**FIRST SEMESTER 2021-2022**
Course Handout Part II

Date: 06-08-2021

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)

**Description :** Topics in advanced networking – Quality of Service in IP networks, IPv6, Wireless and Mobile Networks, Carrier Technologies (Frame Relay, FDDI, ISDN, ATM), Peer-to-Peer Networks and Overlays, Routing and QoS Issues in Optical Networks

**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] |
| 5 | 3 | - To learn modern transport layer protocols | QUIC, Multipath TCP (MPTCP) and Multipath QUIC (MPQUIC) | Class Notes |
| **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 | 5 | - 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 | 5 | - 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 | 6 | - To understand Cellular Internet Access | 2G, 3G and 4G cellular data networks, Introduction to 5G: current status (6G overview) Low-power wireless networks (IoT applications) | Class Notes |

**Evaluation Scheme:**

| EC No. | Evaluation Component | Duration (Mins) | Weightage (%) | Date & Time | Nature of Component |
|---|---|---|---|---|---|
| 1. | Mid Semester | 90 | 35 | As per Timetable | Open Book |
| 2. | Term Project | Take Home | 20 | Pre-compre | Open Book |
| 3. | Lab Quizzes <br> • Lab Quiz-1 <br> • Lab Quiz-2 | 60 | 5+5=10 | Lab Quiz-1 (Pre midsem) Lab Quiz-2 (Pre compre) | Open Book |
| 4. | Comprehensive Examination | 120 | 35 | As per Timetable | Open Book |

**Make-Up:** May be given on prior permission and to only genuine cases.

**Consultation Hour:** To be announced in the class.

**Notice:** Notices concerning this course will be displayed on the Google Classroom only.

**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**