

Name: _____

Subject Code: SEHH2238

Student ID: _____

Lecture Group: _____

SEHH2238 Computer Networking Mid-term Test – Answer Sheet

Suggested Solution

Instruction to Students:

1. **Answer ALL questions.**
2. Fill your personal particulars in the header of this answer sheet.
3. Insert your answer into the space provided in this answer sheet.
4. Show your work clearly and neatly. Marks will be deducted for untidy work.
5. Upon completion, save a copy of this file into **PDF file format**.
6. **Upload the PDF file** to the submission link on Moodle within the **15-minute submission grace period**.

Important:

Ensure the originality of your work. Any form of plagiarism is subject to disciplinary actions such as mark deduction, disqualification or even expulsion by the College.

(Please refer to the relevant section(s) on plagiarism of the Student Handbook.)

For Markers Only	
Question	Mark
1	
2	
3	
4	
Total	

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Answer for Question 1**/25**(a) Max. frequency (f_{\max}) = 4000 HzMin. sampling rate = $2 \times f_{\max}$ = 2×4000 Hz

= 8000 samples / s

If the sampling rate is not enough, undersampling happens. The signal reproduced using the samples will be different and have a lower frequency.

(b) Assume $n = 5$ Number of samples = $8000 \times 5 \times 60 = 2,400,000$ samplesNumber of bits per sample = $\log_2 256 = 8$ bits / sampleFile size = $2,400,000 \times 8 = 19,200,000$ bits = 19.2 Mb

3 rd digit (n)	10	1	2	3	4	5	6	7	8	9
File size (Mb)	38.4	3.84	7.68	11.52	15.36	19.2	23.04	26.88	30.72	34.56

(c) Level = $(25 / 60) \times 255$

= 106.25

 ≈ 106

Bits = 01101010 (8 bits)

Answer for Question 2**/25**

- (a) Flow control: Receiver sends ACK to let sender know it is ready.
Error control: If error, no ACK. Sender retransmits after timeout.

- (b) Transmission delay = $1500 \text{ bits} / 500 \text{ kbps} = 3 \text{ ms}$
Propagation delay = $1000 \text{ km} / 2 \times 10^8 \text{ m/s} = 5 \text{ ms}$

- (c) (4th digit is odd)

file size = 5000 bits

Number of packets = $5000 / (1500 - 24) = 3.3875 \approx 4$

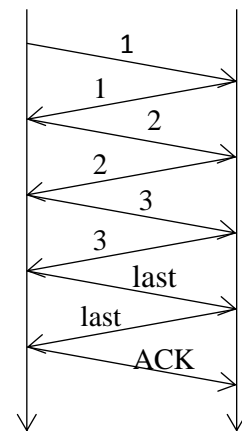
First 3 data packets are max size 1500 bits

Size of last data packet = $5000 - 3 \times (1500 - 24) + 24 = 596 \text{ bits}$

Tx of last data packet = $596 \text{ bits} / 500 \text{ kbps} = 1.192 \text{ ms}$

All ACKs are piggybacked with data packet, except the last ACK.

Tx of last ACK = $24 \text{ bits} / 500 \text{ kbps} = 0.048 \text{ ms}$



Total delay = delay of max size packets + delay of last packets + delay of last ACK
 $= (3 + 5) \times 6 + (1.192 + 5) \times 2 + (0.048 + 5) \text{ ms}$
 $= 48 + 12.384 + 5.048 \text{ ms}$
 $= 65.432 \text{ ms}$

- (4th digit is even)

file size = 6000 bits

Number of packets = $6000 / (1500 - 24) = 4.0650 \approx 5$

First 4 data packets are max size 1500 bits

Size of last data packet = $6000 - 4 \times (1500 - 24) + 24 = 120 \text{ bits}$

Tx of last data packet = $120 \text{ bits} / 500 \text{ kbps} = 0.24 \text{ ms}$

All ACKs are piggybacked with data packet, except the last ACK.

Tx of last ACK = $24 \text{ bits} / 500 \text{ kbps} = 0.048 \text{ ms}$

Total delay = delay of max size packets + delay of last packets + delay of last ACK
 $= (3 + 5) \times 8 + (0.24 + 5) \times 2 + (0.048 + 5) \text{ ms}$
 $= 48 + 10.48 + 5.048 \text{ ms}$
 $= 63.528 \text{ ms}$

10^9 G
 10^6 M
 10^3 k
 10 s
 10^{-3} m
 $10^{-6} \mu$
 10^{-9} n

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Answer for Question 3

/25

(a) Any one of below, 5 hops:

A->B->C->D->G->K, A->B->C->F->G->K, A->B->C->F->I->K,
A->B->E->F->G->K, A->B->E->F->J->K

(b) Delay for circuit switching = setup + transmission + propagation + teardown

$$\begin{aligned} \text{(5th digit is odd)} &= 10 + 40 + 0.5 \times 5 + 0 \\ &= 52.5 \text{ s} \end{aligned}$$

$$\begin{aligned} \text{(5th digit is even)} &= 10 + 80 + 0.2 \times 5 + 0 \\ &= 91 \text{ s} \end{aligned}$$

(c) (5th digit is odd)

$$\text{No. of packets} = 40 / 4 = 10$$

$$\begin{aligned} \text{Delay of packet 1 (5 hops)} &= (\text{transmission} + \text{propagation}) \times 5 + \text{processing} \times 4 \\ &= (4 + 0.5) \times 5 + 1 \times 4 \\ &= 26.5 \text{ s} \end{aligned}$$

$$\begin{aligned} \text{Delay of each packet 2-10 (last hop)} &= 4 + 0.5 + 1 \\ &= 5.5 \text{ s} \end{aligned}$$

$$\text{Total delay} = 26.5 + 5.5 \times 9 = 76 \text{ s}$$

(5th digit is even)

$$\text{No. of packets} = 80 / 4 = 20$$

$$\begin{aligned} \text{Delay of packet 1 (5 hops)} &= (\text{transmission} + \text{propagation}) \times 5 + \text{processing} \times 4 \\ &= (4 + 0.2) \times 5 + 1 \times 4 \\ &= 25 \text{ s} \end{aligned}$$

$$\begin{aligned} \text{Delay of each packet 2-19 (last hop)} &= 4 + 0.2 + 1 \\ &= 5.2 \text{ s} \end{aligned}$$

$$\text{Total delay} = 25 + 5.2 \times 19 = 123.8 \text{ s}$$

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Answer for Question 4**/25**

(a) IP address: 192.168.172.134 (192.168.10101100.10000110)

x	n	Mask (binary)	(decimal)
0	20	11111111.11111111.11110000.00000000	255.255.240.0
1	21	11111111.11111111.11111000.00000000	255.255.248.0
2	22	11111111.11111111.11111100.00000000	255.255.252.0
3	23	11111111.11111111.11111110.00000000	255.255.254.0
4	24	11111111.11111111.11111111.00000000	255.255.255.0
5	25	11111111.11111111.11111111.10000000	255.255.255.128
6	26	11111111.11111111.11111111.11000000	255.255.255.192
7	27	11111111.11111111.11111111.11100000	255.255.255.224
8	28	11111111.11111111.11111111.11110000	255.255.255.240
9	29	11111111.11111111.11111111.11111000	255.255.255.248

x	n	network address	broadcast address	Number of addresses
0	20	192.168.160.0	192.168.175.255	$2^{32-20} = 4096$
1	21	192.168.168.0	192.168.175.255	$2^{32-21} = 2048$
2	22	192.168.172.0	192.168.175.255	$2^{32-22} = 1024$
3	23	192.168.172.0	192.168.173.255	$2^{32-23} = 512$
4	24	192.168.172.0	192.168.172.255	$2^{32-24} = 256$
5	25	192.168.172.128	192.168.172.255	$2^{32-25} = 128$
6	26	192.168.172.128	192.168.172.191	$2^{32-26} = 64$
7	27	192.168.172.128	192.168.172.159	$2^{32-27} = 32$
8	28	192.168.172.128	192.168.172.143	$2^{32-28} = 16$
9	29	192.168.172.128	192.168.172.135	$2^{32-29} = 8$

(b) A1: 3:06 B2: 3:34 C3: 3:42 A4: 3:27

