THE HONG KONG POLYTECHNIC UNIVERSITY
HONG KONG COMMUNITY COLLEGE

Subject Title	: Computer Networking	**Subject Code**	: SEHH2238
Session	: Semester Two, 2020/21	**Examination Time**	: 09:45 – 12:45
Date	: 14 May 2021	**Submission Period**	: 09:45 – 13:00
Subject Examiner(s)	: Dr Hon-sun CHIU Dr Candies LAM		

This question paper has a total of **SEVEN** pages (including this covering page).

Instructions to Candidates:

1. There are TWO sections in this paper.
   - Section A (60%) – Short Questions. Answer any FIVE out of SIX questions in this section in the answer sheet provided. Each question carries 12 marks. If you answer more than five questions, only the first five attempted questions will be marked. Indicate clearly which five questions you are attempting.
   - Section B (40%) – Long Questions. Answer ALL questions in this section in the answer sheet provided. Each question carries 20 marks.
2. Use 1K=1000, 1M=1000K and 1G=1000M. Correct your answer to 4 decimal places.
3. Show all your workings clearly and neatly. Reasonable steps should be shown. Marks will be deducted for untidy work.

Important points to follow:

1. Please type your answers of this Take-home Examination in Microsoft Word.

2. Please strictly follow the **Submission Instructions** posted on Moodle before submission of your answer sheet. In addition,
   - Please make sure that you have submitted the correct and entire file for the subject concerned. Useful information of PDF file generation is available at http://it-training.cpce-polyu.edu.hk/mod/book/view.php?id=1221.
   - Please make sure there is no missing page in your submission.
   - The file MUST include (a) full student name, (b) student number, (c) subject code, (d) subject group, (e) page number and (f) total number of pages on EVERY answer sheet.
   - A submission period of 15 minutes is allowed after the examination end time for you to upload your completed answer sheet to Moodle. This is the Submission Deadline, and your answer scripts must be uploaded to Moodle via submission link before this Submission Deadline.

3. Please make sure that each uploaded page of your answer sheet is clearly captured. Only **ONE** single file in **PDF** format with less than **20MB** will be accepted.

4. Late submission via Moodle is not allowed.

5. Only the last submission you made within the designated timeslot will be counted.

6. Declaration of Original Work:

   By submitting the answer sheet of this Take-home Examination to the subject lecturer through Moodle, you hereby declare that the work in the answer sheet is completely your own work. No part of the answer sheet is taken from other people's work without giving them credit. All references have been clearly cited.

   You understand that an infringement of this declaration leaves you subject to disciplinary actions such as mark deduction, disqualification or even expulsion by the College.

   If necessary, students may be invited to provide more information on their submission.

Section A (60%) – Short Questions

Answer any FIVE out of SIX questions in this section in the answer sheet provided. Each question carries 12 marks. If you answer more than five questions, only the first five attempted questions will be marked. Indicate clearly which five questions you are attempting.

Question A1

Consider an analogue signal with frequency spectrum below, where *x* is the **5th digit** of your student ID number. This signal is converted to digital file using PCM with 1024 levels.

(a) Is the analogue signal periodic or aperiodic? Why? (2 marks)

(b) What is the bandwidth of the signal? (2 marks)

(c) What is the minimum bit rate of the converted digital data? (4 marks)

(d) Calculate the SNR_{dB} of this PCM system. (2 marks)

(e) Briefly explain why there is noise as calculated in (d). (2 marks)

Question A2

(a) Explain the causes of transmission impairment. (6 marks)

(b) The sequence below shows some bits in a transmission of HDLC frame, where the error bits are highlighted.

Sender: ……11010001111101011100001111011111010111110……
Receiver: ……11011100011101111100001100111111010111110……

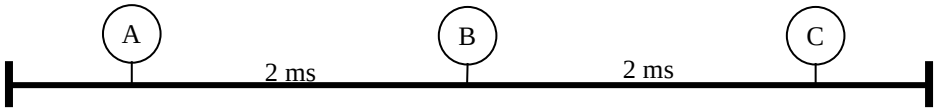
(i) What is the length of the longest error burst? (2 marks)

(ii) What is data transparency in HDLC frame? (2 marks)

(iii) If receiver considers that the bits are correct, and these bits are from the data part of an HDLC frame. What are the data bits as observed by the receiver? (2 marks)

Question A3

Consider a bus network below with 3 stations using 1-presistent CSMA/CD. The bandwidth of the link is (10 + *x*) Mbps, where *x* is the **3rd digit** of your student ID number, and the propagation delay between adjacent stations is 2 ms.



(a) Briefly explain how the stations perform CD. Hence, what is the minimum frame size required for this network? (4 marks)

(b) Suppose that a station stops its transmission in 1 ms and then backoff after detecting a collision. If the stations have the following packets to send, find their individual finish time, i.e. the time that a station completes transmitting a packet. Illustrate using a timing diagram.

Station	Packet ID	Packet Length	Ready at	Backoff time
A	1	10 ms	0 ms	22 ms
B	2	12 ms	5 ms	23 ms
C	3	15 ms	8 ms	20 ms
A	4	13 ms	15 ms	22 ms

(8 marks)

Question A4

Determine the answer below in **DOTTED DECIMAL** notation.

(a) Given the classful IP address *n*.13.22.111, where $n = 50 + x$ and *x* is the **4th digit** of your student ID number. Find

(i) the class. (1 mark)

(ii) the network mask in dotted decimal notation. (1 mark)

(iii) the host-id. (1 mark)

(iv) the network address. (1 mark)

(v) the broadcast address. (1 mark)

(b) A host in a given classless network has the IP address 151.48.23.121/20. Find

(i) the mask. (1 mark)

(ii) the network address. Show your working. (2 marks)

(iii) the broadcast address. Show your working. (2 marks)

(iv) the range of addresses that could be assigned to hosts. (2 marks)

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Question A5

A client is requesting the document located at `/etc/key/0203/img.jpg` from a web server. The server name is NETGOOD. The size of the document is 2048 bytes. The client accepts MIME version 1.0. The HTTP version in use is 1.1.

(a) Suppose the request is made on 28-Feb-2021 at 20:20:20 HKT. Draw the possible HTTP Get request and response messages. (8 marks)

(b) Suppose in the same HTTP session, the user requests another document `readme.txt`.

(i) Is another TCP connection required? Explain your answer. (2 marks)

(ii) Would your answer to (i) be different if HTTP1.0 is used instead? Explain your answer. (2 marks)

Question A6

(a) Encrypt the message "AUTHENTICATION" using a transposition cipher with the following key: 3 2 4 5 1. Use the **6th digit** of your student ID number for padding. Show your working AND the encrypted message. (5 marks)

(b) For RSA, given two numbers p = 5, q = 9.

(i) Find n and ϕ. (2 marks)

(ii) With e = 11, find d. Show your steps in details. (3 marks)

(ii) Hence, state the public key which is announced to the public and the private key which is kept secret. (2 marks)

- End of Section A -

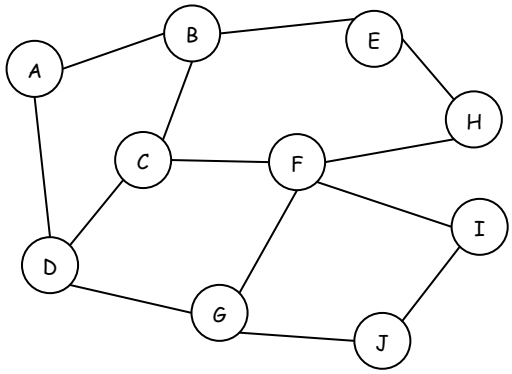
Section B (40%) – Long Questions

Answer <u>ALL</u> questions in this section in the answer sheet provided. Each question carries 20 marks.

<u>Question B1</u>

In the packet-switched network below, station A is sending a 10Mb file to station I using datagram service. The following assumptions apply:

- Shortest path routing is used.
- Bandwidth of each link is 10 Mbps.
- Propagation delay per link is 0.5 second.
- Each intermediate node induces a delay of 0.2 second due to queuing and processing.
- Maximum packet size is 600 Kb, where packet header and trailer can be ignored.
- All packets follow the same path.
- No packet loss or error. Each station knows the packet is correctly received immediately.



(a) In a real network with different delay per link, what problem(s) is / are caused if packets travel along different paths to the destination? (3 marks)

(b) By taking hop count as the measurement of path length, list all possible shortest paths from station A to station I. (2 marks)

(c) How many packets are sent by station A? What is the size of the last packet? (2 marks)

(d) Calculate the delay for station I to receive the first packet. (3 marks)

(e) Hence, or otherwise, calculate the total delay for station I to receive the 10 Mb file if the network operation is:

(i) Stop-and-wait like operation. (5 marks)

(ii) Go-back-N operation with sender window size equals to $5 + x$, where x is the **<u>7th digit</u>** of your student ID number. Assume that once the last packet of a window arrives at the next station, the next window of packets can be transmitted. (5 marks)

Question B2

An IP datagram is received with the following partial header information in hexadecimal:

```
4500076C 0B2A0000 FF06......
```

Answer the following questions. Unless specified otherwise, numerical answers should be expressed as DECIMAL numbers.

(a) (i) What is the IP version number? (1 mark)

(ii) Are there any options? (2 marks)

(iii) What is the size of the data? (2 marks)

(iv) What is the value of identification field? (1 mark)

(v) Is the packet part of a larger fragmented packet? Justify your answer. (2 marks)

(vi) How many more routers can the packet travel to? (1 mark)

(b) The packet arrives at a link with MTU of (550 + *x*) bytes, where *x* is the **8th digit** of your student ID number.

(i) How many fragments are generated? What are the data sizes in bytes? (3 marks)

(ii) For each fragment in (b)(i), indicate the values of the fields ID, Total length, Flags and Fragmentation offset. The Flags should be expressed in BINARY, while other values should be expressed in DECIMAL. (8 marks)

- End of Section B -

- END OF PAPER -