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| --- | --- |
| **This question paper consists of 5**  **printed pages, each of which is**  **identified by ELEC5471M** | **Drawing instruments and electronic calculators may be used.**  **Approved dictionaries may be used** |

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School of Electronic and Electrical Engineering

**January 2015**

**ELEC5471M**

Data Communications and

Network Security

Time allowed: 3 hours

**Attempt any THREE questions.**

**Each question carries the same number of marks.**

**NOTES TO INVIGILATOR AND STUDENT**

To obtain full marks candidates must show how answers are derived

All symbols not specifically defined have their normally accepted meanings

Do not write or draw with red ink or red pencil

This question paper must be attached with a treasury tag to the back of the answer booklets. It is the student’s responsibility to attach the question paper.

**Question 1**

Consider that you have joined a company and have been put on a project to design a communications network. A colleague on this project has little experience of the Internet but has heard of TCP/IP in this context. You need to convince this colleague of the advantages of using a layered protocol architecture.

1. Give four key points that summarize the advantages of using a layered protocol architecture in your design.  *[4 marks]*
2. Having convinced your colleague of the advantage of using a layered protocol architecture you now need to explain how this works. List four key points of the process of how layered protocols architectures operate. *[4 marks]*
3. Your colleague understands your description and asks about the ISO/OSI model layers. Provide the 7 layers of the ISO/OSI communications architecture in the correct order and provide **two** example functions provided by each layer. *[7 marks]*
4. Your colleague has more experience of the TCP/IP operation and has heard of network address translation (NAT). Explain the purpose of network address translation (NAT) and how it works. *[4 marks]*
5. Your colleague has heard that NAT addressing contravenes the ‘ISO/OSI layered protocol architecture rules’. Is this the case and if so how? *[1 mark]*

**Question 2**

You need to design two transport protocols for a communications network to provide respectively an unreliable connectionless service and a reliable connection oriented service; both will be using the services provided by an unreliable connectionless network.

1. Explain what an unreliable connectionless service is offering and how this could be provided. *[2 marks]*
2. Define what a ‘reliable connection oriented service’ is. *[3 marks]*
3. Explain the mechanisms which can provide a reliable connection oriented service when using an unreliable connectionless network. *[5 marks]*
4. TCP is the Internet reliable connection oriented transport layer protocol. In addition to the mechanisms given in part ‘c’, TCP also provides ‘Congestion control’ and ‘Connection setup’.
   1. What is Congestion control aiming to achieve? *[1 mark]*
   2. How does TCP detect congestion and are there any shortcomings in this detection mechanism? *[3 marks]*
   3. When a TCP connection has been established, TCP enters the ‘Slow Start’ mechanism. Describe the Slow Start mechanism. *[4 marks]*
   4. What action is taken by TCP when in the ‘Slow Start’ phase and congestion is detected? *[2 marks]*

**Question 3**

This question is about addressing.

1. By completing a similar table to the following in your answer booklet, describe what (i) MAC addresses, (ii) IP addresses and (iii) Port Numbers are, the size of each in bits, how dynamic or permanent they are, and their purpose and the scope over which they act. *[15 marks]*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Used by: | Bit Size: | Permanence of assignment: | Purpose and scope: |
| 1. MAC address |  |  |  |  |
| 1. IP address |  |  |  |  |
| 1. Port Number |  |  |  |  |

1. Explain how translation is done between MAC addresses and IP addresses and how and why attention is needed to keep the data up to date.  *[5 marks]*

**Question 4**

This question is about routing.

1. Draw the key components of a router and indicate where queuing occurs, describing what causes it and the effects of queuing. *[8 marks]*
2. Two fundamental routing algorithms are ‘Link state routing’ and ‘Distance Vector routing’. Describe how each one works. *[4 marks]*
3. Consider the following network.



With the indicated link delay (additive metric), use Dijkstra’s algorithm to compute the routing table for *x* to all network nodes. Show how the algorithm works by reproducing and completing the following table in your answer booklet (step 0 is given):

*[8 marks]*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **step**  **The End.** | **N’** | **D(y),p(y)** | **D(w),p(w)** | **D(v),p(v)** | **D(u),p(u)** | **D(t),p(t)** |
| 0  1  2  3  4  5 | x | 6, x | 1, x | 3, x | ∞ | ∞ |

Notation in the table:

* D(v): minimum delay of path from the source node to destination v, as of this iteration of the algorithm.
* p(v): previous node (neighbour of v) along the current minimum delay path from the source to v.
* N’: subset of nodes; v is in N’ if the minimum delay path from the source to v is definitively known.

**The End.**