



**Wednesday 19 May 2010
9.30 am – 11:00 am
(Duration: 1 hour 30 minutes)**

DEGREES OF MSci, MEng, BEng, BSc, MA and MA (Social Sciences)

**COMPUTING SCIENCE 3T:
NETWORKED SYSTEMS 3**

(Answer all 3 questions.)

This examination paper is worth a total of 45 marks

You must not leave the examination room within the first half hour or the last fifteen minutes of the examination.

Section A

1. (a) A common type of physical layer connection is a *twisted pair cable*, comprising a pair of copper wires, twisted together in a spiral. Explain why the pair of wires is twisted together, and how the tightness of the spiral (measured in twists per inch) is chosen. [2]
- (b) One of the roles of the data-link layer is to correct any errors that occur on the physical transmission. One effective means of correcting transmission errors that occur within a frame of data is by using a *Hamming code* to add k check bits to every n data bits sent. With the aid of a diagram, describe how the check bits are calculated, where in the frame they are inserted, and how the receiver can use them to correct all single bit errors. [6]
- (c) When transmitting data from one Internet host to another over a TCP/IP connection, that data is generally protected by checksums and error correcting codes at the TCP, IP, and data-link layers. Explain why the checksum at the TCP layer is necessary, given that data is also protected by checksums at the IP- and link-layers. [2]
- (d) In addition to a checksum, which enables the receiver to detect corruption of packets, each TCP packet also contains a sequence number to detect lost packets. The receiver includes an acknowledgement of the highest contiguously received sequence number in its responses to the sender; the sender retransmits a lost packet if it sees *three* or more consecutive acknowledgements for the same sequence number. With the aid of a diagram, discuss why the threshold for retransmission was chosen to be three consecutive acknowledgements of the same sequence number, and explain what would be the effect of setting it to either two or four consecutive acknowledgements instead. [5]

2. (a) Many Internet service providers use the Open Shortest Path First (OSPF) routing protocol for intra-domain routing. OSPF is an example of the class of *link-state* routing protocols. At a conceptual level, describe how link state routing works. [4]
- (b) The alternative to link-state intra-domain routing is *distance vector* routing. Briefly outline the advantages and disadvantages of link-state routing when compared with distance vector routing. [3]
- (c) The IPv4 network address space is nearing exhaustion, with the Internet Assigned Numbers Authority (IANA) being expected to assign the last free blocks of addresses to the Regional Internet Registries within the next year or so. Discuss how you think the network layer of the Internet will continue to grow and evolve once all the available IPv4 addresses are used. Your answer should include a discussion of possible alternatives, and should state – with justification – which you believe to be most likely. [8]

3. (a) Describe what is the *domain name system* (DNS). [2]
- (b) The DNS has been described by some as an essential component of the Internet, that is required for its correct operation. Others claim that it's just one application out of the many that run on the Internet. Which viewpoint is correct? Discuss. [5]
- (c) Domain names are organised in a hierarchy, derived from a single *root zone*. Explain why this hierarchy is necessary to effectively manage and scale the DNS. [6]
- (d) Why is there only a single DNS root zone? What problems would occur if there were multiple root zones? [2]