

## Summary of Learning Objectives

*This is a summary of the learning objectives for this course.*

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### 1 Telecommunication Service Providers

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After this lecture you should be able to: explain the role of access, switching and trunk technologies and give examples for each. You should be able to explain the purpose of a codec and the three goals of communication security. You should also be able to define the terms and acronyms defined in this lecture.

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### 2 POTS Signalling

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After this lecture you should be able to: define the terms introduced in the lecture, describe the POTS services provided by the CO; and describe and recognize the waveform or impedance changes used by POTS signalling for: loop-start and ground-start line seizure, pulse and DTMF dialing, ringing, and basic call-progress tones (dial tone, ringback, busy).

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### 3 HFC Access Plant and DOCSIS Cable Modem

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After this lecture you should be able to:

(1) distinguish between trunk, distribution and drop cables, explain the location and role of optical nodes and distribution amplifiers, convert signal levels between mV, dBm and dBmV, compute the output noise thermal power for an RF amplifier, identify the source of CTB, CSO, gain flatness and group delay distortions and their units, (2) distinguish between upstream and downstream links based on frequency, transmitting device (CM or CMTS), and direction of information flow (US or DS); list four factors that result in lower data rates and more complex processing on the upstream; compute the maximum correctable error burst length for a given value of  $t$  and block interleaver size; compute the raw US and DS data rates for a particular combination of modulation and symbol rate; (3) list the main purpose for each of the (5) protocol layers used by a DOCSIS CM; explain two reasons for the differences between up-

stream and downstream MAC protocols; decode the information contained in the MAP frame time allocation information element, and list the PHY parameters adjusted during ranging.

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### 4 Digitized Speech

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After this lecture you should be able to: decide when it is worthwhile to digitize speech; solve problems involving: the frequencies of the desired, sampling and alias signals; sampling rate and bandwidth; bits per sample and quantization SNR; sampling rate, bit-s/sample and data rate. You should be able to explain how companding increases the average quantization SNR.

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### 5 ADSL

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After this lecture you should be able to: identify the location and frequency response of the high- and low-pass filters used in ADSL systems, state the spectrum of the signal at a POTS phone and ADSL modem; convert from channel number to subcarrier frequency; solve problems involving DMT parameters (sampling rate, cyclic extension samples, symbol duration, and subcarrier spacing), and explain why shorter loops support higher data rates.

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### 6 Passive Optical Networking

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After this lecture you should be able to: explain the advantages of PON relative to HFC or DSL and solve problems involving optical link power budgets.

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### 7 TDM and T-Carriers

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After this lecture you should be able to: multiplex/demultiplex a PCM channel to/from a T1 bit stream; compute the payload and channel bit rates for T1 and T3 carriers; compute the time between frame slips;

convert between a bit stream and B8ZS coded waveforms.

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## 8 SONET

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After this lecture you should be able to: calculate bit rates for SONET OC-*n*/STS-*n* signals; explain the source, destination and purpose of the An, Bn, Dn, En and Hn bytes in SOH, LOH and POH bytes; interleave two STS-1 streams into an STS-*n* byte sequence; calculate pointer adjustment frequency from clock frequency errors; draw a diagram of a SONET ring using ADMs and show how traffic flows around the ring after a link failure.

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## 9 ATM

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After this lecture you should be able to: encapsulate a sequence of bytes into ATM cells using AAL5 SAR and describe the path followed by an ATM cell given the switching table contents for a set of ATM switches.

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## 10 PPP

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After this lecture you should be able to: encapsulate a packet using PPP framing including adding and removing escape characters, generate a PPP frame for an IP packet, and decide whether a configuration item would be negotiated by the LCP, NCP or neither.

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## 11 Internet Protocol Review

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After this lecture you should be able to: differentiate between the Internet and IP; look up IP standards; interpret the values of the most common IP header fields; determine the netmask for an IP network; determine if an IP address is in a particular network; determine if an IP address is public, private or link-local; decide which port a packet would be forwarded on based on the contents of a routing table.

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## 12 DHCP

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After this lecture you should be able to: explain: (a) the need for dynamic assignment of IP addresses, (b) the purpose of address leases, and (c) the reason

for avoiding unnecessary IP addresses changes; state the DHCP message that would be transmitted in response to another DHCP message, in case of imminent lease expiry or when leaving a network; describe how a client and server can verify that an address is not in use; and encode an arbitrary option and value as a type-length-value sequence.

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## 13 DNS

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After this lecture you should be able to: distinguish between authoritative, recursive and secondary name servers, write BIND-format A, NS, MX, and CNAME DNS records, write the nslookup command that would be used to look up a particular DNS record from the default DNS server, write the sequence of DNS queries that would be required to obtain an authoritative DNS query result, explain purpose of DNS record caching, and predict when updated DNS records will become effective based on TTL values of cached data, and write the domain name that would be used to look up the domain name corresponding to an IP address.

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## 14 ICMP

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After this lecture you should be able to: state the contents and probable cause of each of the following ICMP messages: destination unreachable, TTL exceeded, echo request/response, and redirect; and list the sequence of packets transmitted and received by the ping and traceroute commands including the packets' source and destination addresses and their TTL field values.

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## 15 UDP/TCP not covered

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## 16 OSPF

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After this lecture you should be able to: select between RIP, EIGRP, and OSPF based on router capabilities, determine if two routers are adjacent based on Hello packet contents, determine if a received LSA would be flooded or not based on its age and sequence number, manually calculate the shortest paths and SPF-based routing table for a simple network, explain

meaning of OSPF area ID 0.0.0.0, find typical router ID value(s) based on its IP address(es).

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## **17 IP-Based Applications and HTTP**

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After this lecture you should be able to: parse a URL URI into its components, URL-encode an arbitrary string, parse a media (MIME) content type into its components, generate the text for an HTTP 1.1 request given the URL and header values, generate the text for an HTTP response given the content and header values, and add A and B HTML tags to text to create a hypertext document.

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## **18 *VoIP not covered***

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## **19 Communications Security Principles**

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After this lecture you should be able to: distinguish between three different purposes for communication security, and explain how cryptographic digests, symmetric encryption and public key encryption can be used accomplish these.