THE HONG KONG POLYTECHNIC UNIVERSITY
HONG KONG COMMUNITY COLLEGE

Subject Title	: Computer Networking	**Subject Code**	: CCN2238
Session	: Semester Two, 2015/16	**Time**	: 09:30 – 12:30
Date	: 8 May 2016	**Time Allowed**	: 3 hours
Subject Examiner(s)	: Dr Joseph SO		

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

Instructions to Candidates:

1. There are THREE sections in this paper.
   Section A (30%) – Multiple-choice Questions. Answer ALL questions in this section on the multiple-choice answer sheet provided. Each question carries 1 mark.
   Section B (40%) – Short Questions. Answer any FIVE out of the SIX questions in this section in the answer book provided. Each question carries 8 marks.
   Section C (30%) – Long Questions. Answer any TWO out of the THREE questions in this section in the answer book provided. Each question carries 15 marks.
2. Appendix A shows the list of selected well-known TCP and UDP port numbers.
   Appendix B shows the 7-bit ASCII Table.
3. Unless specified in a question, you may assume $1k = 10^3$ and $1M = 10^6$.
4. Candidates are required to pay special attention to neatness and clarity of expression in their answers. Marks will be deducted for untidy work.

Authorised Materials:

	YES	NO
CALCULATOR	[✓]	[ ]
SPECIFICALLY PERMITTED ITEMS	[ ]	[✓]

DO NOT TURN OVER THE PAGE UNTIL YOU ARE TOLD TO DO SO

Section B – (40%) Short Questions

Answer any FIVE out of the SIX questions in this section in the answer book provided. Each question carries 8 marks.

Question B1

(a) The following block of data units is received over a line using two dimensional odd parity check. Each data unit consists of 7 data bits and 1 parity bit at the rightmost position. The last byte of the block consists of the parity bits for the whole block. Assuming that this data block has no more than two error bits, copy the following data unit to the answer book and circle the bit(s) in error.

01001010 11101000 11000111 10001100 00010000

(2 marks)

(b) In a communication system, each character is stored as a 7-bit ASCII. A message with two characters "Ls" is sent to another side. The resulting 14-bit data are added with a FCS generated by a generator x^4+x^3+1. What is the resulting bit stream? (6 marks)

Question B2

We have sampled a signal using 2048 levels of quantization. This signal contains frequencies ranging from 300Hz to 18000Hz and 24000Hz to 35000Hz with a maximum amplitude of 3V.

(a) Sketch the frequency domain graph. (2 marks)

(b) Calculate the number of bits per sample. (1 mark)

(c) Calculate the bit rate of the digitized signal that satisfies the Nyquist sampling theorem. (3 marks)

(d) Calculate the SNRdB due to the quantization. (2 marks)

Question B3

There are three stations A, B and C in a bus network adopting non-persistent CSMA protocol. The data packets may have different lengths in term of transmission time. When the channel is sensed to be busy or when a packet is collided, the same fixed backoff time will be used for a particular station. However the backoff time of station A, B and C are different and are indicated as below. Suppose 6 data packets indicated below are ready to be transmitted.

Station	Packet ID	Packet Length	Ready time (at)	Backoff Time
A	A1	5 minutes	6:00 pm	5 minutes
B	B1	5 minutes	6:02 pm	10 minutes
C	C1	5 minutes	6:03 pm	12 minutes
A	A2	10 minutes	6:06 pm	5 minutes
B	B2	5 minutes	6:18 pm	10 minutes
C	C2	5 minutes	6:18 pm	12 minutes

Assume the propagation delay is negligible and the source station can receive the acknowledgement from the destination station immediately after the packet transmission.

(a) Between 6:00 pm and 6:30 pm, how many times will packet collisions occur? You should also write down which packets are collided at what time. (4 marks)

(b) At what time will packets A1, A2, B1 and C1 successfully finish their transmissions? You should write down individual finish time for each packet. (4 marks)

Question B4

A series of messages is sent from A to B with each message carries one character using selective-repeat ARQ where the window size is 4 for both the sender and the receiver.

(a) What are the minimum number of bits needed in the sequence number of the sender and the receiver? (2 marks)

(b) With the example that A is sending "GREAT" to B, illustrate the problem if the number of bits in the sequence number is less than the required minimum. (6 marks)

Question B5

(a) You are going to develop an App which plays live sports matches. Which transport layer protocol will you use? Explain briefly. (2 marks)

(b) The following is the first part of the content (including the header) of a UDP datagram in hexadecimal format

```
027C C550 00EA A123 C010 3238 3951 .....
```

(i) What is the destination port number in decimal number? (1 mark)

(ii) What is the source port number in decimal number? (1 mark)

(iii) What is the total length of the user datagram in decimal number? (1 mark)

(iv) What is the length of the data in decimal number? (1 mark)

(v) Is the packet directed from a client to a server or vice versa? (1 mark)

(vi) What is the application-layer protocol? (1 mark)

Question B6

A company is granted a block of classful address which contains an address of 205.23.46.11. As a network engineer, you are required to allocate the addresses so that:

- One subnet has 10 servers
- One subnet has 85 hosts; and
- One subnet has 40 hosts

Design the subnets and determine the network address, the subnet mask and the broadcast address of each subnet. (8 marks)

- End of Section B -

Section C – (30%) Long Questions

Answer any TWO out of the THREE questions in this section in the answer book provided. Each question carries 15 marks.

Question C1

A system contains a sender and a receiver. The sender needs to send 7.5M characters in frames. Each frame carries 800 bytes which includes the 5-bit sequence number. The distance between the sender and receiver is 300 km and the propagation speed is 2×10^8 ms^{-1}. The channel rate is 1.2 Mbps. The ACK has 512 bits. There is no data lost or corrupted. The processing delay on both sides is ignored. The overhead due to the header and trailer is ignored.

(a) If Stop-and-Wait ARQ protocol is used, what is the total time required to complete the data transmission and acknowledgement? (6 marks)

(b) Go-back-N ARQ protocol is used with the maximum allowable window size in the sender. The receiver acknowledges immediately when a frame is received. What is the total time required to complete the data transmission and acknowledgement? (5 marks)

(c) It is known that, in an instant, the values of variables are $S_f = 17$, $S_n = 22$ and $R_n = 20$. Assume that the network does not duplicate or reorder the packets.

(i) What are the sequence numbers of data packets in transit? (2 marks)

(ii) What are the acknowledgement numbers of ACK packets in transit? (2 marks)

Question C2

Three routers (RA, RB and RC) in a network are connected by links with MTU of 2400 bytes in each link. A client, P, sends a request as IP datagram to a server Q as shown in Figure C.2. The link from P to router RA has an MTU of 2100 bytes. Q is connected to RC in the Ethernet LAN. The length of the original IP datagram (including the header) is 12800 bytes. Suppose this datagram is stamped with the identification number (ID) 593 and there is no optional information in the header.

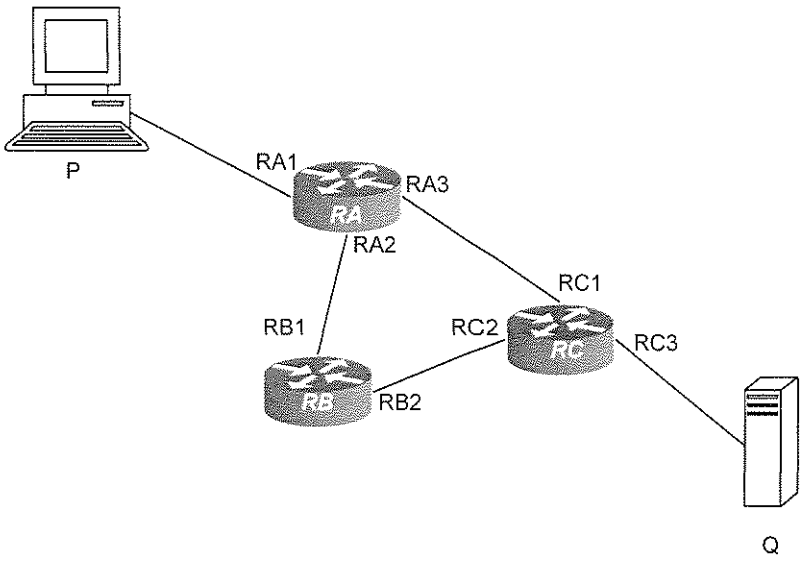

Figure C.2

(a) Derive the number of fragments needed in sending the datagram through the link from P towards the interface RA1. (3 marks)

(b) What are the values of ID, Flag (the M-bit) and Fragment Offset in the corresponding headers of the first, second and the last fragments in (a)? (5 marks)

(c) If no loss and resend is needed, derive the number of fragments needed to be received in Q from RC3 in order to get the original datagram. (4 marks)

(d) What are the values of Fragment Offset in the IP and size of the Ethernet frames in the corresponding headers of the first, second and the last fragments? (3 marks)

Question C3

(a) Explain briefly the services of BSS and ESS in the architecture of IEEE 802.11 wireless LAN. (3 marks)

(b) What are the **THREE** main concerns when developing WANs for internetworking? (3 marks)

(c) Alice sends an agreed contract to Bob via the Internet. Bob is afraid that Alice will refuse to the agreed content in the contract after a year. Suggest how the message digest, the digital signature and encryption be used before the contract is sent to ensure the contract's authenticity and the prevent repudiation. (9 marks)

- End of Section C -

Appendix A: List of selected well-known TCP and UDP port numbers

Port in Decimal	TCP or UDP	Service or Protocol Name	RFC
7	TCP/UDP	Echo	792
20	TCP	File Transport Protocol (FTP)	959
21	TCP	FTP control	959
22	TCP	Secure Shell (SSH)	4253
23	TCP	Telnet	854
25	TCP	Simple Mail Transfer Protocol (SMTP)	5321
53	TCP/UDP	Domain Name System (DNS)	1034
67	UDP	Bootstrap Protocol Server (BootP, bootps)	951
68	UDP	Bootstrap Protocol Client (bootpc)	951
69	UDP	Trivial File Transfer Protocol (TFTP)	1350
79	TCP	Finger	1288
80	TCP	Hypertext Transfer Protocol (HTTP)	2616
88	TCP	Kerberos	4120
106	TCP	Password Server(Unregistered Use)	-
110	TCP	Post Office Protocol (POP3) Authenticated Post Office Protocol (APOP)	1939
115	TCP	Simple File Transfer Protocol (SFTP)	913
119	TCP	Network News Transfer Protocol (NNTP)	3977
123	TCP/UDP	Network Time Protocol (NTP)	1305
137	UDP	Windows Internet Naming Service (WINS)	-
143	TCP	Internet Message Access Protocol (IMAP)	3501
161	UDP	Simple Network Management Protocol (SNMP)	1157
192	UDP	OSU Network Monitoring System	-
311	TCP	Secure server administration	-
427	TCP/UDP	Service Location Protocol (SLP)	2608
443	TCP	Secure Sockets Layer (SSL, or "HTTPS")	2818
445	TCP	Microsoft SMB Domain Server	-
464	TCP/UDP	kpasswd	3244
500	UDP	ISAKMP/IKE	2408
514	TCP	shell	-
514	UDP	Syslog	-
548	TCP	Apple Filing Protocol (AFP) over TCP	-
554	TCP/UDP	Real Time Streaming Protocol (RTSP)	2326
587	TCP	Message Submission for Mail (Authenticated SMTP)	4409
600-1023	TCP/UDP	Mac OS X RPC-based services	-
626	TCP	AppleShare Imap Admin (ASIA)	-
626	UDP	serialnumberd (Unregistered Use)	-
631	TCP	Internet Printing Protocol (IPP)	2910
636	TCP	Secure LDAP	-
660	TCP	Server administration	-
687	TCP	Server administration	-
749	TCP/UDP	Kerberos 5 admin/changepw	-
985	TCP	NetInfo Static Port	-
1085	TCP/UDP	WebObjects	-
1099 & 8043	TCP	Remote RMI and IIOP Acess to JBOSS	-

Appendix B: 7-bit ASCII Table

Decimal	Octal	Hex	Binary	Value	
048	060	030	0110000	0	
049	061	031	0110001	1	
050	062	032	0110010	2	
051	063	033	0110011	3	
052	064	034	0110100	4	
053	065	035	0110101	5	
054	066	036	0110110	6	
055	067	037	0110111	7	
056	070	038	0111000	8	
057	071	039	0111001	9	
058	072	03A	0111010	:	(colon)
059	073	03B	0111011	;	(semi-colon)
060	074	03C	0111100	<	(less than)
061	075	03D	0111101	=	(equal sign)
062	076	03E	0111110	>	(greater than)
063	077	03F	0111111	?	(question mark)
064	100	040	1000000	@	(AT symbol)
065	101	041	1000001	A	
066	102	042	1000010	B	
067	103	043	1000011	C	
068	104	044	1000100	D	
069	105	045	1000101	E	
070	106	046	1000110	F	
071	107	047	1000111	G	
072	110	048	1001000	H	
073	111	049	1001001	I	
074	112	04A	1001010	J	
075	113	04B	1001011	K	
076	114	04C	1001100	L	
077	115	04D	1001101	M	
078	116	04E	1001110	N	
079	117	04F	1001111	O	
080	120	050	1010000	P	
081	121	051	1010001	Q	
082	122	052	1010010	R	
083	123	053	1010011	S	
084	124	054	1010100	T	
085	125	055	1010101	U	
086	126	056	1010110	V	
087	127	057	1010111	W	
088	130	058	1011000	X	
089	131	059	1011001	Y	
090	132	05A	1011010	Z	
091	133	05B	1011011	[	
092	134	05C	1011100	\	(back slash)
093	135	05D	1011101	]	
094	136	05E	1011110	^	
095	137	05F	1011111	_	(underscore)
096	140	060	1100000	`	

Decimal	Octal	Hex	Binary	Value
097	141	061	1100001	a
098	142	062	1100010	b
099	143	063	1100011	c
100	144	064	1100100	d
101	145	065	1100101	e
102	146	066	1100110	f
103	147	067	1100111	g
104	150	068	1101000	h
105	151	069	1101001	i
106	152	06A	1101010	j
107	153	06B	1101011	k
108	154	06C	1101100	l
109	155	06D	1101101	m
110	156	06E	1101110	n
111	157	06F	1101111	o
112	160	070	1110000	p
113	161	071	1110001	q
114	162	072	1110010	r
115	163	073	1110011	s
116	164	074	1110100	t
117	165	075	1110101	u
118	166	076	1110110	v
119	167	077	1110111	w
120	170	078	1111000	x
121	171	079	1111001	y
122	172	07A	1111010	z

- END OF PAPER -