Final Exam covers the following chapters:

Chapter 13 LAN technologies: packet, frames and topologies

* Circuit switching and packet switching
* Standard bodies and corresponding layers
* LLC and MAC (roles)
* LAN topologies
* Broadcast, multicast, unicast
* Wireless types (when to use which)
* Frame format (Ethernet/IEEE)
* Bit/byte stuffing

Chapter 14 The IEEE MAC Sub-layer

* Multi-access protocols – terminologies and when to use what
* CSMA/CD, CSMA/CA - should be able to explain on how it works
* Randomness - how do collided stations wait for a random amount of time?
* What happens when collision happens

Chapter 15 Wired LAN

* Ethernet/IEEE frame format
  + the difference in the formats – can you tell the difference between IEEE and Ethernet?
  + Type field?
* ARP
  + Purpose?
  + When to use?
* Purpose/role of LLC/SNAP?
* Format of IEEE 802.3
  + Frame size, header size
* Layer and connection device, e.g., layer 1 device is a hub, layer 2, switch,..
* Backward compatibility of Ethernet device?
* Categories of twisted pair Ethernet, esp. On category 6, 7, and 8 (when to use what)

Chapter 16 Wireless LAN

* When to use which technology, e.g., infrared is for the communication between small devices
* Three factors important for wireless LAN – frequencies, modulation techniques, and data rates
* Spread spectrum technologies: The three key multiplexing techniques, e.g., DSSS, FHSS, and DFDM (how it works)
* IEEE 802.11 Frame format
  + Why 4 addresses are needed? Would that work with only three addresses?
    - Identify three addresses using a scenario
* Contention and contention-free access – the differences
* What is a hidden station problem?
* Technologies used in PAN (personal area network)
* When to use RFID, some application areas
* Cellular communication
  + Frequencies and cell cluster
  + 4G and 5G – main characteristics

Chapter 17 Extending LANs: Fiber modems, Repeaters, Bridges, and Switches

* Link access
* What are the factors considered import when designing a LAN
* Clear definition of connecting devices – repeaters, bridges, routers, and gateways – their operating layers
* Meaning of a collision domain
* How does a bridge connecting two LAN segments know the address of all connected devices? Recall filtering bridge. Why full of broadcast frames when a bridge initially starts up?
* Bridges and cycles: why broadcast frame is a problem when all bridges in a LAN are connected together? What is a solution? How does a spanning tree work?
* How does a switch handles collision?
* For a long distance communication, should CSMA/CD be disabled? Why or why not?
* VLAN: how does that work and when to use?

Chapter 18 WAN Technologies and Routing

* Why packet switched instead of shared medium for long distance communication?
* Store-and-forward switch
  + How it works
* Next-hop forwarding
  + Routing table – all possible packet switches and next hop information for each switch
* Source independence
  + What it is and justification for that
* Forwarding table must have:
  + universal communication and optimal routes – what are these?
* Routing software
  + Use of graph – edge and node
  + Routing table contains destination and next hop information
  + Static routing and dynamic routing
  + Dijkstra’s algorithm – the shortest path computation
    - Must know how to follow the algorithm and complete the shortest path computation
  + Distance-vector routing
    - How it works
  + Link-state routing
    - How it works
  + Comparison between distant-vector and link-state
  + Convergence problem
* MPLS (multi-protocol label switching and tunneling
  + How it works and compare with IP based switching

IP protocol address

* Classes of IP addresses
  + How to tell the class of an IP address – how many bits are needed to tell the class
  + IP address structure: network + host address – how to extract network address?
  + How to calculate the number of host addresses in a subnet – more bits for network address, less number of host addresses
  + How to divide a network into a number of subnets: IP subnetting
* Address mask
  + Subnet masking
  + CIDR notation
    - How to find the same subnet among IP addresses – must know how to convert decimal to binary
* Special IP addresses
  + Network address – all zeros in host address
  + Directed broadcast address
  + Limited broadcast
  + This computer
  + Loopback address
* Must know how to come up with subnet mask
  + How to Subdivide a network into multiple subnets
  + How to Extract network address

Datagram

* Forwarding datagram: what’s in the header?
* What is a default route? when to use?
* When to use next-hop address? Where to find next-hop information?
* Best-effort delivery
  + In which case packets are delivered out-of-order? – packet departure order and arrival order are different
* Understand IP header (when to use which field)
* PathMTU discovery
  + How to do
  + Purpose
  + Involved protocols
* IP fragmentation
  + When to use
  + When IP packet is fragmented, how to retrieve fragmented packets at the destination using which field in the IP packet header
* What is address resolution in datagram forwarding
  + How is ARP protocol used?
* ICMP
  + Roles
  + When to use
* NAT
  + Address translation: Public IP and private IP
  + Port mapping
  + Static NAT, dynamic NAT, port address translation (PAT)

UDP

* UDP Headers
* Port numbers, well-known port numbers
* Where and when to use
* How to check error

TCP

* Connection-oriented
* Features
  + Stream interface, three-way handshake, graceful connection shutdown
  + Use IP and port number for data delivery (like UDP)
  + Reliable delivery
  + How to recover lost packet
  + Stream -> segments with sequence number
  + One ACK can acknowledge many segments
* How to pick timeout value
* TCP sliding window
* TCP segment format
* Three-way handshake
* Closing a connection
* Congestion control