

National Exams December 2018

17-Comp-B5 Computer Communications

3 hours

Note

- If doubt exists as to the interpretation of any question, the candidate is urged to submit with the detailed answer paper, a clear statement of any assumptions made.
- Candidates may use either the approved Sharp or Casio calculator models. This is a Closed Book exam.
- Any five questions constitute a complete paper. Only the first five questions as they appear in your answer book will be marked.
- All nine (9) questions are of equal value (20% each).

Question 1 (20 marks)

An analog voltage signal (sine wave) of 100 Hz with a peak-to-peak amplitude of 10 Volt is sampled at the sampling frequency of 500 Hz. Find another two analog sinusoids (other than 100 Hz) which, when sampled at 500 Hz, will yield the identical sample values (as the 100 Hz sine wave). Explain: (1) why this situation can happen; (2) what this phenomena is called; and (3) How can one guarantee that the sampled signals are unique representations of the original analog signal?

Question 2 (20 marks)

A signal of 100 mW is being transmitted over a channel with several series sections. The first section contains a power amplifier with an absolute gain of 15, the second section has a loss of 12 dB, and the third section has a further loss of 3 dB. Determine the power level of the received signal at the receiver end.

Question 3 (20 marks)

For a communication channel with an intended capacity of 500 Mbps, the bandwidth of the channel is 25 MHz. What would be the desired signal-to-noise ratio to achieve this capacity?

Question 4 (20 marks)

- (a) What does AM stands for? and
- (b) What does FM stands for.

Suppose that a signal to be transmitted can be expressed as:

$$v(t) = 10 \sin (100 \pi t + \phi)$$

- (c) Use a carrier frequency of 500 Hz to sketch the AM signal modulated by $v(t)$; and
- (d) If a carrier frequency of 1 kHz is used for FM modulation, sketch the modulated signal with $v(t)$.

Note: In both (c) and (d) cases, explain your sketches to gain full marks.

Question 5 (20 marks)

In a Cyclic Redundancy Check (CRC) scheme, if $P= 110011$ and $M=11100011$, determine the corresponding CRC.

Question 6 (20 marks)

Suppose that you are given a task to design a network for 10 computers in an office building together with two shared network enabled printers. You are free to choose any of the following network architectures: (a) Star; (b) Multi-drop; (c) Loop; (d) Tree; (e) Mesh; and (f) Mesh of trees.

- (1) Draw the network topologies for each of the above options; and
- (2) Comment on advantages and drawbacks for each topology in terms of reliability; speed; easy of sharing common resources; and security.

Question 7 (20 marks)

A QPSK uses phase-shift of multiple of $\pi/2$ (90°), i.e.

$$s(t) = \begin{cases} \cos(2\pi f_c t + \frac{\pi}{4}) \sim 11 \\ \cos(2\pi f_c t + \frac{3\pi}{4}) \sim 10 \\ \cos(2\pi f_c t + \frac{5\pi}{4}) \sim 00 \\ \cos(2\pi f_c t + \frac{7\pi}{4}) \sim 01 \end{cases}$$

For the digital sequence below:

0 0 1 0 0 1 1 1 1 0 0 0 0 1

Draw QPSK modulation signal for the above sequence.

Question 8 (20 marks)

For a network with the address 198.53.147.45 and the subnet mask 255.255.255.224, what is the class of the network? and what are the network ID, subnet ID, and host ID? Explain how you arrive at your answers in detail.

Question 9 (20 marks)

Explain the following technical terms: (1) Parity bit; (2) Bit Error Rate; (3) modem; (4) Codec; (5) Crosstalk; (6) CSMA/CD; (7) Decibel; (8) B-ISDN; (9) TCP/IP; and (10) Packet.