# COMPUTER NETWORKS (M.Tech. Optional Core)

Course Syllabus

July 2014

**Credits:** 4

**Prerequisites:** C programming, Basic Networking Principles, Data Communications.

## UNIT - I: DATA LINK LAYER

PPP, PPPoE, MAC Layer: Ethernet, Switched Ethernet, VLANs, Spanning Tree Protocol and its variants such as Rapid Spanning Tree.

## UNIT - II: NETWORK LAYER: DATA PLANE

Internet Protocol Addressing: CIDR, Internet Protocol Datagram (including fragmentation and reassembly, routing options), IP Forwarding Algorithm, ARP, ICMP (including ICMP Redirect, ICMP Path MTU discovery, ICMP Destination Unreachable options).

## UNIT - III: TRANSPORT LAYER

UDP, TCP sliding window protocol, TCP connection establishment, TCP reliability including cumulative and delayed acknowledgements, Nagle algorithm, Karn's algorithm for RTT and RTO estimation, TCP AIMD Congestion Control Algorithm, TCP half-close connections including TCP keepalive timer and probe timer, TCP Fast Retransmit and Fast Recovery.

## UNIT - IV: NETWORK LAYER: CONTROL PLANE

Distance Vector Algorithm and Routing Information Protocols V1 and V2, Link State Algorithm and Open Shortest Path First Protocol (OSPF).

## UNIT - V: APPLICATION LAYER

Domain Naming System (DNS) and Dynamic Host Configuration Protocol (DHCP). Telnet, SSH, FTP, HTTP, SMTP, Network Management using SNMP, P2P (Bittorrent and DHT).

# TEXTBOOKS

1. Douglas Comer. *Computer Networks And Internets Sixth Edition*, 2014. ISBN 0133587932/9780133587937, Pearson Education.

2. Douglas Comer. *Internetworking With TCP/IP Volume 1: Principles Protocols, and Architecture, 6th edition*, 2013. ISBN-10: 0-13-608530-X ISBN-13: 9780136085300, Pearson Education.

3. Kevin R. Fall and W.Richard Stevens. *TCP/IP Illustrated, Volume 1: The Protocols, 2/E*, 2012, ISBN-10: 0321336313  ISBN-13: 9780321336316, Pearson Education.

4. James F. Kurose and Keith W. Ross. *Computer Networking: A top-down approach*, $6^{th}$ edition, Pearson Education.

5. Radia Perlman. *Interconnections: Bridges, Routers, Switches, and Internetworking Protocols, 2/E*, 2000, ISBN-10: 0201634481 ISBN-13: 9780201634488. Pearson Education.

# SUGGESTED ASSIGNMENTS

1. Implement the IP fragmentation and reassembly algorithm.

2. Implement the IP forwarding algorithm.

3. Implement the simplest sliding window protocol of TCP.

4. Connect two systems using a switch and configure private IP addresses to the systems and *ping* them from each other. Using *Wireshark*, capture packets and analyze all the header information in the packets captured.

5. Convert a system with two network interface cards (NICs) into a router by configuring each NIC in a different LAN and enabling forwarding. Use two switches to connect one NIC each of the router to these two switches. Connect two other systems, one each to each switch. Now, we have two VLANs. Ping from one system to the other through the router after configuring the required default routes in the hosts and static routes in the router.

6. Install *Telnet Server* on one of the systems connected by a switch and telnet to it from the other system. Using *Wireshark*, capture the packets and analyze the TCP 3-way Handshake for connection establishment and tear down.

7. Use Mininet to create multiple compute nodes, multiple VMs in each compute node, an OVS to connect VMs in a compute node and one OVS that connects the nodes. Configure IP addresses to these VMs in different VLANs, configure static routes in the VMs and *ping* them from one another.

8. Once the initial Mininet assignment is successful, try commands like *traceroute* to trace the route from one VM to another.