

<b>Subject Code: 2CS2010305</b>	<b>Subject Title: Advanced Networking (Elective-III)</b>
<b>Pre-requisite:</b>	Digital Data communication concepts, Layered architecture as per OSI and TCP/IP model, Functionality of all layers in the OSI and TCP/IP model, Concepts of LAN, WAN, Internet, HTTP, Ethernet, General concepts in routing and basic routing algorithms like Dijkstra's shortest path, distance vector routing, link state routing, etc., Overview of popular application layer services like HTTP, DNS, FTP etc

**Course Objective:**

The objectives of the course are to:

- Develop strong analysis, design, implementation; testing and troubleshooting skills in students regarding TCP/IP based networks and services as relevant to the computer networking needs of the IT industry.
- Establish a strong conceptual foundation of the TCP/IP protocol stack, services and related tools/technologies so as to facilitate the development of the above-mentioned skills.
- Design and implement customized TCP/IP based application layer services.
- Familiarize with security and performance issues in TCP/IP networks.
- Familiarize with Wireless Networks, WiFi and Mobile Networks, Browser Networking, XML Http Request and Server-Sent Events (SSE) and WebSocket and WebRTC
- Create a strong conceptual foundation and offer maximum possible development of required theoretical and practical skills for students aspiring to make a career in Computer Networking Like Network Designer, Network administrator, etc.

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture	Tutorial	Practical	Credit	Theory		Practical		Total
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	-	3	6	60	40	30	20	150

Subject Contents			
Sr. No	Topic	Total Hours	Weight (%)
1	<b>Primer on Latency and Bandwidth, Building Blocks of TCP and UDP and Transport Layer Security (TLS).</b> Speed is a Feature, Components of Latency, Speed of Light and Propagation Latency, Last-Mile Latency, Bandwidth, Delivering Higher Bandwidth and Lower Latencies, TCP Three Way Handshaking, Congestion Avoidance and Control, Bandwidth Delay Product, Optimization for TCP, UDP and Network Address Translator, NAT Traversal, STUN, TURN and ICE. TLS Handshake, TLS Session Resumption, Chain of Trust and Certificate Authorities, Certificate Revocation, TLS Record Protocol and Optimizing for TLS.	10	30
2	<b>Wireless Networks, WiFi</b> Ubiquitous Connectivity, Types of Wireless Networks, Performance Fundamentals of Wireless Networks, From Ethernet to a Wireless LAN, WiFi Standards and Features, Measuring and Optimizing WiFi Performance, Optimizing for WiFi Networks.	6	10

<b>3</b>	<b>Browser Networking, XMLHttpRequest and Server-Sent Events (SSE)</b> Primer on Browser Networking, XMLHttpRequest: Brief History of XHR, Cross-Origin Resource Sharing (CORS), Downloading and uploading Data with XHR, Monitoring Download and Upload Progress, Streaming Data with XHR, Server-Sent Events (SSE): Event Source API and Event Stream Protocol.	10	30
<b>4</b>	<b>WebSocket and WebRTC</b> Introduction to WebSocket, WebSocket API, WebSocket Protocol, WebSocket Use Cases and Performance, WebRTC: Standards and Development of WebRTC, Audio and Video Engines, Real-Time Network Transports, Establishing a Peer-to-Peer Connection, Delivering Media and Application Data, Data Channel, WebRTC Use Cases and Performance.	10	30

#### Course Outcome:

At the end of this course, the student would be able

- To have a thorough understanding of TCP/IP based systems, services and related tools and technologies.
- To be fluent in design and developing Java based TCP/IP socket-based networking solutions.
- To Effectively use available OS commands/utilities as well as popular third-party tools for TCP/IP networking depending upon the needs.
- To geared to adapt to more sophisticated networking related packages in Java and hence develop relatively complex applications more reliably and faster.

#### List of References:

1. Ilya Grigorik, "High-Performance Browser Networking", 2013: First Edition, O'Reilly
2. E-book also available <https://hpbn.co/>
3. Douglas E. Comer, "Internetworking with TCP/IP - (Vol. 1) Principles, Protocols, and Architecture", 6<sup>th</sup> Edition, Prentice Hall of India (PHI) Publishers.
4. Behrouz A. Forouzan, "TCP/IP Protocol Suite", 4th Edition, McGraw-Hill
5. W. Richard Stevens, G. Gabriani, "TCP/IP- Illustrated, Vol. 1 (The Protocols)", Pearson Publishers.

#### List of Experiments:

**Note:** The experiment list provided beneath is for reference only. The course teacher may Change/formulate it as per his/her methodology and requirement.

Sr.No	Practical Experiments
1.	Download Wireshark is a network packet analyzer from its official webpage <a href="https://www.wireshark.org/">https://www.wireshark.org/</a>
2.	Install Wireshark under Windows/Linux platform, Windows installer names contain the platform and version. Install WinPcap
3.	Analyze Internet Protocol (IPv4/IPv6) Traffic Normal IPv4 Traffic, IPv4 Problems, IPv4 Packet Structure, IPv6 Traffic, Dissect the IPv6 Packet Structure, IPv6 Addressing, Filter on IPv4Traffic, Filter on IPv6 Traffic
4	Analyze Address Resolution Protocol (ARP) Traffic Normal ARP Requests/Responses, Gratuitous ARPs, ARP Problems, Dissect the ARP Packet Structure, Filter on ARP Traffic
5	Analyze User Datagram Protocol (UDP) Traffic Normal UDP Traffic, UDP Problems, Dissect the UDP Packet Structure, Filter on UDP Traffic
6	Analyze Transmission Control Protocol (TCP) Traffic Established of TCP Connections, Termination of TCP Connections, How TCP Tracks Packets Sequentially, Review the Trace File: Packet Loss Detected by the Receiver – Fast Recovery, Packet Loss Detected by the Sender – RTO Timeout, Improve Packet Loss recovery with Selective

	Acknowledgments, TCP Flow Control, The TCP Window Size > Zero Can Still Stop Data Transfer.
<b>7</b>	Analyze Hypertext Transfer Protocol (HTTP) Traffic Normal HTTP Communications, HTTP Problems, Dissect HTTP Packet Structures, Display HTTP Statistics, Graph HTTP Traffic Flows, Set HTTP Preferences, Analyze HTTPS Communications, Analyze SSL/TLS Handshake
<b>8</b>	Analyze File Transfer Protocol (FTP) Traffic Normal FTP Communications, FTP Problems, Dissect the FTP Packet Structure, Filter on FTP Traffic
<b>9</b>	Analyze Email Traffic Normal POP Communications, POP Problems, Dissect the POP Packet Structure, Filter on POP Traffic, Normal SMTP Communications, SMTP Problems, Dissect the SMTP Packet Structure, Filter on SMTP Traffic
<b>10</b>	Analyze IEEE 802.11 (WLAN) Wireless LANs (WLANs) Traffic, Signal Strength and Interference, Capture WLAN Traffic, Monitor Mode vs. Promiscuous Mode, 802.11 Traffic Basics like Data Frame, Management Frame and Control Frames etc., Normal 802.11 Communications, Dissect the 802.11 Frame Structure, Filter on All WLAN Traffic Frame Control Types and Subtypes
<b>11</b>	Analyze Dynamic Host Configuration Protocol (DHCPv4/DHCPv6) Traffic