage Security and Management:** Storage security framework and various security domains - Security implementation in SAN, NAS and IP-SAN networking. Monitoring and Storage management activities and challenges

Text Book(s):
1. Information Storage and Management, EMC
3. Ulf Troppens, Rainer Erkens, Wolfgang Mueller-Friedt, Rainer Wolafka, Nils Haustein, Storage Networks Explained
Reference Book(s):

Pre-requisite:
- Familiarity with managing Virtual Environments.

Objectives:
- Identify various constraints and challenges in setting up a data center
- Demonstrate Enterprise level virtualization and access control in virtual machines
- Discuss the components needed for end-to-end virtualization.

Module-I: 9 hrs

Introduction: Introduction Virtualization History and Definitions - Data Center Essential Definitions - The Origins of Data Center Virtualization Classifying Virtualization Technologies Data Center Network Evolution - Data Center Network Topologies - Network Virtualization Benefits.

Module-II: 9 hrs


Module-III: 9 hrs

Virtualization In Storage Technologies: Data Center Storage Devices - Accessing Data in Rest - Storage Virtualization - Some Fibre Channel Definitions - Fabric Processes - Defining and Exploring VSANs - Fibre Channel over IP - Inter-VSAN Routing - Data Center Bridging - Introducing Fibre Channel over Ethernet - Deploying Unified Server Access - Configuring Multihop FCoE - Unified Fabric Designs - FCoE and SAN Extension.

Module-IV: 9 hrs


Module-V: 9 hrs

Text Book(s):
1. Gustavo Alessandro, Data Center Virtualization Fundamentals
2. Mike Laverick, VMware vSphere 4 Implementation
3. Jason W. McCarty, Scott Lowe, Matthew K. Johnson, VMware vSphere Administration Instant Reference

Reference Book(s):
1. Brian Perry, Chris Huss, Jeantet Fields, VCP VMware Certified Professional on vSphere 4 Study Guide
2. Jason Kappel, Anthony Velte, Toby Velte, Microsoft Virtualization with Hyper-V: Manage Your Datacenter with Hyper-V, Virtual PC, Virtual Server, and Application Virtualization
CSNS817: DATA CENTER NETWORKING

Pre-requisite:
- Familiarity of Network function Virtualization

Objectives:
- Critically discuss data center networking technologies and protocols
- Evaluate key concepts in modern Layer 2 & Layer 3 data center networks
- Research a topic related to networking technologies in modern data centers
- Design, build and configure complex routed and switched networks

Module-I: 9 hrs

Module-II: 9 hrs
Data Center Architectures: Network connectivity optimization evolution: Top of rack (TOR), end of rack (EOR), scale up vs scale up, solutions that reduce power and cabling - Data Center standards; TIA/EIA-942 - Structured cabling standards, fiber and copper cabling characteristics, cable management, bandwidth requirements, I/O connectivity.

Module-III: 9 hrs

Module-IV: 9 hrs
Layer 2 Networks: Ethernet; IEEE 802.3ba; 40 Gbps and 100 Gbps Ethernet. IEEE 802.1D Spanning Tree Protocol (STP), RSTP, PVST, MSTP. TRILL (Transparent Interconnection of Lots of Links), RBRidges, IEEE 802.1Qbg Edge Virtual Bridging, 802.1Qbh Bridge Port Extension – Fiber Channel over Ethernet (FCoE) vs Internet Small Computer System Interface (iSCSI). Data Center Bridging (DCB); priority-based flow control, congestion notification, enhanced transmission selection, Data Center Bridging Exchange (DCBX) - Layer 2 Multicasting; Case studies.

Module-V: 9 hrs
Layer3&Beyond: Layer 3 Data Center technologies, network virtualization. Protocols; IPv4, IPv6, MPLS, OSPF, IS-IS, BGP. OTV, VPLS layer 2 extension protocols. Locator Identifier Separation Protocol (LISP) - Layer 3 Multicasting - Data Center application services - Data
center networking use case studies and the enabling technologies and protocols in the modern data center.

**Text Book(s):**
1. Gary Lee, *Cloud Networking: Understanding Cloud-based Data Center Networks*
2. Silvano Gai, Tommi Salli, Roger Andersson, *Cisco Unified Computing System*
3. Ron Fuller, David Jansen, Matthew McPherson, *NX-OS and Cisco Nexus Switching: Next-Generation Data Center Architectures*
4. Silvano Gai, Claudio DeSanti, *I/O Consolidation in the Data Center*
5. Kevin Corbin, Ron Fuller, David Jansen, *NX-OS and Cisco Nexus Switching: Next Generation Data Center Architectures*
6. *Data Center Virtualization Fundamentals Understanding Techniques And Designs*

**Reference Book(s):**
1. Nash Darukhanawalla, Patrice Bellagamba, *Interconnecting Data Centers Using VPLS*
2. Robert W. Kembel, Roger Cummings (Introduction), *The Fiber Channel Consultant*
3. *Fiber Channel Switched Fabric*
CYBER SECURITY
CSNS821: CYBER FORENSICS

Pre-requisite:
- Knowledge on basic Cryptographic Algorithms and Protocols, Computer Networks, Web and Mobile Technology AND Security

Objectives:
- Learn the security issues network layer and transport layer
- Be exposed to security issues of the application layer
- Learn computer forensics
- Be familiar with forensics tools
- Learn to analyse and validate forensics data

Module-I: 9 hrs
Legal and Ethical Principles: Introduction to Forensics – The Investigative Process – Code of Ethics, Ethics of Investigations, Evidence Management – Collection, Transport, Storage, access control, disposition

Module-II: 9 hrs
Forensic Science: Principles and Methods – Scientific approach to Forensics, Identification and Classification of Evidence, Location of Evidence, Recovering Data, Media File Forensic Steps, Forensic Analysis – Planning, Case Notes and Reports, Quality Control

Module-III: 9 hrs
Digital Forensics: Hardware Forensics – Hidden File and Anti-forensics - Network Forensics – Virtual Systems - Mobile Forensics

Module-IV: 9 hrs
Application Forensics, Tools and Report Writing – Application Forensics, Email and Social Media Investigations, Cloud Forensics, Current Digital Forensic Tools, Report Writing for Investigations

Module-V: 9 hrs

Text Book(s):

Reference Book(s):
CSNS822: BLOCK CHAIN TECHNOLOGY

Pre-requisite:
- Basic knowledge on Private Key Cryptography and P2P Network.

Objectives:
- Understand crypto currency concepts
- Understand the working and transactions of bit coin
- Analyse the function Blockchain

Module-I: 9 hrs


Bitcoin Overview - Transaction Inputs and Outputs - Transaction Chains - Making Change - Common Transaction Forms - Constructing a Transaction - Getting the Right Inputs - Creating the Outputs - Adding the Transaction to the Ledger - Bitcoin Mining - Mining Transactions in Blocks - Spending the Transaction

Module-II: 9 hrs

Bitcoin Core: The Reference Implementation - Bitcoin Development Environment - Compiling Bitcoin Core from the Source Code - Selecting a Bitcoin Core Release - Configuring the Bitcoin Core Build - Building the Bitcoin Core Executables - Running a Bitcoin Core Node - Running Bitcoin Core for the First Time - Configuring the Bitcoin Core Node - Bitcoin Core Application Programming Interface (API) - Getting Information on the Bitcoin Core Client Status - Exploring and Decoding Transactions - Exploring Blocks - Using Bitcoin Core

Module-III: 9 hrs

Module-IV: 9 hrs

Advanced Transactions and Scripting: Multisignature -Pay-to-Script-Hash (P2SH) -P2SH Addresses -Benefits of P2SH -Redeem Script and Validation -Data Recording Output (RETURN) -Time locks -Transaction Lock time (nLocktime) -Check Lock Time Verify (CLTV) -Relative time locks -Relative time locks with nSequence -Relative time locks with CSV -Median-Time-Past -Time lock Defense Against Fee Sniping-Scripts with Flow Control (Conditional Clauses) -Conditional Clauses with VERIFY Opcodes -Using Flow Control in Scripts -Complex Script Example The Bitcoin Network -Peer-to-Peer Network Architecture -Node Types and Roles -The Extended Bitcoin Network -Bitcoin Relay Networks -Network Discovery -Full Nodes -Exchanging Inventory - Simplified Payment Verification (SPV) Nodes - Bloom Filters -How Bloom Filters Work -How SPV Nodes Use Bloom Filters -SPV Nodes and Privacy - Encrypted and Authenticated Connections -Tor Transport -Peer-to-Peer Authentication and Encryption -Transaction Pools

Module-V: 9 hrs

Block chain :The Blockchain Structure of a Block -Block Header -Block Identifiers: Block Header Hash and Block Height -The Genesis Block -Linking Blocks in the Blockchain -Merkle Trees -Merkle Trees and Simplified Payment Verification (SPV) -Bitcoin Test Blockchains - Testing Playground -The Segregated Witness Testnet -The Local Blockchain - Using Test Blockchains for Development,

Text Book(s):

Reference Book(s):
CSNS823: PATTERN RECOGNITION TECHNIQUES IN CYBER CRIME

Pre-requisite:

- A good foundation of probability and linear algebra and any Machine Learning background will help.

Objectives:

- Pattern classification algorithm for a pattern recognition problem and properly implement the algorithm using modern computing tools
- Clustering is an important aspect of supervised learning and has been covered extensively in this course.
- Cybercrime techniques and how to apply in pattern recognition.
- To solve real-world problems using Pattern Recognition techniques.

Module-I: 9 hrs


Module-II: 9 hrs


Module-III: 9 hrs


Module-IV: 9 hrs


Module-V: 9 hrs

Protecting consumer web and production systems: types of abuse and data that can stop them – learning for abuse problems- large attacks - production systems - ML for system

**Text Book(s):**

**Reference Book(s):**
CSNS824: CYBER LAWS AND SECURITY POLICIES

Pre-requisite:
- Familiarity with Cyber Security and Cyber Crime.

Objectives:
- To explain the basic information on cyber security.
- To understand the issues those are specific to amendment rights.
- To have knowledge on copyright issues of software's.
- To understand ethical laws of computer for different countries.

Module-I: 9 hrs

Module-II: 9 hrs

Module-III: 9 hrs

Module-IV: 9 hrs

Module-V: 9 hrs

Text Book(s):
5. https://www.dhs.gov/topic/cybersecurity
Reference Book(s):

Pre-requisite:
- A broad knowledge of Information security technologies is assumed: cryptography (public key and symmetric key), firewalls, IDS, viruses/virus detection, access control, etc.

Objectives:
- To present a system and management view of information security: what it is, what drives the requirements for information security
- How to integrate it into the systems design process, and life cycle security management of information systems.

Module-I: 9 hrs
RISK I: Identifying and categorizing risks: Risk Management – Risk Identification – Risk Assessment -Documenting the Results

Module-II: 9 hrs

Module-III: 9 hrs

Module-IV: 9 hrs

Module-V: 9 hrs

Text Book(s):
1. Management of Information Security by Michael E. Whitman and Herbert J. Mattord, Second edition,

Reference Book(s):
CSNS826: INTRUSION DETECTION SYSTEMS AND FIREWALL

Pre-requisite:

- Fundamental knowledge in Operating Systems and Networks

Objectives:

- Understand when, where, how, and why to apply Intrusion Detection tools and techniques in order to improve the security posture of an enterprise.
- Apply knowledge of the fundamentals and history of Intrusion Detection in order to avoid common pitfalls in the creation and evaluation of new Intrusion Detection Systems
- Analyse intrusion detection alerts and logs to distinguish attack types from false alarms

Module-I:

9 hrs

History of Intrusion Detection: Audit, Concept and definition, Internal and external threats to data, attacks, Need and types of IDS, Information sources Host based information sources, Network based information sources.

Module-II:

9 hrs

Intrusion Prevention System and Snort: Network IDs protocol based IDs, Hybrid IDs, Analysis schemes, thinking about intrusion. A model for intrusion analysis- Incident Responses – Incident Response Process – IDS ad IPS response Phases Forensics –Corporate Issues - Snort Installation Scenarios, Installing Snort, Running Snort on Multiple Network Interfaces, Snort Command Line Options. Step-By-Step Procedure to Compile and Install Snort Location of Snort Files, Snort Modes Snort Alert Modes

Module-III:

9 hrs

Snort Rules and ACID: Rule Headers, Rule Options, the Snort Configuration File etc. Plugins, Preprocessors and Output Modules, Using Snort with MySQL - Using ACID and Snort Snarf with Snort -Agent development for intrusion detection - Architecture models of IDs and IPs

Module-IV:

9 hrs

Module-V: 9 hrs

**Building Firewalls:** Firewall Architectures - Firewall Design - Packet Filtering - Proxy Systems - Bastion Hosts - UNIX and Linux Bastion Hosts 176 - Windows NT and Windows 2000 Bastion Hosts

**Text Book(s):**
3. Elizabeth D. Zwicky, Simon Cooper & D. Brent Chapman, “Building Internet Firewalls” O’Reilly

**Reference Book(s):**
Pre-requisite:
- Basic knowledge of analysis, authentication, hiding and recovery of data.

Objectives:
- Become knowledgeable in the concepts of various functions of operating systems
- Gain hands-on experience in the basic administration of a Linux system.
- Understand the concepts of securing operating systems.

Module-I: 9 hrs

Module-II: 9 hrs

Module-III: 9 hrs

Module-IV: 9 hrs

Module-V: 9 hrs

Text Book(s):

Reference Book(s):
Pre-requisite:
- Good knowledge of computer networks.

Objectives:
- To comprehend the differences between traditional networks and software defined networks
- Understand advanced and emerging networking technologies
- Obtain skills to do advanced networking research and programming
- Learn how to use software programs to perform varying and complex networking tasks
- Expand upon the knowledge learned and apply it to solve real world problems

Module-I: 9 hrs

Module-II: 9 hrs

Module-III: 9 hrs

Module-IV: 9 hrs
Sdn Applications and Use Cases: SDN in the Data Center - SDN in Other Environments - SDN Applications - SDN Use Cases - The Open Network Operating System 3

Module-V: 9 hrs
SDN'S Future and Perspectives: SDN Open Source - SDN Futures - Final Thoughts and Conclusions

Text Book(s):
2. SDN - Software Defined Networks by Thomas D. Nadeau & Ken Gray, O'Reilly, 2013

Reference Book(s):


CSNS832: CLOUD ORCHESTRATION AND NFV

Pre-requisite:
- Basic understanding of cloud-based services and virtualization.

Objectives:
- To learn about advanced OS technologies
- To learn virtualization techniques and Cloud orchestration
- To design next generation cloud applications

Module-I:

Overview and Designing: OpenStack Cloud architectural Consideration- Logical architecture, Nova-Compute service, Neutron-Networking Services, Architecture setup Deploying OpenStack, Cloud Controller and service. Case Studies - OpenStack – Amazon- Google – Microsoft

Module-II:

Advanced OS Technologies: Introduction to virtualization - Xen, Hyper-V, KVM, Hardware support for virtualization - Memory virtualization (IOMMU) - Network virtualization - SR-IOV – VMQ – Advance Networking (SDN and NFV)

Module-III:


Module-IV:


Module-V:

NFV deployment in the Cloud-Orchestrating: Deploying and Managing NFV Infrastructure - Network services - Software Defined Networking (SDN)

Text Book(s):
1. Mastering OpenStack, Chandan Duttan Chawdhury, PACKT Publishing 2017

Reference Book(s):

CSNS833: SOFTWARE DEFINED OPTICAL NETWORKS

61
Pre-requisite:
- Basic understanding of SDN.

Objectives:
- To acquire knowledge of Optical networks and its basic principles
- To acquire knowledge of SDN and its application areas
- To learn the use of SDN in Optical network environments and its applications

Module-I: 9 hrs


Module-II: 9 hrs


Module-III: 9 hrs

SDN in Other Environments: Wide Area Networks - Service Provider and Carrier Networks - Campus Networks - Hospitality Networks - Mobile Networks - In-Line Network Functions - Optical Networks - SDN vs. P2P/Overlay Networks

Module-IV: 9 hrs


Module-V: 9 hrs

Case Studies in Software Defined Optical Networks: Review the latest development like A Software Defined optical Network emulation platform (SONEP) - S-BVT Based HYDRA - SDN Space Division Multiplexing (SDM) in optical networks - ROLEX version with centralized SDN - OpenFlow enabled restoration in EONs

Text Book(s):

Journal / Paper(s):
1. https://www.osapublishing.org/jocn/home.cfm

Reference Book(s):
Pre-requisite:
- Basic understanding of SDN and familiarity with modern networking technologies.

Objectives:
- To learn techniques to migrate legacy networks towards SDN
- To apply SDN techniques for converging wired and wireless networks

Module-I: 9 hrs
Software-Defined Networking: Software Defined Networking– The Basics-SDN Controllers-A Little History about SDN Controller Platforms-Open Daylight SDN Controllers-What is Open SDN?- SDN in the data center: Sustainable support for tomorrow’s applications-Benefits that SDN offers in the data center.

Module-II: 9 hrs
Software Defined Networking For Cloud Computing: Applying Software-defined Networks to Cloud Computing Cloud Computing and Network Virtualization-. Software-defined Networks (SDNs)- Cloud Network Virtualization using SDN Case Study with Open Daylight and Open Stack- Final Considerations, Challenges and Perspectives

Module-III: 9 hrs

Module-IV: 9 hrs

Module-V: 9 hrs

Text Book(s):
2. Software-Defined Networking (SDN) with OpenStack By Sriram Subramanian, Sreenivas Voruganti, Packt 2016
3. Network Function Virtualization: Concepts and Applicability in 5G Networks By Ying Zhang, john wiley and sons 2018
5. Internet of Things for Architects: Architecting IoT solutions by By Perry Lea, Packt publishing 2018

Reference Book(s):
CSNS835: SOFTWARE DEFINED RADIOS

Pre-requisite:
- Advanced Networks And Communication Systems

Objectives:
- Understand the principles behind the Software Defined Radios over the conventional Cognitive Radios.
- Ability to analyse Software Defined Networking protocols and cognitive radio techniques
- Understand the data traversal over SDN
- Design algorithms for Software Defined Radio and cognitive radio environments

Module-I:
9 hrs

Module-II:
9 hrs

Module-III:
9 hrs

Module-IV:
9 hrs

Module-V:
9 hrs
Text Book(s):

Reference Book(s):
Internet of Things
Pre-requisite:
- Understanding of computer networks and Cloud computing.

Objectives:
- Understand basics of IOT
- Discuss IoT Enablers And Solutions
- To Understand the Reliability, Security, And Privacy Of Iot
- Have a brief study on the IoT Applications

Module-I: 9 hrs


Module-II: 9 hrs


Module-III: 9 hrs


Module-IV: 9 hrs


**Module-V:**


**Text Book(s):**


**Reference Book(s):**

Pre-requisite:
- Networking Basics: TCP, UDP, TCP/IP and OSI Model.

Objectives:
- To Understand the Architectural Overview of IoT
- To Understand the IoT Reference Architecture and Real World Design Constraints
- To Understand the various IoT Protocols (Datalink, Network, Transport, Session, Service)

Module-I: 9 hrs


Module-II: 9 hrs


Module-III: 9 hrs


Module-IV: 9 hrs


Module-V: 9 hrs


Text Book(s):
Reference Book(s):

1. Peter Waher, “Learning Internet of Things”, PACKT publishing, BIRMINGHAM – MUMBAI
2. Bernd Scholz-Reiter, Florian Michahelles, “Architecting the Internet of Things”,
3. Daniel Minoli, “Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications”,
CSNS83: EMBEDDED SYSTEMS

Pre-requisite:
- Good understanding of the concepts of basic electronics such as circuits, logic gates.

Objectives:
- To understand the architecture and functions of 8085 processor
- To Learn Assembly language programming
- To understand the Basic concepts of Embedded systems and 8051 microcontroller
- To gain knowledge about how the I/O devices are interfaced with 8051 microcontroller
- To understand the basics of RTOS and to learn the method of designing a real time systems

Module-I: 9 hrs


Module-II: 9 hrs


Module-III: 9 hrs


Module-IV: 9 hrs


Module-V: 9 hrs

RTOS Programming: Basic Functions – Types of RTOS – RTOS mCOS – RTLinux – Real Time Linux Functions- Programming with RTLinux – Case Study

Text Book(s):

Reference Book(s):
CSNS844: PRIVACY AND SECURITY IN IoT

Pre-requisite:
- Basic understanding of IoT Architecture And Protocols

Objectives:
- Ability to understand the Security requirements in IoT and to understand the cryptographic fundamentals for IoT.
- Ability to understand the authentication credentials and access control.
- Understand the various types Trust models and Cloud Security.

Module-I: 9 hrs


Module-II: 9 hrs


Module-III: 9 hrs


Module-IV: 9 hrs

Privacy Preservation and Trust Models For IOT: Concerns in data dissemination – Lightweight and robust schemes for Privacy protection – Trust and Trust models for IoT – self-organizingThings - Preventing unauthorized access.

Module-V: 9 hrs

Cloud Security For IOT: Cloud services and IoT – offerings related to IoT from cloud service providers – Cloud IoT security controls – Enterprise IoT cloud security architecture – New directions in cloud enabled IoT computing

Text Book(s):
1. Practical Internet of Things Security by Brian Russell, Drew Van Duren
Reference Book(s):
  1. Securing the Internet of Things Elsevier
  2. Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations
Pre-requisite:

- Basic understanding of big data and IoT.

Objectives:

- To learn the concepts of big data analytics
- To learn the concepts about Internet of things
- To understand and implement smart systems

Module-I: 9 hrs

**Big Data Platforms For The Internet Of Things:** Big Data Platforms for the Internet of Things: network protocol- data dissemination –current state of art- Improving Data and Service Interoperability with Structure, Compliance, Conformance and Context Awareness: interoperability problem in the IoT context- Big Data Management Systems for the Exploitation of Pervasive Environments – Big Data challenges and requirements coming from different Smart City applications

Module-II: 9 hrs


Module-III: 9 hrs

**Big Data Management:** A Platform for Internet of Things and Analytics: a massively distributed number of sources - Big Data Metadata Management in Smart Grids: semantic inconsistencies – role of metadata

Module-IV: 9 hrs


Module-V: 9 hrs

**Sustainability Data and Analytics:** Sustainability Data and Analytics in Cloud-Based M2M Systems – potential stakeholders and their complex relationships to data and analytics applications - Social Networking Analysis - Building a useful understanding of a social
network - Leveraging Social Media and IoT to Bootstrap Smart Environments: lightweight Cyber Physical Social Systems – citizen actuation

Text Book(s):
1. NikBessis, CiprianDobre, Big Data and Internet of Things: A Roadmap for Smart Environments

Reference Book(s):
**CSNS846: FOG COMPUTING**

**Pre-requisite:**
- Basic understanding of cloud computing

**Objectives:**
- Become 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

**Module-I:**

**Introduction To Fog Computing:** Characteristics of the Fog Layer - Design and Organization – Services - Computing Services- Storage Services- Communication Services.

**Module-II:**


**Module-III:**

**Services Of The Fog Layer:** Privacy-Preserving Computation in Fog Computing – Blockchain - Multi-Party Computation - Multi-Party Computation and Blockchain

**Module-IV:**

**Self-Aware Fog:** Cloud, Fog, and Mist Computing Networks - Self-Aware Data Processing – Case Studies I,II,III and IV - Requirements and Architecture for a Smart Gateway Based on Hierarchical Temporal Memory - Urban IoT Edge Analytics - Design Challenges - Edge-Assisted Architecture

**Module-V:**


**Text Book(s):**
1. Amir M. Rahmani, *Fog Computing in the Internet of Things Intelligence at the Edge*
2. *Fog Computing: Helping the Internet of Things Realize its Potential* Amir Vahid Dastjerdi and Rajkumar Buyya, *University of Melbourne*
3 Multi-Dimensional payment Plan in Fog Computing with Moral Hazar, Yanru Zhang, Nguyen H. Tran, Dusit Niyato, and Zhu Han, IEEE, 2016

Reference Book(s):
5 CloudPath: A Multi-Tier Cloud Computing Framework
6 Cloud4Home -- Enhancing Data Services with @Home Clouds
7 Femto Clouds: Leveraging Mobile Devices to Provide Cloud Service at the Edge
8 Fast, Scalable and Secure Onloading of Edge Functions Using AirBox
Pre-requisite:
- Understanding of OSI model.

Objectives:
- Understand basic sensor network concepts
- Know physical layer issues, understand and analyse Medium Access Control Protocols
- Comprehend network and transport layer characteristics and protocols and implement conventional protocols
- Understand the network management and Middleware services

Module-I: 9 hrs


Module-II: 9 hrs


Module-III: 9 hrs


Module-IV: 9 hrs


Module-V: 9 hrs

WSN Design Issues - Performance Modeling of WSNs - Case Study: Simple Computation of the System Life Span

**Text Book(s):**

**Reference Book(s):**
Wireless Computing
Pre-requisite:
- Understanding of Multiple Radio Access Techniques for Wireless Communication.

Objectives:
- To understand Radio Network Planning & Optimization.
- To provide detailed descriptions of the radio network planning and optimization of UMTS networks based on Frequency Division Duplex (FDD) WCDMA technology.

Module-I: 9 hrs
Introduction: Introduction to Radio Network Planning and Optimization - Future Trends - Towards a Service driven Network Management - Wireless Local Area Networks (WLANs) - Next-generation Mobile Communication

Module-II: 9 hrs
WCDMA Radio Network Planning: Dimensioning - Detailed Planning - Verification of Dimensioning with Static Simulations - Verification of Static Simulator with Dynamic Simulations - Optimization of the Radio Network Plan

Module-III: 9 hrs

Module-IV: 9 hrs

Module-V: 9 hrs

Text Book(s):

Reference Book(s):
Pre-requisite:
- Good knowledge of fundamentals of computer networks is required.

Objectives:
- To build an understanding of the fundamental concepts of wireless networking.
- To familiarize with the basic taxonomy and terminology of the various channel modeling and layers of the network.
- To get introduced to resource management and security issues in wireless networks.
- To gain expertise in some specific areas of networking such as Ad Hoc networks, sensors networks, and active networks.

Module-I:


Module-II:


Module-III:


Module-IV:


Module-V:


Text Book(s):
Reference Book(s):

Pre-requisite:
- Basic understanding of wireless transmissions and computer networks.

Objectives:
- To understand the issues involved in mobile communication system design and analysis.
- To understand the concept of frequency reuse. To understand the characteristics of wireless channels.
- To acquire knowledge in different modulation schemes and its error probability in wireless system.
- To know the fundamental limits on the capacity of wireless channels.
- To understand the diversity concepts.

Module-I: 9 hrs

The Wireless Channel: Overview of wireless systems – Physical modeling for wireless channels – Time and Frequency coherence – Statistical channel models – Capacity of wireless Channel- Capacity of Flat Fading Channel — Channel Distribution Information known – Channel Side Information at Receiver – Channel Side Information at Transmitter and Receiver – Capacity with Receiver diversity – Capacity comparisons – Capacity of Frequency Selective Fading channels

Module-II: 9 hrs


Module-III: 9 hrs


Module-IV: 9 hrs


Module-V: 9 hrs

CELLULAR CONCEPTS: Frequency Reuse – Channel Assignment Strategies – Hand off Strategies – Interference and system capacity- Co-Channel Interference- Adjacent Channel

**Text Book(s):**

**Reference Book(s):**
Pre-requisite:
- Basic Knowledge on wireless networks and understanding of OSI model.

Objectives:
- To introduce the characteristic features of Ad-hoc wireless networks and their applications to the students.
- To enable the student to understand the functioning of different access and routing protocols that can be.
- To enable the student to understand the Mobility in MANETs

Module-I: 9 hrs

Module-II: 9 hrs

Module-III: 9 hrs

Module-IV: 9 hrs
Module-V: 9 hrs

Mobility Models For MANET: Mobility Model Classifications - Formulation of Mobility Models - Mobility Metrics - Impact of Mobility Models on MANET - Random Walk Mobility - Notation, Characteristics of Random Walk Mobility, Stationary Distribution of Random Walk Mobility, Limitations of Random Walk Mobility Model - Random Waypoint Mobility - Notation - Random Waypoint Stochastic Process - Transition Length and Duration - Limitations - Smooth Random Mobility - Notation - Characteristics of Smooth Random Mobility Model - Speed Control – Direction Control - Correlation Between Direction and Speed Change

Text Book(s):

Reference Book(s):
2. B. V. V. S. PRASAD, ”ROUTING ISSUES IN MANETS”, Educreation Publishing - 2016
CSNS855: ADVANCED MOBILE COMPUTING

Pre-requisite:
- Understanding of OSI model and wireless channel transmissions.

Objectives:
- To learn mobile computing techniques
- To be familiar with mobile computing trends and wireless application protocol.
- To learn about the mobile Internet
- To study about various application languages and mobile application development platforms

Module-I: 9 hrs


Module-II: 9 hrs


Module-III: 9 hrs


Module-IV: 9 hrs

Module-V: 9 hrs


Text Book(s):

Reference Book(s):
CSNS856: HIGH SPEED NETWORKS

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Pre-requisite:
- Familiarity with types of computer network, network architecture and network topologies.

Objectives:
- Introduce to ATM and Frame relay.
- Up-to-date survey of developments in High Speed Networks.
- To know techniques involved to support real-time traffic and congestion control.
- Analyse the different levels of quality of service (QoS) to different applications.

Module-I: 9 hrs

High Speed Networks: Introduction to Computer Networks –Protocols and the TCP/IP Suite- TCP and IP -Frame Relay - High Speed LAN

Module-II: 9 hrs

ATM: Introduction: ATM cell Layered organization Connection admission control ATM cell switching routing and addressing - IP over ATM - Segmentation and reassembly SVC establishment - Circuit emulation Performance management Multicast optical

Module-III: 9 hrs

Congestion and Traffic Management: Congestion Control in Data Networks and Internet – Link Level Flow and Error Control – Traffic and Congestion Control in ATM networks

Module-IV: 9 hrs


Module-V: 9 hrs

Optical Networks: Introduction to Optical networks Wavelength division multiplexing (WDM) Introduction to broadcast-and-select networks - Switch architectures - channel accessing Wavelength routed networks Switch architectures - Routing and wavelength assignment virtual topology design IP over SONET over ATM over WDM IP over ATM over WDM IP over WDM.

Text Book(s):

Reference Book(s):