SECOND SEMESTER 2022-2023
Course Handout (Part II)

Date: 16 Jan 2023

In addition to Part-I (General handout for all courses appended to the timetable) this portion gives further specific details regarding the course.

COURSE NO.	**: CS F303**
COURSE TITLE	**: COMPUTER NETWORKS**
INSTRUCTOR-IN-CHARGE	**: VIRENDRA SINGH SHEKHAWAT**
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Course page: http://nalanda-aws.bits-pilani.ac.in

Scope and Objectives:

This course will give you a breakdown of the applications, communications protocols, and network services that make a computer network work. We will closely follow the top-down approach to computer networking as given in the textbook, enabling you to understand the most visible part, i.e., the applications, and then see, progressively, how each layer is supported by the next layer down. Most of the time, our example network will be the Internet. Also, a module on wireless and mobile networks will be covered as, currently, users access the Internet from offices, from homes, while on the move, and from public places wirelessly. The last module of the course focuses on how to secure communication over the network so that users' data integrity can be maintained. There will be laboratory sessions to provide practical skills using a network protocol analyzer tool (**Wireshark**) and TCP/IP socket programming.

TEXT BOOKS

[T1] James F. Kurose, and Keith W. Ross: Computer Networking: A Top-Down Approach Featuring the Internet, Eighth Edition, Pearson Education, India, 2022.

[T2] L. Peterson and B. Davie, Computer Networks: A Systems Approach, Fifth Edition, Elsevier, 2012

REFERENCE BOOKS

[R1] Behrouz A. Forouzan & Firouz Mosharraf, Computer Networks - A Top Down Approach, First Edition, McGraw Hill, New Delhi, 2017.

[R2] Douglas E. Comer: Hands-on Networking, Pearson, New Delhi, 2015.

[R3] W. R. Stevens, UNIX Network Programming, Vol I, Networking APIs: Sockets and XTI, Pearson Education, 3rd Edition.

Module No.	Topics	Learning Objectives
M1	**Internet Architecture and Computer Network Primitives:** Overview of computer network building blocks, Internet architecture, protocol layers	✓ To know about elements of computer networks ✓ To understand the Internet design philosophy and its layered architecture.
M2	**Network Applications (Application Layer):** Principles of network applications (e.g., HTTP, FTP, e-mail, P2P, DNS etc.), Creating network applications using socket programming	✓ To understand working of various network applications ✓ To learn network application implementation process using socket programming.
M3	**End to End Data Transfer (Transport Layer):** Data transport services: Connectionless (UDP), Connection oriented (TCP), Reliable data transfer protocol design, Congestion control and resource allocation principles, TCP congestion control Algorithms and performance measurement	✓ To understand an end-to-end data transfer mechanism used in the Internet. ✓ To understand congestion control and resource allocation principles used in the Internet on end-to-end basis. ✓ To understand reliable data transfer between two end points in the networks.
M4	**Data Routing and Forwarding (Network Layer):** IP addressing (IPv4 and IPv6) for host and network devices, Network segmentation using subnets, IP Routing algorithms and protocols to move datagrams in the Internet (One to one, One to all, One to many)	✓ To understand how to assign addresses to the communicating nodes in the IP network ✓ To understand IP addressing mechanism to segregate a network into multiple subnetworks for scalability ✓ To understand data routing and forwarding mechanisms used in the Internet
M5	**Access Networks & LANs (Link Layer):** Hop by Hop data transmission using link layer frames, Multiple access links and protocols: Point-to-Point and Broadcast link (LANs), Node addressing in switched LANs (Ethernet), Link Virtualization (MPLS)	✓ To understand how data moves from one hop to another hop between two end points. ✓ To learn about local area network design and performance issues. ✓ To understand different channel access protocols.
M6	**Wireless and Mobile Networks:** Wireless links and network characteristics, Wi-Fi (802.11) networks, Node mobility management in wireless networks (Mobile IP)	✓ To understand wireless network access in IP networks. ✓ To understand the challenges faced by IP network due to mobile nodes.
M7	**Security in Computer Networks:** Overview of threats, Principles of cryptography, Message authentication, End-point Authentication, Securing TCP Connections (SSL), Firewalls.	✓ To understand threats in computer networks. ✓ To learn about solutions to the threats, e.g., cryptography, authentication, firewalls, etc.

PLAN OF STUDY

Lect. No.	Topics	References
M1: Internet Architecture and Computer Network Primitives		
1-3	Internet Architecture, Network Hardware: The Network Edge, The Network Core, ISPs and Internet Backbones, Delay, Loss and Throughput in Packet Switched Networks, Protocol Layers and their Service Models (TCP/IP)	T1: 1.1 – 1.5
M2: Network Applications (Application Layer)		
4-5	Principles of Network Applications, Hypertext Transfer Protocol (HTTP): Persistent vs. Non-persistent connections, Cookies, Web Caching, HTTP/1.0 and HTTP/2.0, File Transfer Protocol (FTP)	T1: 2.1 – 2.3
6-7	Mail Transfer Protocols (SMTP, POP3, IMAP), The Internet Directory: Domain Name Systems (DNS), DNS services,	T1: 2.4 – 2.5
8-9	Peer to Peer (P2P) File distribution: BitTorrent, Distributed Hash Tables (DHTs)	T1: 2.6
M3: End to End Data Transfer (Transport Layer)		
10-12	Transport layer services: Connection oriented vs. Connectionless, Multiplexing, De-multiplexing, UDP, Principles of Reliable Data Transfer (Go-Back-N, and Selective Repeat).	T1: 3.1 – 3.4
13-14	Introduction to Socket Programming; TCP, UDP, Creating simple Client Server Applications	T1: 2.7
15-18	Connection oriented transport using TCP: TCP connection management, RTT Estimation and Retransmission Timeout, TCP Flow Control. TCP Error Control and Congestion control algorithms (Slow start, Congestion avoidance, Fast Recovery, Fast Retransmit), TCP Fairness	T1: 3.5 – 3.7
M4: Data Routing and Forwarding (Network Layer)		
19-21	Virtual Circuits Networks vs. Datagram Networks, Internal Architecture of Router, Forwarding and Addressing in the Internet (IP). IPv4 Addressing, Network Address Translation (NAT), Internet Control Management Protocol (ICMP), IPv6 Addressing, Queuing/Packet Scheduling Algorithms: FIFO, Fair Queuing, Random Early Detection (RED)	T1: 4.1 – 4.3
22-25	Routing Algorithms: Shortest Path Routing, Flooding, Link State, Distance Vector, and Hierarchical Routing, Routing in the Internet: Intra-domain routing (RIP, OSPF),	T1: 5.1 – 5.3
26-27	Inter-domain routing (BGP): Advertising BGP Route Information, Routing Policy, IP-Anycast, Network Management: SNMP Protocol, NETCONF, MIB	T1: 5.4, 5.7
M5: Access Networks & LANs (Link Layer)		
28-29	Link Layer Services, Error Detection and Correction Techniques: Parity Checks, Checksums, CRC).	T1: 6.1 – 6.2
30-31	Multiple Access Protocol: TDM, FDM, Slotted ALOHA, Pure ALOHA, CSMA, CSMA/CD	T1: 6.3

32-34	Local Area Networks, Link Layer addressing: MAC addresses, Address Resolution Protocol (ARP), Domain Host Control Protocol (DHCP), Ethernet, Link Layer switches, Virtual Local Area Networks (VLANs), Link Virtualization	T1: 6.4 – 6.5
M6: Wireless and Mobile Networks		
35-37	Wireless Links and Network Characteristics, Wi-Fi: 802.11 Wireless LAN Architecture and Protocol, Mobility management: addressing and routing, Mobile IP.	T1: 7.3, 7.5
M7: Network Security		
38-40	Network Security: Overview of threats, cryptography, authentication, Securing TCP connections using SSL, Firewalls.	T1: 8.1 – 8.6

EVALUATION SCHEME

S. No.	Component	Duration	Weightage	Date and Time	Nature of component
1.	Quiz (2 nos.)	0.75 hrs	20%	Quiz1: 03/03/2023 Quiz2: 21/04/2023	Close Book
2.	Mid Semester Exam	1.5 hrs	25%	13/03/2023	Close Book
3.	Assignment	--	15%	--	Open Book
4.	Comprehensive Exam	3.0 hrs	35%	08/05/2023	Partly Open Book
5.	Lab Participation	--	05%	--	--

Notices: All notices will be posted on the **NALANDA LMS.**

Makeup Policy: In genuine cases, on a case-by-case basis, makeup shall be allowed. Prior permission from the Instructor-In-charge is a must.

Makeup Policy for the Quiz Component: Only one combined makeup exam will be conducted toward the end of the semester. The syllabus for the makeup exam will be the topics covered to date.

Makeup Policy for the Lab Participation Component: One buffer lab session will be provided.

Chamber Consultation Hour: Monday, Wednesday @ 5:00 PM – 6:00 PM

Instructor-In-Charge
CS F303