4:14~ 5:26

UNIVERSITY OF VICTORIA
EXAMINATIONS
COMPUTER COMMUNICATIONS NETWORKS
ECE458 (2023)

STUDENT NAME: [redacted]
INSTRUCTOR: Lin Cai
DURATION: 45 minutes

STUDENT NO.: [redacted]
SECTION:

TO BE ANSWERED ON PAPER

IMPORTANT NOTICE: STUDENTS MUST COUNT THE NUMBER OF PAGES IN THE QUESTIONS PAPER BEFORE BEGINNING TO WRITE, AND REPORT ANY DISCREPANCY IMMEDIATELY TO THE INVIGILATOR.

THIS QUESTIONS PAPER HAS EIGHT (6) PAGES INCLUDING THIS COVER PAGE.

This is an open-book exam. Books and notes are allowed.

Non-programmable calculator with no network connectivity is allowed.

Check the units of your answers.

Please read all questions and [marks] assigned to each question. Total marks: 20

Question	1 [3]	2 [9]	3 [6]	4 [2]	Total [20]
Earned Marks	1.5	9	6	1.5	18

kg MGTP

x10^3 = kilo
x10^6 = mega
x10^9

1. (a) In a communication network with a shared medium, assume all packets have the same size of 1000 bytes and the transmission rate is 8 Mbps. The propagation time between nodes within the network is 100 ns. Please answer the following questions.

i. What is the vulnerable period of packet transmission using pure Aloha? [1]

Pure aloha vulnerable period is 2 frame times ✓

$\Rightarrow \frac{1000 \text{ bytes}}{8\text{Mbps}} = \frac{1000 \times 8}{8 \times 10^6} = \boxed{125 \text{ ns}}$ frame time $\Rightarrow 2 \cdot 125 = \boxed{250 \text{ ns} \times 8 \text{ vuln. period}}$

ii. What is the vulnerable period of packet transmission using CSMA? [1]

CSMA vulnerable period is 2× propagation time

$\Rightarrow \boxed{100 \text{ ns}}$

−0.5

(b) Use an example to show how Collision Detection (CD) can improve the efficiency in local area networks. [1]

For examples in a local area network, with high amounts of traffic, collision detection gives a higher probability of not colliding, this increasing efficiency. ✗

−1

2. (a) A character is represented in its binary format: 01111110. Please write down the character in Hamming coded format with even parity. [3]

bit pos.	1	2	3	4	5	6	7	8	9	10	11	12
bin:	1	10	11	100	101	110	111	1000	1001	1010	1011	1100
Codeword:	0	0	0	1	1	1	1	1	1	1	1	0

R1: 0, 1, 1, 1, 1 ⇒ 0 at R1 (3 5 7 9 11)
R2: 0, 1, 1, 1, 1 ⇒ 0 at R2 (3 6 7 10 11)
R4: 1, 1, 1, 0 ⇒ 1 at R4 (5 6 7 12)
R8: 1, 1, 1, 0 ⇒ 1 at R8 (9 10 11 12)

(b) Given the generator polynomial $x^3 + x + 1$, please write down the CRC-appended bit string of the following bit sting: 001100110011. [3]

Polynomial: 1011 | Binary Divide 001100110011000 by gen. poly. (1011) then append the remainder.

remove leading zeros

```
1011 ) 1100110011000
       1011
       01111
        1011
        01001
         1011
         001000
           1011
           00111
             1011
             01000
              1011
              001100
                1011
                0111
```

remainder is 111

⇒ appended bit string

$\boxed{001100110011\,111}$

(c) Given the frame flag 01111110, please write down the bit stuffed string (**including flags**) for the following bit string: 1111110011111000. [3]

assuming this means ~~this~~ including start/end frame flags

add 0 after every 5 ones

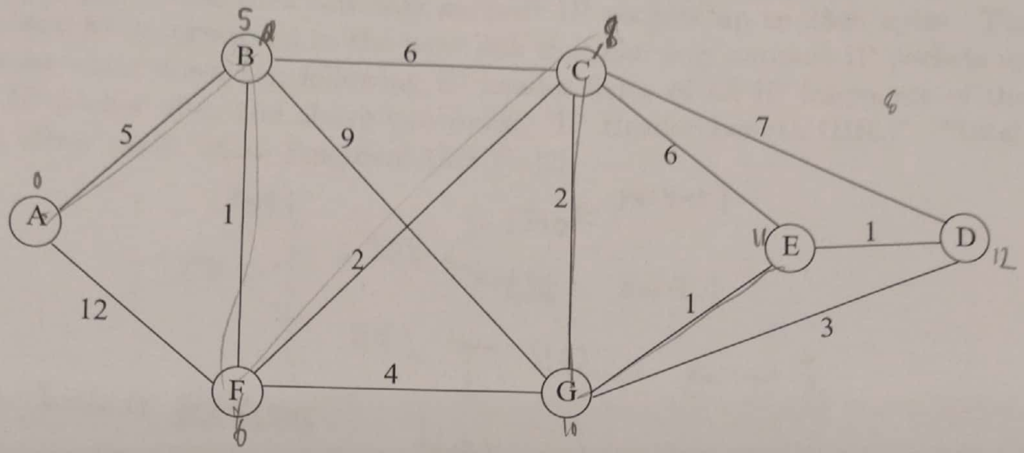
111110100111110000

including flags:

$\underbrace{01111110}_{\text{start flag}}\overbrace{111110100111110000}^{\text{string}}\underbrace{01111110}_{\text{end flag}}$

stuffing

3. In the following graph that represents the topology of a network, vertexes represent network routers, and edges represent bidirectional, symmetric communication links and are labeled by the link cost.



With link-state routing, please find the paths with the least cost from router A to all other routers, respectively. **You need to show each step of your work using the following tables.** [6]

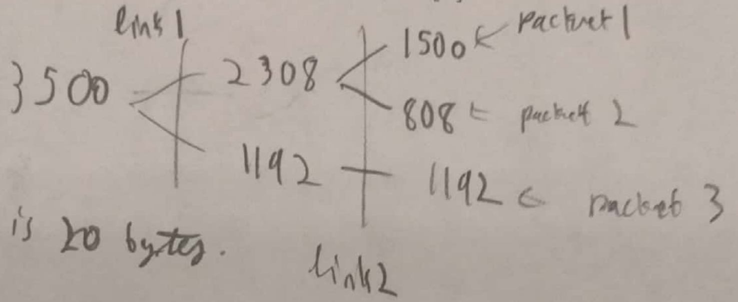
Iterations	A	B	C	D	E	F	G
Initially	(0, A)	(5, A)	(∞, .)	(∞, .)	(∞, .)	(12, A)	(∞, .)
1	(0, A)	(5, A)	(11, B)	(∞, ·)	(∞, ·)	(6, B)	(14, B)
2	(0, A)	〃	(8, F)	〃	〃	(6, B)	(10, F)
3	(0, A)	〃	(8, F)	(15, C)	(14, C)	〃	(10, F)
4	(0, A)	〃	〃	(13, G)	(11, G)	〃	〃
5	(0, A)	〃	〃	(12, E)	〃	〃	〃
6	(0, A)	〃	〃	(12, E)	〃	〃	〃

Give the least cost **path** and cost from A to other routers in the following table.

	Full Path	Cost
From A to B:	A−B	5
From A to C:	A−B−F−C	8
From A to D:	A−B−F−C−G−E−D	12
From A to E:	A−B−F−C−G−E	11
From A to F:	A−B−F	6
From A to G:	A−B−F−G	10

~~A~~ F−C−G has the same cost as F−G

4. An IP packet (with no IP header options) has the length of 3500 bytes. The packet has been forwarded through a link that can only support IP packets up to 2308 bytes. Then, these fragments have been forwarded to the next link that can only support IP packets up to 1500 bytes. Please write down the following IP header fields of all IP fragments of the original 3500-byte IP packet after the above two links: "IP Header Length (IHL)", "Total length", "Fragment offset" and "More Fragment (MF)". [2]



No options ⇒ IHL is 20 bytes.

−0.5

	IHL	total Length	MF	Fragment offset
Packet 1	20	1500 ✓	1	0 ✓
" 2	20	808 ✗	1	185 ✓
" 3	20	1192 ✗	0	286 ✓

5

$\frac{1500-20}{8}$ = offset = 185

$\frac{1500+808-20}{8}$ = 286

— END —