



**UNIVERSITY OF COLOMBO, SRI LANKA**

**UNIVERSITY OF COLOMBO SCHOOL OF COMPUTING**

**DEGREE OF BACHELOR OF INFORMATION TECHNOLOGY (EXTERNAL)**

**Academic Year 2017 – Semester 4 Examination**

***IT4405: Computer Networks***

***PART 2 - Structured Question Paper***

**November, 2017**

**(ONE HOUR)**

**To be completed by the candidate**

BIT Examination Index No: .....

**Important Instructions:**

- The duration of the paper is **1 (One) hour**.
- The medium of instruction and questions is English.
- This paper has **3 questions** and **9 pages**.
- **Answer all questions.** All questions **do not** carry equal marks.
- **Write your answers** in English using the space provided **in this question paper**.
- Do not tear off any part of this answer book.
- Under no circumstances may this book, used or unused, be removed from the Examination Hall by a candidate.
- Note that questions appear on both sides of the paper.  
If a page is not printed, please inform the supervisor immediately.
- Calculators are **not** allowed.

**Questions Answered**

Indicate by a cross (x), (e.g. 

X
---

) the numbers of the questions answered.

To be completed by the candidate by marking a cross (x).	Question numbers		
	1	2	3
To be completed by the examiners:			

1)

- (a) Suppose you are assigned a class C network 192.168.100.0 /24 for your organization, from which you need to create nine subnets.

- (i) How many subnet bits are needed to create nine subnets?

[2 marks]

**ANSWER IN THIS BOX**

$2^N - 2 \geq 9$ , and  $N = 4$ . So you need 4 bits to create nine subnets.

- (ii) What is the network number of the first subnet?

[2 marks]

**ANSWER IN THIS BOX**

11000000.10101000.01100100.00000000

- (iii) Write down the usable host address range for each of the first three subnets.

[2 marks]

**ANSWER IN THIS BOX**

11000000.10101000.01100100.00000001 -- 11000000.10101000.01100100.00001110  
 11000000.10101000.01100100.00010001 -- 11000000.10101000.01100100.00011110  
 11000000.10101000.01100100.00100001 -- 11000000.10101000.01100100.00101110

- (iv) Identify the broadcast address of each of the nine sub networks.

[2 marks]

**ANSWER IN THIS BOX**

1<sup>st</sup> network 11000000.10101000.01100100.00001111

2<sup>nd</sup> network 11000000.10101000.01100100.00011111

3<sup>rd</sup> network 11000000.10101000.01100100.00101111

4<sup>th</sup> network 11000000.10101000.01100100.00111111

5<sup>th</sup> network 11000000.10101000.01100100.01001111

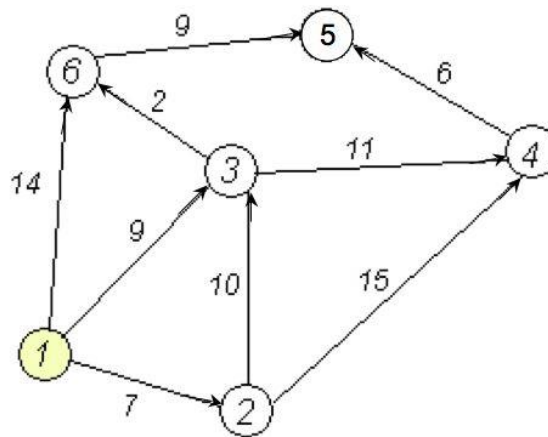
6<sup>th</sup> network 11000000.10101000.01100100.01011111

7<sup>th</sup> network 11000000.10101000.01100100.01101111

8<sup>th</sup> network 11000000.10101000.01100100.01111111

9<sup>th</sup> network 11000000.10101000.01100100.10011111

- (b) Consider the following data network with vertices as hosts and edges as links. With the indicated link costs, use Dijkstra's shortest-path algorithm to compute the shortest path from node 1 to all other network nodes. Show how the algorithm works by constructing a table showing the path cost from one node to another.



[5 marks]

**ANSWER IN THIS BOX**

Step	N'	$d(2),p(2)$	$d(3),p(3)$	$d(4),p(4)$	$d(5),p(5)$	$d(6),p(6)$
0	1	7,1	9,1	inf	inf	14,1
1	1,2	7,1	9,1	22,2	inf	14,1
2	1,2,3	7,1	9,1	20,3	inf	11,3
4	1,2,3,6	7,1	9,1	20,3	20,6	11,3
5	1,2,3,6,4	7,1	9,1	20,3	20,6	11,3
6	1,2,3,6,4,5	7,1	9,1	20,3	20,6	11,3

- (c) Fill in each box of the table below by term or terms most appropriate for the given application type.

[12 marks]

Application	Application layer protocol(s)	Transport layer protocol (UDP or TCP)	Delay tolerant? (Yes/No)	Loss tolerant? (Yes / No)
Electronic mail	SMTP	TCP	Yes	No
Remote terminal access	FTP	TCP	No	No
Web browsing	HTTP	TCP	No	No
On-line multi-player gaming	HTTP	TCP	Yes/No	No
Streaming multimedia (e.g., Skype)	Skype (Proprietary)/ RTP/RTSP	UDP/TCP	No	Yes

- 2) (a) In a certain point to point network, a host A is connected to host B through a router X. The link A to X has a bandwidth of 1Mbps and a one way propagation delay of 100 msec. The link from X to B has a bandwidth of 500kbps and a one way delay of 200 msec. A transmits a large file to B continuously in constant length packets of size 1kbytes. Links are dedicated to A and B.

- (i) What is the effective throughput between A and B (in packets per second)?

[2 marks]

**ANSWER IN THIS BOX**

Bottleneck throughput for the file transfer is 500kbps

Throughput for the file transfer in packets per second is = 500 kilo bits per second / (1 x 8 kilo bits / packet)  
= 500/8 packets per second

- (ii) How long does it take to transfer a file of 4GBytes? [1 mark]

**ANSWER IN THIS BOX**

$(4 \times 10^9 \times 8) \text{ bits} / 500 \times 10^3 \text{ bits per second} = 64 \times 10^3 \text{ seconds}$

- (iii) If the hosts A and B are sliding window flow controlled, what is the effective window size (that is the number of packets in transit at any given time)? **[2 marks]**

**ANSWER IN THIS BOX**

Total RTT delay at A to receive an ack for a sent packet is =  
 Transmit time at two links + 2 x propagation delay at the two links  
 $= (1\text{KB}/1\text{Mbps}) + (1\text{KB}/500\text{Kbps}) + 2 \times (100 + 200) \text{ ms}$   
 $= 8/1000 \text{ sec} + 8/500 \text{ sec} + 600 \text{ ms}$   
 $= 8 \text{ ms} + 16 \text{ ms} + 600 \text{ ms}$   
 $= 624 \text{ ms}$

Throughput = Window Size / RTT  
 $500/8 \text{ packets per second} = \text{Window Size} / 624 \text{ ms}$   
 $\text{Window Size} = 500/8 \times 624$   
 $= 39 \text{ packets}$

- (b) Answer each of the following questions in one sentence.

**[10 Marks]**

- (i) A continuous time signal with a maximum frequency component of 20 kHz is sampled at the rate of 35000 samples per second and digitized. The resulting digital signal is sent through a low pass filter to recover the original continuous signal. Can the recovery be done?

**ANSWER IN THIS BOX**

No. Because it is sampled at less than Nyquist rate.

- (ii) A number of packet data streams are multiplexed on to a single stream to increase the utilization of a link. In the case of digitized video data, which form of multiplexing is better, statistical or time division multiplexing?

**ANSWER IN THIS BOX**

Time division multiplexing.

- (iii) In data communication over a wide area network, either we can provide hop-by-hop reliability or end-to-end-reliability or both. To provide such reliability, do we use datagrams or virtual circuits?

**ANSWER IN THIS BOX**

Virtual circuits.

- (iv) In an on-line stock market operation, brokers buy and sell stocks of companies. Why is UDP recommended as the transport protocol for such an application?

**ANSWER IN THIS BOX**

Short request-response messages without overhead of connection establishment

- (v) In audio and video streaming applications, it is recommended that RTSP (real time streaming protocol) over UDP is used. What is the reason for use of RTSP (or RTP)?

**ANSWER IN THIS BOX**

To maintain a constant data rate (to reduce data packet jitter/delay variation).

- (vi) An HTTP client wants to retrieve a web document at a given URL. The IP address of the web-server is initially unknown. What transport and application-layer protocols besides HTTP are needed in this scenario?

**ANSWER IN THIS BOX**

DNS.

- (vii) Access resolution in a shared medium like that of a wired Local Area Network can be provided through tokens or by carrier sensing. Which form of access is better if the traffic on the LAN is heavy?

**ANSWER IN THIS BOX**

Tokens.

- (viii) For wireless LANs, why is CSMA/CA recommended over CSMA/CD as an access protocol?

**ANSWER IN THIS BOX**

To avoid hidden station problem.

- (ix) In Mobile Ad-hoc Networks (MANET), nodes move and are wireless connected. What two key properties should be exploited by a routing protocol for route discovery in MANET's?

**ANSWER IN THIS BOX**

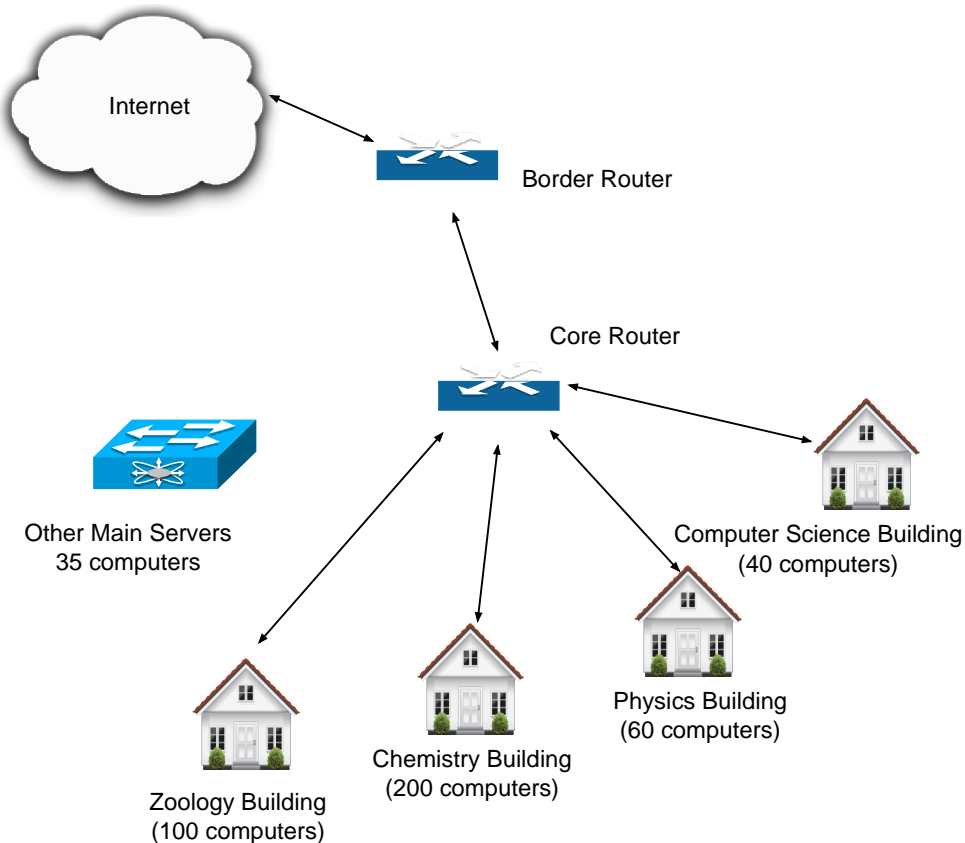
Broadcasting, neighbour based routing.

- (x) In a hierarchical switched LAN based organizational network, what is the use of the VLAN concept?

**ANSWER IN THIS BOX**

To configure logical user groups.

- 3) A small university campus would like to have its four different departments housed in physically separate buildings connected to the internet via the core router and the border router to the Internet. The university also would like to have a set of servers for the use of each of the four departments as shown in the diagram below.



- (a) Propose a suitable network design plan for the overall connectivity of the university campus. You may assume that the university has an IPv4 address space of 172.16.0.8/22.

[5 marks]

**ANSWER IN THIS BOX**

Network	No of Devices	IPv4 subnet size	Allocation
Router – Router	2 devices	/30	172.16.0.8/30
Server network	35 devices	/26	172.16.3.72/26
CompScience	40 devices	/26	172.16.3.72/26
Physics	60 devices	/25	172.16.2.8/25
Chemistry	200 devices	/24	172.16.0.8/24
Zoology	100 devices	/25	172.16.1.8/25



- (b) Suppose each of the four buildings have three storeys of floors. Propose a suitable network design for this departmental intranet. Identify the key network concepts. State your assumptions.

[5 marks]

**ANSWER IN THIS BOX**

We can have two VLANs in a each floor of these buildings. One is for voice and the other is for data.  
Choose a suitable numbering system to identify each floor of the building and then the VLAN number.

\*\*\*\*\* END \*\*\*\*\*