

# The University of Nottingham

SCHOOL OF COMPUTER SCIENCE

A LEVEL 4 MODULE, AUTUMN SEMESTER 2010-2011 – Resit Paper

## **Advanced Computer Communications**

Time allowed TWO hours

---

*Candidates may complete the front cover of their answer book and sign their desk card but must NOT write anything else until the start of the examination period is announced*

### **Answer FOUR questions only**

*Only silent, self-contained calculators with a Single-Line Display or Dual-Line Display are permitted in this examination.*

*Dictionaries are not allowed with one exception. Those whose first language is not English may use a standard translation dictionary to translate between that language and English provided that neither language is the subject of this examination. Subject specific translation dictionaries are not permitted.*

*No electronic devices capable of storing and retrieving text, including electronic dictionaries, may be used.*

**DO NOT turn your examination paper over until instructed to do so**

1. This question concerns multiplexing.
  - (a) What is *statistical multiplexing*? Describe the multiplexing techniques that use it, and the benefits of doing so. [9 marks]
  - (b) Describe a simple M/M/1 queue model of a network buffer with arrival rate  $\lambda$  and departure rate  $\mu$ , and show the average queue length and the conditions under which it applies. [9 marks]
  - (c) Describe three types of CDMA multiplexing and outline their operation. [7 marks]
  
2. This question concerns the datalink layer.
  - (a) Describe the operation of Quadrature Amplitude Modulation, giving at least two examples, and illustrate with constellation diagrams. [12 marks]
  - (b) How is QAM used in the Discrete Multitone modulation as used in modern ADSL access networks? [8 marks]
  - (c) How can Discrete Multitone adapt to dynamic changes in the underlying channel characteristics? [5 marks]
  
3. This question concerns Ethernet and switching.
  - (a) Describe some limitations in the scaling of CSMA/CD, or Ethernet, networks and how the introduction of bridges and switches alleviates the problems. [10 marks]
  - (b) Given an arbitrary topology can be built using such bridges and switches, how do we prevent packets from looping in the network. [10 marks]
  - (c) How do VLANs operate and why would we deploy them? [5 marks]
  
4. This question concerns addressing and forwarding in IP networks.
  - (a) Describe the format of an IP address, and discuss the need for address aggregation within the Internet with reference to at least 2 different schemes for doing so. [10 marks]
  - (b) State the distinction between *routing* and *forwarding*, and describe the process of *forwarding* within an IP router with reference to relevant router data structures and IP header fields. [10 marks]
  - (c) The BGP routing protocol disseminates reachability information between networks that make up the Internet. Discuss some of the problems faced in disseminating information at this scale, with reference to the techniques BGP uses to address these problems. [5 marks]

5. This question concerns transport and naming in IP networks.
- (a) Discuss the purpose of the UDP protocol, the features it provides, and the means by which it implements them. [9 marks]
  - (b) Describe, using a simple example, the purpose and operation of simple NAT, its impact on other protocol layers, and suggest means for mediating its effects. [8 marks]
  - (c) Describe the structure of the DNS, and the operation of the DNS name resolution (lookup) protocol. [8 marks]
6. This question concerns HTTP and REST.
- (a) HTTP typically layers above TCP. Discuss the features that HTTP provides as a protocol over and above those provided by TCP. You answer consider aspects including, but not limited to: purpose, use and structure of URLs; HTTP requests and responses; the impact of multiple concurrent connections; and cookies. [10 marks]
  - (b) REST is an architectural approach to building web applications. State the constraints it imposes, and discuss their benefits and implications. [10 marks]
  - (c) Discuss how *tickets* can be used in a RESTful application to provide *at-most-once* semantics for operations. [5 marks]