SEMESTER S7

ADVANCED COMPUTER NETWORKS

Course Code	**PECST751**	**CIE Marks**	40
Teaching Hours/Week (L:T:P:R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	None	**Course Type**	Theory

Course Objectives:

1. To give a comprehensive understanding of advanced networking concepts, including MPLS, VPNs, Data Center Networks, and Software-Defined Networking (SDN).
2. To impart the skills necessary to analyze, design, and evaluate complex networking architectures, addressing the challenges and emerging trends.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Review of Computer Networking Fundamentals - OSI and TCP/IP Models, Layers and Protocols, IP Addressing and Subnetting, Routing Protocols - RIP, OSPF, BGP; QoS in IP networks - Random Early Detection, Protocols for QoS support - RSVP, RTP, Multiprotocol Label Switching (MPLS): Overview and Use Cases; Network Security Basics - Firewalls, ACLs, and NAT; Working of NAT; Virtual Private Networks (VPNs) - Types and Architectures; Overview of Data Center Networks: Key Components and Topologies;	8
2	DLL switching - Overview, VLANs, Inter-VLAN Routing; Spanning Tree Protocol (STP) - IEEE 802.1D, Rapid Spanning Tree Protocol (RSTP) - IEEE 802.1w, Multiple Spanning Tree Protocol (MSTP) - IEEE 802.1s, STP Enhancements - BPDU Guard, Root Guard, and Loop Guard; Data Center Network Architectures - Traditional vs. Modern Data Center Designs (Spine-Leaf, Clos Networks), Ethernet Fabrics and TRILL; Data Center Design Considerations - Scalability, Redundancy, and Latency.	9
3	SDN Architecture and Components - Control Plane, Data Plane, and Application Plane; OpenFlow Protocol and its Role in SDN; SDN Controllers - Ryu, OpenDaylight, and ONOS; SDN Use Cases - Traffic	9

	Engineering, Network Function Virtualization (NFV) - NFV Concepts, Virtualizing Network Functions and Services; NFV Infrastructure (NFVI) and Management (MANO); Service Function Chaining (SFC); NFV in Telecom Networks.	
4	Data Center Interconnect (DCI) - Technologies for Data Center Interconnection(VPLS, OTV, and VXLAN), DCI Design and Deployment Considerations; Intent-Based Networking (IBN) - Introduction to Intent-Based Networking; Content Distribution on the Internet - Architectures for Information-Centric Networking; Content Naming, Routing and Caching, Security in Named Data Networking; Network Automation and Orchestration; Automation Tools - Ansible, Terraform; Orchestration Frameworks - Kubernetes.	**10**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
● 2 Questions from each module. ● Total of 8 Questions, each carrying 3 marks **(8x3 =24 marks)**	● Each question carries 9 marks. ● Two questions will be given from each module, out of which 1 question should be answered. ● Each question can have a maximum of 3 subdivisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain and critically analyze advanced networking protocols and technologies, including MPLS, VPNs, and SDN, and their applications in modern networks	**K3**
CO2	Demonstrate an understanding of data center network architectures, including the design considerations and protocols that ensure scalability, redundancy, and efficiency.	**K3**
CO3	Use Software-Defined Networking (SDN) and Network Function Virtualization (NFV) to automate and optimize network operations.	**K3**
CO4	Explain emerging trends such as Intent-Based Networking (IBN) and network automation, applying this knowledge to modernize and innovate networking solutions.	**K2**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	2								3
CO2	3	3	3	2								3
CO3	3	3	3	2								3
CO4	3	2	3									3

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Computer Networking: A Top-Down Approach	James F. Kurose, Keith W. Ross	Pearson	8/e, 2022
2	Data Center Virtualization Fundamentals: Understanding Techniques and Designs for Highly Efficient Data Centers with Cisco Nexus, UCS, MDS, and Beyond	Gustavo A. A. Santana	CISCO Press	1/e, 2013
3	MPLS and VPN Architectures	Jim Guichard, Ivan Pepelnjak, Jeff Apcar	CISCO Press	1/e, 2000
4	High-speed networks and Internet: Performance and Quality of Service	William Stallings	Pearson	2/e, 2002
5	Software Defined Networks: A Comprehensive Approach	Paul Goransson, Chuck Black, Timothy Culver	Morgan Kaufman	2/e, 2016
6	Information-Centric Networking (ICN): Content-Centric Networking (CCNx) and Named Data Networking (NDN) Terminology	B. Wissingh, C. Wood, A. Afanasyev, L. Zhang, D. Oran, C. Tschudin	RFC 8793	2020

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Cloud Networking: Understanding Cloud-based Data Centre Networks	Gary Lee	Morgan Kaufman	1/e, 2014

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/106/106/106106243/