



Birla Institute of Technology & Science, Pilani
Hyderabad Campus

ACADEMIC-GRADUATE STUDIES AND RESEARCH DIVISION

FIRST SEMESTER 2023-2024

Course Handout Part II

Date: 01-08-2023

In addition to part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No. : CS G525
Course Title : Advanced Computer Networks
Instructor-in-Charge : Dr. Nikumani Choudhury (nikumani@hyderabad.bits-pilani.ac.in)

Scope of the Course:

This course is an advanced computer networking course focusing on the relevant and state-of-the-art networking protocols and architectures. The focus is on the protocols used in the modern networked systems including wireless and mobile networks. The goals of the course is to build on basic networking course material in providing a deep understanding of existing technology with concrete experience of the challenges through a series of lab exercises. The course is divided into four parts where the first two parts aim to provide deep understanding of protocols, architectures and segment structures at different layers of the protocol stack specifically transport and network and link layers. The third part will focus on the application layer and services/applications. The final part is designed to provide a comprehensive understanding and evolution of the wireless networks.

Objectives of the Course:

- To understand the state-of-the-art networking protocols at different layers of the protocol stack.
- To develop a strong understanding of the core concepts of computer networks.
- To gain experience in research oriented activities where the lab is designed for students to gain practices of reading research papers, design experiments, perform analysis and presentation of results.
- To gain hands-on experience with the networking protocols.

Textbooks:

[T1] James F. Kurose and Ross, Computer networking: a top-down approach featuring the Internet, 6th Ed., Pearson, 2016.

Reference Books:

[R1] L. L. Peterson B.S. Davie, “Computer Networks: A Systems Approach”, 5th Ed., Morgan Kaufmann, Elsevier, 2012.

[R2] A S Tanenbaum, Computer Networks, 5th Ed, Pearson, 2013.

Course Plan:

S. No.	No. of Lectures	Learning objectives	Topics to be covered	Chapter in the Textbook
1	1	- To understand the course components and structure.	Basic introduction to the course, explanation of exams and evaluations.	Class Notes
PART A: TRANSPORT LAYER				
2	1	- To understand the basics of User Datagram Protocol (UDP)	UDP protocol, UDP segment structure, UDP checksum.	T1: Chapter 3, Class Notes
3	1	- To learn reliable data transfer protocols	Go-Back-N and Selective Repeat protocols	T1: Chapter 3, Class Notes
4	6	-To understand the basics of TCP and TCP variants	TCP connection, TCP segment structure, round trip time, understanding congestion, congestion control algorithms, TCP variants, Fairness	T1: Chapter 3, Class Notes, Congestion Avoidance and Control [Jacobson 1988], Analysis of Increase and Decrease Algorithms for Congestion Avoidance in Computer Networks [Raj Jain 1989]
			Congestion Control at Routers: Queuing Methods (e.g. RED, FQ, CSFQ etc.), Estimating Router Buffer Size	Random Early Detection Gateways for Congestion Avoidance [Sally Floyd 1993], Sizing Router Buffers [Guido-2004]
5	2	- To learn modern transport layer protocols	QUIC, Multipath TCP (MPTCP) and Multipath QUIC (MPQUIC)	Class Notes, How Hard Can It Be? Designing and Implementing a Deployable Multipath TCP [Raiciu 2012]
PART B: NETWORK LAYER				
6	3	-To introduce network layer and network service models	CBR ATM network service, ABR ATM network service, routers, queueing.	T1: Chapter 4, Class Notes
7	3	- To understand the Internet Protocol (IP)	IP datagram, IPv4 addressing, NAT, IPv6, Quality of service (QoS) in IP networks.	T1: Chapter 4, Class Notes
8	3	- To understand routing algorithms	Link-State (LS), Distance-Vector (DV), Hierarchical routing, RIP, OSPF, BGP, Broadcast routing algorithms, multicast routing algorithms, other advanced routing algorithms.	T1: Chapter 4, Class Notes, Traffic Engineering with Traditional IP Routing Protocols [Bernard 2002], Making Intra-Domain Routing Robust to Changing and Uncertain Traffic Demands: Understanding Fundamental Tradeoffs [David 2003]
PART C: APPLICATION LAYER				
9	3	To gain an understanding of applications, QoS	Multimedia applications, Peer-to-peer applications, QoS	Class Notes
10	4	To know about the service specific networks and their characteristics. Performance and implementation related challenges and their solutions.	DNS and Naming System, DNS and CDN, HTTP and CDN, Coral CDN DNS Caching and Performance,	Class Notes, Democratizing content publication with Coral [Freedman 2004], DNS Performance and the Effectiveness of Caching [Jung 2002]

11	4	- Introduction to sockets, socket Programming, client/server architecture	UDP/TCP sockets, Deadlocks, Half-open Connections	Class Notes
PART D: WIRELESS NETWORKS				
12	2	- To understand Cellular Internet Access	2G, 3G and 4G cellular data networks, Introduction to 5G: current status (6G overview)	Class Notes
13	7	- To understand Low-power Wireless Networks	IEEE-802.15.4-DSME, TSCH, 6TiSCH Networks, Bluetooth, and BLE, LoRaWAN for IoT applications	Class Notes

Evaluation Scheme:

EC No.	Evaluation Component	Duration (Mins)	Weightage (%)	Date & Time	Nature of Component
1.	Mid Semester	90	25	10/10 - 11.30 - 1.00PM	Closed Book
	Class Interaction	In class	10	In class (best 10/15)	Open Book
2.	Term Project-1	Take Home	10	Pre-midsem	Open Book
3.	Term Project-2	Take Home	10	Post-midsem	Open Book
4.	Lab Exam	60	10	Post-midsem	Open Book
5.	Comprehensive Examination	120	35	9/12/23 FN	Closed Book

Mid-Semester grading: Minimum 40% weightage will be considered for the mid-semester grading

Make-Up: May be given on prior permission and to only genuine cases. A request email should reach the I/C on or before the test.

Chamber Consultation Hour: To be announced in the class.

Notice: Notices concerning this course will be posted on the CMS.

Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

**Instructor-in-charge
CS G525**