UNIVERSITY OF COLOMBO, SRI LANKA

UNIVERSITY OF COLOMBO SCHOOL OF COMPUTING

DEGREE OF BACHELOR OF INFORMATION TECHNOLOGY (EXTERNAL)

Academic Year 2004/2005 – 2nd Year Examination – Semester 4

IT4102: Data Communication and Computer Networks
PART 2 – Structured Question Paper

13th August, 2005
(ONE AND HALF HOURS)

To be completed by the candidate

BIT Examination Index No: _____

Important Instructions:

- The duration of the paper is **1 ½ (One and Half) hours**.
- The medium of instruction and questions is English.
- This paper has **4 questions** and **12 pages**.
- **Answer question 1 (50** marks**) and any 2 of the other questions (25** marks each**) only**.
- **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.

Questions Answered

Indicate by a cross (✗), (e.g. ✗) the numbers of the questions answered.

To be completed by the candidate by marking a cross (✗).	1	2	3	4	
To be completed by the examiners:					

1) (a) An analogue television picture transmission typically occupies a bandwidth of 6MHz. Suppose the TV signal is sampled and digitized at 20 bits/sample. Using standard theorems and equations, and clearly showing the step by step workings, obtain answers to the following.

(i) What is the minimum uncompressed data rate at which the digital TV signal can be transmitted and reproduced at the receiver?

(02 marks)

ANSWER IN THIS BOX

(ii) Suppose this digital TV signal is to be transmitted over the same 6MHz bandwidth channel. What is the minimum signal-to-noise ratio required of the channel to support this data rate?

(03 marks)

ANSWER IN THIS BOX

(b) The table below is intended to summarise some properties of local area networks, both wired and wireless. Fill in the blanks in each numbered row with appropriate terms chosen from the corresponding parameter options which follow.

(25 marks)

Row (1) – co axial cable, UTP cable, fibre optic cable, microwave

Row(2) – 10Mbps, 11Mbps,16Mbps, 54Mbps,100Mbps, 1Gbps, 10Gbps

Row(3) – token passing, TDMA, CDMA, CSMA, CSMA/CA, CSMA/CD, dedicated channel, CSMA/CA with polling, polling only

Row(4) – 1m, 10m, 100m, 1km, 10km, 100km

Row(5) – yes, no

ANSWER IN THIS BOX

LAN / Parameter	Token Ring	shared Ethernet	switched Ethernet	Bluetooth	WLAN
(1) Media					
(2) Max. data rate					
(3) Packet access control					
(4) Max. distance					
(5) Voice support					

(c) A full block of IP addresses from 192.246.120.0 to 192.246.120.255 is required to be sub netted into seven subnets with each subnet having 25,15,18,10, 24, 5, 15 hosts respectively.

(i) What is the required subnet mask?

(03 marks)

ANSWER IN THIS BOX

(ii) What is the maximum number of hosts which can be supported by any of the subnets?

(02 marks)

ANSWER IN THIS BOX

(d) The table below is required to show the relevant protocols of the Internet Protocol Suite used by each of the applications mentioned. Fill in the blanks in each numbered column with appropriate terms chosen from the corresponding protocol options which follow.

(15 marks)

Column (1) – *HTTP, SMTP, FTP, TFTP, POP, IMAP, RTP, RPC, none*

Column (2) – *none, UDP, TCP*

Column (3) – *none, H.323, SIP*

ANSWER IN THIS BOX

Protocol / Application	(1) Application protocol	(2) Transport protocol	(3) signaling/control protocol
Email			

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VoIP			
NFS (remotely mountable file system)			
Web services (SOAP invocations or XML over RPC invocations)			
Real time streaming			

2) (a) **Figure 1** shows a typical propagation diagram for an Ethernet. A and B are nodes d (meters) apart and the one way propagation delay is τ (sec). Node A starts transmitting at t=0 and node B starts sending at t= t' (>0).

Figure 1
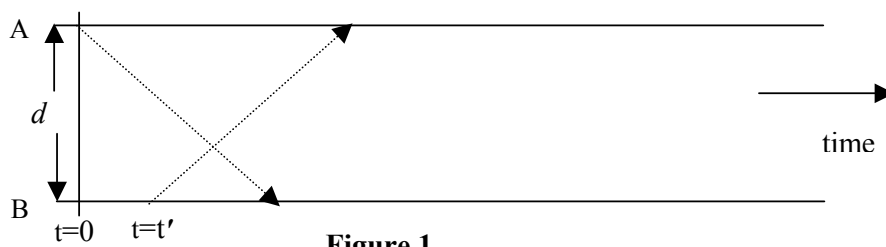
   (i) Complete the propagation diagram assuming that there is a jamming period of β.

                                                         (05 marks)

ANSWER IN THIS BOX

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(ii) At what time would node A hear a collision?

(02 marks)

ANSWER IN THIS BOX

(iii) At what time would node B hear a collision?

(02 marks)

ANSWER IN THIS BOX

(iv) With a jamming period of β, at what time would the channel fall silent?

(03 marks)

ANSWER IN THIS BOX

(b) **Figure 2** shows a switched local area network architecture for a small organization. The users of PC-A, PC-C and Server_1 belong to the same user group.
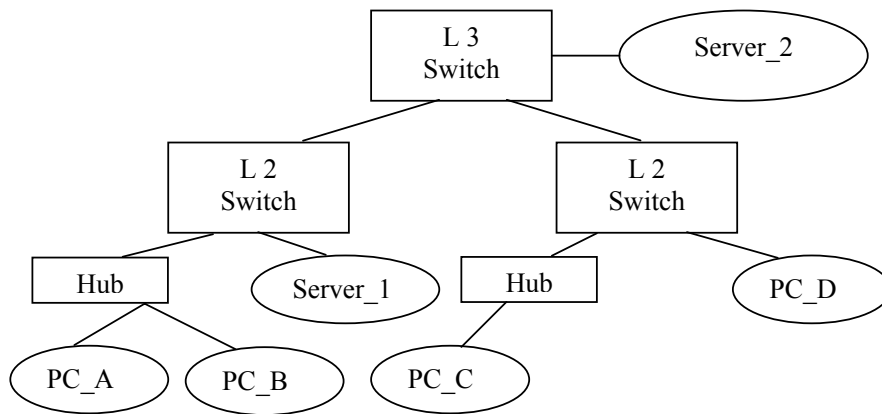
```
                    ┌──────────┐
                    │   L 3    │          ╭───────────╮
                    │  Switch  │──────────│ Server_2  │
                    └──────────┘          ╰───────────╯
                     ╱        ╲
          ┌──────────┐        ┌──────────┐
          │   L 2    │        │   L 2    │
          │  Switch  │        │  Switch  │
          └──────────┘        └──────────┘
           ╱       ╲            ╱        ╲
    ┌───────┐  ╭──────────╮ ┌───────┐  ╭──────────╮
    │  Hub  │  │ Server_1 │ │  Hub  │  │  PC_D    │
    └───────┘  ╰──────────╯ └───────┘  ╰──────────╯
     ╱    ╲                    │
╭────────╮ ╭────────╮     ╭────────╮
│  PC_A  │ │  PC_B  │     │  PC_C  │
╰────────╯ ╰────────╯     ╰────────╯
```

Figure 2

(i) What is the main purpose of the L3 switch?

(02 marks)

ANSWER IN THIS BOX

(ii) Draw a circle around a typical collision domain.

(02 marks)

ANSWER IN THIS BOX

*You should draw this on the diagram above (***Figure 2***).*

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(iii) Suppose the organization is housed in a multi-storey building and there is an L2 switch in each floor. How can the user group of PC-A, PC-C and Server_1 be defined in this network setting?

(02 marks)

ANSWER IN THIS BOX

(iv) Identify from among the elements PC-A, PC-B, PC-C, PC-D, Server_1 and Server_2, those which belong to a broadcast domain.

(02 marks)

ANSWER IN THIS BOX

(v) Identify from among the elements PC-A, PC-B, PC-C, PC-D, Server_1 and Server_2 those which can belong to a particular IP subnet.

(02 marks)

ANSWER IN THIS BOX

(vi) What could make Server_1 to be placed at the L2 switch and Server_2 to be placed at the L3 switch?

(03 marks)

ANSWER IN THIS BOX

3) (a) **Figure 3** shows the graph topology of a certain wide area network. The routers are identified as vertices A, B, C, D, E and the unidirectional links as edges. The relative costs of the links are shown closer to the edges. By applying the iterative formula

$d[v] = minimum \{d[v], d[u]+c (u, v)\}$

or otherwise, find the shortest path from vertex A to all other vertices B, C, D, E and fill in **Table 3**. Here, d[v] is the weight of vertex v, d[u] is the weight of vertex u and, c(u,v) is the cost of link from u to v, where u and v are adjacent vertices. <u>Hint</u>: Initialize weight of A to zero at the beginning of iteration.
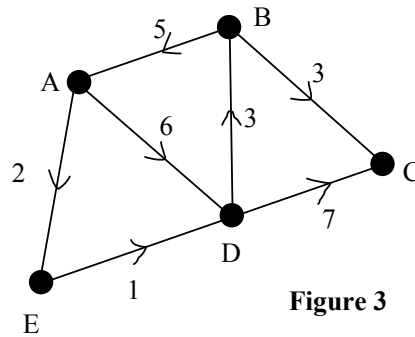

Figure 3

(06 marks)

ANSWER IN THIS BOX

source	destination	through nodes
A	E	
A	D	
A	B	
A	C	

Table 3

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(b) A local bank has its Head Office in Colombo and branches spread throughout major cities in the island. The bank wishes to link up all branches to its Head Office, and set up an island wide TCP/IP WAN.

(i) The table below describes the network options available to the WAN implementer. Fill in the blanks in each parameter column using the words (low, moderate, high).

(12 marks)

ANSWER IN THIS BOX

Parameter \ Network Option	supported data rate	network delay	monetary cost
IP over leased lines			
IP over Frame Relay			
VSAT (satellite)			
IP over SONET			

(ii) Bank transactions usually require some form of end to end security. State <u>two</u> techniques which can be employed to provide the required level of security.

(03.5 marks)

ANSWER IN THIS BOX

(ii) Bank transactions also require a higher level of network resiliency (i.e., quick recovery from failure). State <u>two</u> approaches which can be used to provide the level of network resiliency.

(03.5 marks)

ANSWER IN THIS BOX

4) (a) The digital signing of a document is intended to satisfy two requirements, first, is that though the content may be public it cannot be tampered with, and the second, the content's author is authenticated. Using the standard symbolic notation or a block diagrammatic representation, show how the encryption and the decryption procedure can be carried out to achieve these objectives. Note that there is one originator, but possibly many recipients.

(10 marks)

ANSWER IN THIS BOX

(b) (i) State <u>three</u> advantages of IPv6 over IPv4.

(08 marks)

ANSWER IN THIS BOX

(ii) Complete the block diagram shown in **Figure 4** which is intended to show a typical differentiated services (diff-serv) architecture to provide QoS over IP, using the Type Of Service (TOS) bits in the IP header.

(07 marks)

ANSWER IN THIS BOX

Figure 4

Traffic in → □ → □ → □ → QoS guaranteed traffic

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