

# ROUTING AND SWITCHING

## ENCTNS 56x

**Credits: 4**

**Year: I**

**Part: II**

### Course Objectives

This course provides an in-depth understanding of networking and associated securities from the perspective of IT governance, focusing on the principles, architecture, and configuration of routing and switching technologies. It covers essential topics such as VLANs, dynamic and static routing, network design, and troubleshooting. Students will gain hands-on experience with configuring routers, switches, and network protocols to build scalable and efficient networks. The course prepares students for real-world networking challenges with recent trends in routing and switching technologies.

Learning Outcomes	Chapter Contents	Credit Hours	Teaching Methods
<ul style="list-style-type: none"> <li>▪ Understand Digital Transformation and Cybersecurity Challenges</li> <li>▪ Understand Rubik Cube Model for Information Security</li> <li>▪ Understand ITSM and Information Security Management Framework</li> <li>▪ Understand IT Governance</li> </ul>	<p><b>1 Cyber Security and IT Governance</b></p> <ul style="list-style-type: none"> <li>1.1 Digital Transformation and Cyber Security Issues</li> <li>1.2 Information Security with Rubik Cube Model</li> <li>1.3 Information Technology Service Management (ITSM)</li> <li>1.4 Information Security Management Framework</li> <li>1.5 Information Technology Governance</li> <li>1.6 Framework of ICT Policy, Procedures and Guidelines</li> </ul>	10	<ul style="list-style-type: none"> <li>▪ Lectures: overview on each topic.</li> <li>▪ Group Discussion: Defense in Depth Approach of Information Security</li> <li>▪ Seminar on IT Governance with COBIT</li> <li>▪ Assignment on development of Standard Operating Procedures (SOP)</li> </ul>
<ul style="list-style-type: none"> <li>▪ Understand the Converged Network Design Guidelines</li> <li>▪ Review IP Network Concepts with IPv4 and IPv6</li> </ul>	<p><b>2 Converged Network Design Guidelines</b></p> <ul style="list-style-type: none"> <li>2.1 Converged Network Design Guidelines</li> <li>2.2 Network Foundation Protection Framework</li> <li>2.3 Review of IP Networks (IPv4 and IPv6)</li> <li>2.4 Cross Layer Protocol Engineering</li> <li>2.5 Network Planning and Documentation</li> </ul>		<ul style="list-style-type: none"> <li>▪ Lectures: overview on each topic.</li> <li>▪ Group Discussion: Network Foundation protection Framework</li> <li>▪ Case Study: Network</li> </ul>

<ul style="list-style-type: none"> <li>▪ Understand Cross Layer Protocol Engineering</li> <li>▪ Understand the Importance of Network Documentation and Planning</li> </ul>	<p>2.6 Building Network Terms of Reference (ToR) and Access Network Design Guidelines</p>	<p>10</p>	<p>Planning, Documentation of an Enterprise</p> <ul style="list-style-type: none"> <li>▪ Group Exercise: Develop TOR of Network Projects.</li> <li>▪ Research Trends: Cross Layer Protocol Engineering</li> </ul>
<ul style="list-style-type: none"> <li>▪ Understand to Design Scalable and Secure Enterprise Network Architectures</li> <li>▪ Analyze and Apply Enterprise Network Case Studies.</li> <li>▪ Implement Advanced Routing Techniques</li> <li>▪ Explore Emerging Trends in Routing and Switching</li> </ul>	<p><b>3 Enterprise Routing and Packet Forwarding</b></p> <p>3.1 Enterprise Network Architecture with Fault Tolerance, Scalability, QoS and Security</p> <p>3.2 Enterprise Network Case studies</p> <p>3.3 Interior and Exterior Routing</p> <p>3.4 Enterprise Routing Architecture (Homogeneous/Heterogeneous)</p> <p>3.5 Policy Based Routing</p> <p>3.6 Routing with IPv6</p> <p>3.7 Principles of segment routing</p> <p>3.8 Introduction to routing and switching over SDN and Quantum Networks</p> <p>3.9 Multi-path routing and load balancing techniques</p> <p>3.10 Predictive analytics for proactive routing</p>	<p>12</p>	<ul style="list-style-type: none"> <li>▪ Lectures: overview on each topic.</li> <li>▪ Hands on Lab: Interior and Exterior Routing Protocols with IPv4 and IPv6.</li> <li>▪ Seminar: Routing and Switching over SDN and Quantum Networks</li> <li>▪ Paper Presentations</li> </ul>
<ul style="list-style-type: none"> <li>▪ Understand to Design Enterprise Local Area Network Architecture</li> <li>▪ Configure and Manage VLANs and VLAN Trunking Protocols</li> <li>▪ Utilize Load Balancing and Link Aggregation Techniques</li> </ul>	<p><b>4 Enterprise Local Area Network</b></p> <p>4.1 Enterprise Local Area Network Architecture</p> <p>4.2 Virtual LAN (VLAN), VLAN Trunking Protocol</p> <p>4.3 Inter VLAN Routing Protocol</p> <p>4.4 Enterprise LAN Security</p> <p>4.5 Load Balancing Protocols</p> <p>4.6 Link Aggregation Technologies and Protocols</p>	<p>10</p>	<ul style="list-style-type: none"> <li>▪ Lectures: overview on each topic.</li> <li>▪ Hands on Lab: VLAN, Inter VLAN Routing</li> <li>▪ Group Discussion: Enterprise LAN Security Best Practices.</li> <li>▪ Case Study: Link Aggregation for Software Defined Infrastructure.</li> </ul>

<ul style="list-style-type: none"> <li>▪ Understand to Design Enterprise-Wide Area Network Architectures</li> <li>▪ Develop and Implement VPN Policies</li> <li>▪ Understand to Monitor Network Performance with Real-time Analytics</li> </ul>	<p><b>5 Enterprise-Wide Area Networks</b></p> <ul style="list-style-type: none"> <li>5.1 Enterprise-Wide Area Network Architecture</li> <li>5.2 Network Address Translation (NAT)</li> <li>5.3 Introduction to Virtual Private Networks</li> <li>5.4 Formulation of VPN Policy</li> <li>5.5 Site to site IPSec VPN</li> <li>5.6 GRE over IPSec VPN</li> <li>5.7 Dynamic Multipoint VPN</li> <li>5.8 Real-time network monitoring and analytics</li> </ul>	10	<ul style="list-style-type: none"> <li>▪ Lectures: overview on each topic.</li> <li>▪ Hands on Lab: NAT</li> <li>▪ Group Discussion: Formulation of VPN Policy</li> <li>▪ Case Study: Dynamic Multipoint VPN deployment in an enterprise.</li> </ul>
<ul style="list-style-type: none"> <li>▪ Explore Hyper-Converged and Software-Defined Infrastructure</li> <li>▪ Evaluate NFV and SDN Deployment Challenges</li> <li>▪ Understand to Implement Network Segmentation and Blockchain Security</li> <li>▪ Analyze the Impact of Emerging Technologies</li> </ul>	<p><b>6 Emerging Trends in Switching and Routing</b></p> <ul style="list-style-type: none"> <li>6.1 Routing and switching in edge networks</li> <li>6.2 Drivers of change: IoT, cloud computing, and edge computing.</li> <li>6.3 Hyper Converged Infrastructure and Software Defined Infrastructure</li> <li>6.4 NFV and SDN deployment challenges and benefits</li> <li>6.5 Network segmentation and micro-segmentation trends</li> <li>6.6 Blockchain on network routing and security</li> <li>6.7 Fundamentals of quantum routing and switching</li> </ul>	8	<ul style="list-style-type: none"> <li>▪ Lectures: overview on each topic.</li> <li>▪ Group Discussions on Emerging Trends in Switching and Routing Industry</li> <li>▪ Case Study: NFV and SDN Implementations</li> <li>▪ Paper Presentations</li> <li>▪ Research Assignments : Explore the opportunities of quantum routing and switching.</li> </ul>

### Lab Activities

1. Formulate Comprehensive ICT policy of the organization.
2. Develop Terms of Reference for Network Implementation
3. Develop Routing and Switching Architecture for the Enterprise
4. Develop VPN Policy and Framework for the Enterprise
5. IPv4 Routing Protocols
6. IPv6 Routing Protocols

7. VLAN, VTP, Inter VLAN Routing
8. Deployment of VPN (IPSec Site to Site, GRE over IPSec, DMVPN)

## Evaluation Schemes

### a. Internal Evaluation

Type	Weightage
Minor tests	70%
Assignments	30%

### b. Final Exam

The questions will cover all chapters of the syllabus. The evaluation scheme will be as indicated in the table:

Chapter	Hours	Mark distribution*
1	10	10
2	10	10
3	12	12
4	10	10
5	10	10
6	8	8
Total	60	60

\*There may be minor deviation in marks distribution.

## References

1. James F. Kurose, Keith W. Ross (2021), “Computer Networking, A top down approach featuring the Internet “, Pearson Edition, Eight Edition.
2. A S Tanenbaum (2010), “Computer Networks “, Prentice Hall, Fifth Edition, January 9
3. Behrouz A Forouzan (2013), “Data Communications and Networking “, McGraw-Hill, Fourth Edition.
4. Brad Edgeworth. , Kevin Wallace, David Hucaby, Ramiro Rios, Jason Gooley(2019), CCNP and CCIE Enterprise Core ENCOR 350-401 Official Cert Guide, Cisco Press