Sample final exam paper

This sample is taken from an actual exam used a few years ago. In that exam, students could choose questions worth up to 150 marks out of set of questions worth a total of 190 marks. The number of marks, and availability of choice will differ in the actual exam paper this year - see the cover sheet for this year's exam. Similarly, the topics covered by the course have changed somewhat (e.g. the signalling topic of Q8 is no longer covered in the course, nor is Frame Relay, whereas the course has added coverage of caches). You should also expect this year's exam to have a few more questions that apply ideas covered in the course (like Q2c & Q6) and a few less questions that are purely descriptive.
Question 1 (30 marks)

a. Describe the generic structure of a switch, and the role of each component. For example, be sure to describe the switching fabric, the line interfaces, and points where packet classification and scheduling occur. (10 marks)

b. How do switches that operate in the core of a public network differ from those that operate at the edge of a network, near end-users? (5 marks)

c. What are the benefits of switched networks over broadcast and select, or full-mesh networks? (5 marks)

d. Define the terms “packet switching” and “circuit switching”. (5 marks)

e. What are the relative merits of packet switching and circuit switching? (5 marks)

Question 2 (20 marks)

a. How does the presence of multicast information affect the performance of time-division and space-division switches? (5 marks)

b. How does a Time-Slot-Interchange switch work? What applications are such switches generally used for? (5 marks)

c. Show how blocking can occur internally to the Banyan switch fabric illustrated below. You can draw on the illustration below in this examination paper as part of your answer. However, if you do, then ensure that:
   i. Your answer book refers to your drawing in the examination paper, and
   ii. All drawing on this illustration relates to your answer.
d. How does the introduction of a sorting network at the input of a Banyan switch affect the performance of the switch? (5 marks)

**Question 3** (20 marks)

a. How does the move from electro-optic to all-optical operation affect how switch functions are implemented? (5 marks)

b. Describe how packet-switching can be implemented in the “optical domain”, i.e. in a manner in which the payload of each packet does not need to be converted to electronic form as it traverses a switch. (10 marks)

c. How can Micro-Electro-Mechanical Systems be used to construct an all-optical switch? For what applications are such switches best suited? (5 marks)

**Question 4** (20 marks)

Describe the purpose of each of the following functions in a bridge:

a. Source address lookup. (5 marks)

b. Destination address lookup. (5 marks)

c. Aging (5 marks)

d. Spanning Tree Algorithm (5 marks)
**Question 5** (20 marks)
a. What is “longest prefix matching”, and why do modern routers use this technique, rather than trying to find exact matches for network addresses? (10 marks)

b. How does a switch that operates in a “store-and-forward” manner differ from one that operates in a “cut-through” manner? What are the relative merits of these two forwarding techniques? (10 marks)

**Question 6** (20 marks)
a. Consider a Weighted Fair Queueing scheduler that is subjected to the following packet arrival pattern:

<table>
<thead>
<tr>
<th>Time (seconds)</th>
<th>Packet length (bits)</th>
<th>Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10</td>
<td>a</td>
</tr>
<tr>
<td>0</td>
<td>10</td>
<td>b</td>
</tr>
<tr>
<td>0</td>
<td>5</td>
<td>c</td>
</tr>
<tr>
<td>1.5</td>
<td>10</td>
<td>a</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>a</td>
</tr>
<tr>
<td>2.5</td>
<td>10</td>
<td>b</td>
</tr>
</tbody>
</table>

Describe the output of the scheduler, i.e. when packets from each connection are output.

Assume that:
- The service rate is 10 bits/second
- All connections have equal weighting
- No packets arrived before the packets listed in the table
- The scheduler has a buffer capacity of 30 bits.

(14 marks)

b. Is Weighted Fair Queueing a work conserving algorithm? (3 marks)
c. Can Weighted Fair Queueing be used to provide delay guarantees? (3 marks)
Question 7 (20 marks)

a. Describe the purpose and operation of “Leaky Buckets” when used in networks, e.g. in conjunction with scheduling algorithms, Frame Relay, and Asynchronous Transfer Mode (ATM) networks. (10 marks)

b. What is the purpose of Virtual Paths in Asynchronous Transfer Mode (ATM) networks? (5 marks)

c. Why do ATM cells have a small, fixed, length? (5 marks)

Question 8 (20 marks)

a. Define the terms “in-band signalling” and “out-of-band signalling”. (4 marks)

b. What are two advantages of out-of-band signalling over in-band signalling? (4 marks)

c. What is one advantage of in-band signalling over out-of-band signalling? (2 marks)

d. What is “soft state”, and how does it simplify RSVP signalling? (10 marks)

Question 9 (20 marks)

Compare and contrast the methods used by intserv and diffserv networks for providing Quality, or Classes, of Service. (20 marks)