

**Programme : Diploma in Computer Engineering (Sandwich Pattern)****Course Code: CO23107****Course Title : Computer Networks****Compulsory / Optional: Compulsory**

Teaching Scheme and Credits						Examination Scheme							
CL	TL	LL	SLH	NLH	Credits	FA-TH		SA-TH (02.30 Hrs.)	FA- PR	SA		SLA	Total
						T1	T2			PR	OR		
03	--	02	01	06	03	20	20	60	25	--	25#	25	175

**Total IKS Hrs. for course:**

**Abbreviations:** CL- Class Room Learning, TL- Tutorial Learning, LL- Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, SLA- Self Learning Assessment

**Legends:** @ Internal Assessment, # External Assessment, \*# On Line Examination, @\\$ Internal Online Examination

**Note:**

1. FA-TH represents two class tests of 20 marks each conducted during the term.
2. SA-TH represents the end term examination.

**I. Rationale**

In this era of globalization almost everyone is connected to each other using computers, smart devices, gadgets and appliances.. Everyone wants remote access of their gadgets and appliances. This is possible using the networks which connect all these devices, gadgets and appliances. Students of Computer Engineering should know how these devices are connected to each other. They should also understand what are networking protocols addressing, Internet, wired and wireless networking, etc. The knowledge of TCP / IP Protocol Suite is also essential for them. This course tries to encapsulate all possible concepts of computer networking. Despite of the concepts of computer networking being very vast some concepts are covered in details and some are covered superficially. Considering the grasping level of students and limited time given to learn the course.

**II. Industry / Employer Expected Outcome**

Students will be able to

1. Understand the OSI and TCP/IP reference models of networking
2. Understand different layers in TCP/IP reference model.
3. Understand different networking protocols.
4. Solve problems regarding networking based on different protocol.

**III. Course Outcomes:** Students will be able to achieve & demonstrate the following COs on completion of course based learning

CO1	To understand the TCP/ IP Protocol Suite
CO2	To understand underlying wired and wireless technology of TCP/ IP Protocol Suite
CO3	To understand the network layer protocols of TCP/ IP Protocol Suite
CO4	To understand the transport layer protocols of TCP/ IP Protocol Suite
CO5	To understand the application layer protocols of TCP/ IP Protocol Suite

**IV. Course Content Details:**

Unit No.	Learning Outcome	Topics / Sub-topics
1	<b>Course Outcome:</b> CO 1 TLO1.1 To Understand the today's Internet TLO1.2 To Understand Protocol And Standards TLO1.3 To understand Protocol Layers of TCP/ IP Protocol Suite TLO1.4 Compare and Contrast TCP/IP Protocol Suite and OSI Model TLO1.5 To Understand Physical, Logical, Port AND Application Specific Addresses	<b>The TCP / IP Protocol Suite</b> 1.1 The Internet Today, World Wide web 1.2 Protocols and Standards ,Standards Organizations 1.3 Protocol Layers: Hierarchy, Services 1.4 Reference Models: Introduction to OSI Reference Model and TCP/IP Protocol Suite: 1.5 Comparison between OSI and TCP/IP Protocol Suite, 1.6 Layers in TCP/IP Protocol Suite 1.7 Addressing: Physical Addresses, Logical Addresses, Port Addresses, Application-Specific Addresses <b>Course Outcome : CO1    Teaching Hours :04 hrs    Marks: 06</b>
2	<b>Course Outcome:</b> CO 2 TLO2.1 To understand Ethernet Frame Format and Addressing TLO2.2 To understand types of Ethernet TLO2.3 To understand Fiber Optic LAN TLO2.4 To understand Wi-Fi technology 802.11 and its extensions TLO2.5 To understand MAC Sublayer and Addressing TLO2.6 To understand Bluetooth and Wi-Fi Direct	<b>Underlying Technologies</b> 2.1 Wired LANs 2.1.1 IEEE Standards (802.3) 2.1.2 Ethernet Frame Format 2.1.3 Addressing 2.1.4 Standard Ethernet, Fast Ethernet, Gigabit Ethernet, Ten-Gigabit Ethernet 2.1.5 Fiber Optic LAN 2.2 Wireless LANs 2.2.1 IEEE 802.11 (Wi-Fi) 2.2.2 Extensions of IEEE 802.11: b/a/g/n/ac/ax/be/bn 2.2.3 MAC Sublayer 2.2.4 Addressing 2.2.5 Bluetooth and Wi-Fi Direct <b>Course Outcome : CO2    Teaching Hours :04 hrs    Marks: 06</b>

3	<b>Course Outcome: CO 3</b> TLO3.1 To understand connectionless and connection oriented services TLO3.2 To understand network layer services TLO3.3 To understand network layer issues TLO3.4 To understand IPv4 Addressing TLO3.5 To understand Classful and Classless Addressing TLO3.6 To understand Special Addresses TLO3.7 To understand NAT TLO3.8 To understand IPv4 Protocol in details TLO3.9 To understand ARP in brief TLO3.10 To understand Inter-and Intra-domain routing TLO3.11 To understand Unicasting, Multicasting and Broadcasting To understand multicast routing in brief	<b>Network Layer</b> 3.1 Introduction 3.1.1 Packet Switching at Network Layer: Connectionless Service, Connection-Oriented Service 3.1.2 Network Layer Services: 3.2 Network Layer Issues: 3.3 IPv4 Addresses 3.3.1 Address Space, Notation, Range of Addresses, Operations 3.3.2 Classful Addressing: Classes, Classes of Blocks, Two Level Addressing, Three Level Addressing: Subnetting, Supernetting 3.3.3 Classless Addressing: Variable Length Blocks, Two Level Addressing, Block Allocation, Subnetting 3.3.4 Special Addresses 3.4 Network Address Translation (NAT) 3.5 Internet Protocol Version 4 (IPv4): 3.5.1 Datagrams 3.5.2 Fragmentation: Maximum Transfer Unit (MTU), Fields related to Fragmentation 3.5.3 Options: Format, Option Types 3.5.4 Checksum: Calculation at Sender and Receiver, Checksum in the IP Packet 3.6 IPV6 Addressing and IPV6 protocol 3.7 Address Resolution Protocol (ARP): Introduction 3.8 Unicast Routing Protocols 3.8.1 Cost or Metric, Static versus Dynamic Routing Tables, Routing Protocol 3.8.2 Intra- and Inter-Domain Routing 3.8.3 Distance Vector Routing 3.9 Link State Routing 3.10 Multicast Addresses 3.11 Virtual Private Network (VPN)
4	<b>Course Outcome: CO 4</b> TLO4.1 To understand Transport Layer Services and Protocols TLO4.2 To understand UDP Protocol in details TLO4.3 To understand TCP Protocol in details TLO4.4 To understand QUIC Protocol in brief	<b>Transport Layer</b> 4.1 Introduction to Transport Layer 4.1.1 Transport Layer Services 4.1.2 Transport Layer Protocols 4.2 User Datagram Protocol (UDP) 4.2.1 User Datagram 4.2.2 UDP Services: Process-To-Process Communication, Connectionless Services, Flow Control, Error Control, Congestion Control, Encapsulation and Decapsulation 4.3 Transmission Control Protocol (TCP) 4.3.1 TCP Services 4.3.2 TCP Features 4.3.3 Segment

		<p>4.3.4 A TCP Connection          4.3.5 Windows in TCP          4.3.6 Flow Control          4.3.7 Error Control          4.3.8 Congestion Control          4.3.9 TCP Timers          4.3.10 Options</p> <p>4.4 QUIC Protocol</p>
		<b>Course Outcome : CO4    Teaching Hours :06 hrs    Marks: 08</b>
<b>5</b>	<b>Course Outcome: CO 5</b>	<p><b>HTTP and HTTPS</b></p> <p>TLO 5.1 To understand client server and peer-to-peer paradigms</p> <p>TLO 5.2 To understand world Wide Web in details</p> <p>TLO 5.3 To understand web documents</p> <p>TLO 5.4 To understand HTTP Protocol</p> <p>TLO 5.5 To understand HTTP versions</p> <p>TLO 5.6 To understand TLS, VPN, SSL, in brief</p> <p>TLO 5.7 To understand HTTPS</p> <p>To understand Digital Certificates Issuing Authorities</p> <p>5.1 Introduction to Application Layer</p> <p>5.1.1 Client-Server Paradigm          5.1.2 Peer-To-Peer Paradigm</p> <p>5.2 World Wide Web Architecture: Hypertext and Hypermedia, Web Client (Browser), Web Server, Uniform Resource Locator (URL)</p> <p>5.3 Web Document: Static, Dynamic, Active Documents</p> <p>5.4 HTTP: HTTP Transaction, Conditional Request, Persistence, Cookies, Web Caching (Proxy Server), HTTP Security</p> <p>5.5 Versions of HTTP</p> <p>5.5.1 HTTP1.0 and HTTP1.1          5.5.2 HTTP2          5.5.3 HTTP3</p> <p>5.6 Overview of TLS, SSL, Websocket</p> <p>5.7 HTTPS</p> <p>5.8 Certificate Issuing Authority,: Let's encrypt (free), digicert, digisign, verisign</p> <p>5.9</p>
		<b>Course Outcome : CO5    Teaching Hours :08 hrs    Marks: 10</b>
<b>6</b>	<b>Course Outcome: CO 5</b>	<p><b>Other Application Layer Protocols</b></p> <p>TLO 6.1 To understand DHCP Protocol in details</p> <p>TLO 6.2 To understand DNS in details</p> <p>TLO 6.3 To perform remote login using TELNET and SSH</p> <p>TLO 6.4 To understand FTP in details</p> <p>TLO 6.5 To understand Electronic Mail</p> <p>TLO 6.6 To understand Packet Filter and Proxy Firewalls</p> <p>6.1 Host Configuration: DHCP</p> <p>6.1.1 Overview of Protocols: RARP, BOOTP, DHCP          6.1.2 Configuration: Static &amp; Dynamic Address Allocation</p> <p>6.2 Domain Name System (DNS): Need for DNS, Domain, Generic Domain, Country Domain, Registrar, Resolution: Mapping Names to Addresses, Mapping Addresses to Names</p> <p>6.3 Introduction to Remote Login:</p> <p>6.3.1 TELNET          6.3.2 Secured Shell (SSH)</p> <p>6.4 File Transfer Protocol: FTP, TFTP, SFTP</p> <p>6.4.1 FTP: Connection, File Transfer          6.4.2 Overview of TFTP and SFTP</p> <p>6.5 Overview of Electronic Mail: User Agent, Message Transfer Agents (SMTP), Message Access Agent (POP, IMAP)</p> <p>6.6 Firewalls: Packet Filter Firewall and Proxy Firewall</p>
		<b>Course Outcome : CO5    Teaching Hours :09 hrs    Marks: 12</b>

## V. Laboratory Learning Outcome and Aligned Practical / Tutorial Experiences.

Sr No	Laboratory Learning Outcomes	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
1	LLO1 Download and install WireShark Network Traffic Analyzer and Cisco Packet Tracer Software.	Download and install WireShark Network Traffic Analyzer and Cisco Packet Tracer Software.	02	CO1
2	LLO2 Download and install GNS3 Software.	Download and install GNS3 Software.	02	CO1
3	LLO3 Check and setup network settings on a computer.	3.1 Check the Physical Address, Logical Address of a computer. 3.2 Check the manual proxy setup of a computer.	02	CO1
4	LLO4 Configure a wired LAN in Packet Tracer.	Configure a wired LAN in Packet Tracer.	02	CO2
5	LLO5 Configure a wireless LAN in Packet Tracer.	Configure a wireless LAN in Packet Tracer.	02	CO2
6	LLO6 Simulate the networking topology of the institute in Packet Tracer	Simulate the networking topology of the institute in Packet Tracer	02	CO2
7	LLO7 Assign the IP classful addresses to the the computing and networking devidces	Assign the IP classful addresses to the the computing and networking devidces simulated in previous experiment.	02	CO3
8	LLO8 Perform initial switch configuration in Packet Tracer. LLO9 Perform initial router configuration in Packet Tracer.	Perform initial switch configuration in Packet Tracer. Perform initial router configuration.	02	CO3
9	LLO10 Analyze the network traffic and capture the packets of IP, ARP, ICMP protocols and analyze them in Packet Tracer or Wireshark.	Analyze the network traffic and capture the packets of IP, ARP, ICMP protocols and analyze them in Packet Tracer or Wireshark.	02	CO3
10	LLO11 Analyze the network traffic and capture the packets of UDP, TCP, SCTP QUIC protocols and analyze them in Packet Tracer or Wireshark	Analyze the network traffic and capture the packets of UDP, TCP, SCTP QUIC protocols and analyze them in Packet Tracer or Wireshark	02	CO4
11	LLO12 Execute nslookup, traceroute/ tracert and netstat commands on command prompt / terminal	Execute nslookup, traceroute/ tracert and netstat commands on command prompt / terminal	02	CO4
12	LLO13 Download and install Caddy Server. Create a Caddy file and Perform the actions such as start, stop, restart the server, etc.	Download and install Caddy Server. Create a Caddy file and Perform the actions such as start, stop, restart the server, etc.	02	CO5

13	LLO14 Write a program to send emails.	Write a program to send emails.	02	CO5
14	LLO15 Perform remote login using TELNET and SSH. in Packet Tracer	Perform remote login using TELNET and SSH in Packet Tracer	02	CO5
15	LLO16 Create your own FTP server to download and upload files using FTP Protocol in Packet Tracer	Create your own FTP server to download and upload files using FTP Protocol in Packet Tracer	02	CO5

## VI. Suggested Micro Project / Assignment/ Activities for Specific Learning / Skills Development (Self Learning):

1. Market survey of networking devices
2. Numerical problems on Ethernet Frame format
3. Numerical Problems on IP Addressing
4. Numerical Problems on Header formats of given protocols
5. Explore Caddy Server
6. Create a proxy server
7. Create a VPN

## VII. Specification Table:

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	The TCP/ IP Protocol Suite	04	02	--	06
2	Underlying Technologies	02	04	--	06
3	Network Layer	02	06	10	18
4	Transport Layer	02	06	--	08
5	HTTP and HTTPS	--	04	06	10
6	Other Application Layer Protocols	02	04	06	12
<b>Total</b>		<b>12</b>	<b>26</b>	<b>22</b>	<b>60</b>

## VIII. Assessment Methodologies/Tools

### Formative assessment (Assessment for Learning)

- Rubrics for continuous assessment based on process and product related performance indicators(\_\_\_\_ marks)

### Summative Assessment (Assessment of Learning)

- End term examination, Viva-voce, Workshop performance (\_\_\_\_marks)

## IX. Suggested COs - POs Matrix Form

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CO1	03	03	01	03	01	--	03	03	03	03
CO2	03	03	01	03	01	--	03	03	03	03
CO3	03	03	03	03	--	02	03	03	03	03
CO4	03	03	03	03	--	02	03	03	03	03
CO5	03	03	03	03	--	03	03	03	03	03

Legends: - High:03, Medium:02, Low:01, No Mapping: --

## X. Suggested Learning Materials / Books

Sr.No	Author	Title	Publisher
1	Behrouz A. Forouzan	The TCP/ IP Protocol Suite, Fourth Edition	McGraw-Hill Forouzan Networking Series
2	Andrew Taninbaum	Computer Networks, Sixth Edition	Pearson Education

## XI. Learning Websites & Portals

Sr.No	Link / Portal	Description
1	<a href="#">Wireshark . Download</a>	Link to download Wireshark Network Traffic Analyzer Software and its documentation
2	<a href="#">Cisco Packet Tracer - Networking Simulation Tool (netacad.com)</a>	Link to download Cisco Packet Tracer Software and its documentation
3	<a href="#">GNS3 Windows Install   GNS3 Documentation</a>	Link to download GNS3 Software and its documentation
4	<a href="#">Caddyfile Quick-start — Caddy Documentation (caddyserver.com)</a>	Link to download Caddy Server and its documentation
5	<a href="#">Configuring LAN in Packet Tracer - CCNA TUTORIALS</a>	Configure a wired LAN in Packer Tracer
6	<a href="https://www.computernetworkingnotes.com/ccna-study-guide/how-to-configure-wireless-network-in-packet-tracer.html">https://www.computernetworkingnotes.com/ccna-study-guide/how-to-configure-wireless-network-in-packet-tracer.html</a>	Configure a wireless LAN in Packer Tracer

**XII. Academic Consultation Committee/Industry Consultation Committee:**

Sr. No	Name	Designation	Institute/Organization
1	Mr. Vivek Pawar	Director and CEO	Atoconn Systems Pvt. Ltd.
2	Prof. Nirmala Shinde-Baloorkar	Assistant Professor, Department of Computer Engineering	K. J. Somaiya College of Engineering
3	Mrs. Jijnasa S. Patil	Lecturer in Computer Engineering	Government Polytechnic, Mumbai

Coordinator,  
Curriculum Development,  
Department of Computer Engineering

Head of Department  
Department of Computer Engineering

I/C, Curriculum Development Cell  
Government Polytechnic, Mumbai

Principal  
Government Polytechnic, Mumbai

