This paper comprises seven 20-mark questions. Candidates must answer exactly FIVE questions. Calculators are not permitted. The paper is not prior-disclosed.
1. (a) Describe, perhaps with the help of a diagram, the TCP/IP 5-layer reference model. You should name each layer and describe one of its main functions. 

(b) Consider the following element declaration in an XML document type definition (DTD):

```xml
<!ELEMENT p (#PCDATA | em | img | b)* >
```

What is the name given to the type of content model defined above? Explain precisely the allowed content for p elements in a document valid with respect to the above declaration.

(c) Consider the following fragment of HTML code:

```html
<button type="button"
    onclick="$('#target1').append($('<li />', {'text':'Hello'}))">
    Do something
</button>
```

The value of the onclick attribute is JavaScript code which uses the jQuery library. Explain what this code does.

2. (a) The HTML form element can have action and method attributes. Explain what types of values are expected for each of these attributes, as well as the functionality provided as a result of using these attributes.

(b) Describe how the transmission control protocol (TCP) implements flow control.

(c) Consider the following network comprising 5 nodes and 7 links:

The nodes are labelled A to E, while each link is labelled with its cost. Recall the open shortest path first (OSPF) routing algorithm which computes costs from a single source node to all other nodes. Assuming the source node is A, what costs would be computed by OSPF for each of the nodes B, C, D and E? In the resulting routing table for A, which initial link(s) would be used for traffic destined for each of D and E?
3. (a) Assume that you are asked to write an XSLT stylesheet which will transform an XHTML document into another XHTML document. The output document is to be identical to the input document, except that it should include an additional table of contents at the beginning of the document. The table of contents should be an ordered list of list items, with the contents of each corresponding to the contents of an h1 heading in the document. You can assume that all h1 headings in the input document are children of div elements which have a class attribute value of chapter. Write down a single XSLT template rule which will perform the required transformation (do not worry about including the stylesheet element).

(b) Explain what function a bridge performs in a local area network (LAN).

4. (a) In XPath, what is the difference, syntactically and semantically, between an absolute expression and a relative expression?

(b) Explain what is meant by pipelining in the context of HTTP (the hypertext transfer protocol). Describe advantages of pipelining, as well as consequences for an HTTP server which uses pipelining.

(c) Consider a method of communication in which each bit is sent three times in succession, so 0 is sent as 000 and 1 is sent as 111. Explain how a recipient could automatically correct any single bit error in the received transmission. What is the problem with this simple method?

(d) Explain the main difference between channel partitioning protocols and random access protocols. Give two examples of the former and one example of the latter.
5. (a) Explain the syntax used for declaring XML namespaces in an XML document. How is the default namespace declared? 

(b) Give reasons for choosing XSLT rather than CSS for applying a stylesheet to an XML document. 

(c) Consider the following sequence of Transmission Control Protocol (TCP) segment exchanges between two hosts:

Host A sends segments with sequence numbers 92 and 100 at times $t_1$ and $t_2$, respectively, to Host B. The first acknowledgement Host B sends to Host A is lost. (i) What name is given to the form of acknowledgements used by TCP? 

Now consider the timeout interval at Host A for the segment with sequence number 92. (ii) Explain why Host A does not retransmit if the interval expires after $t_3$. 

Explain how the above interaction would have been different if the interval had expired (iii) before $t_2$, and (iv) after $t_2$ but before $t_3$. 

6. (a) Consider the use of an XML vocabulary for representing the results of any number of football matches. For each match, two teams are involved. For each team, we want to represent the name of the team, as well as any number of goals or bookings (fouls). For each goal and booking, we want to record the player involved and the time (do not worry about differentiating between penalties and other goals). For each booking, we want to record whether the card issued was yellow or red, with the default being yellow. Write down a document type definition (DTD) which captures the above requirements. 

(b) Explain how the Domain Name System (DNS) is organised and how DNS servers operate.
7.  (a) Describe 6 limitations of document type definitions (DTDs) with respect to their ability to constrain the contents of XML documents.  

(6 marks)

(b) Consider the following fragment of JavaScript code, assuming that the variable `searchReq` holds an `XMLHttpRequest` object:

```javascript
var str = escape(document.getElementById('txtSearch').value);
searchReq.open("GET", 'searchSuggest.php?search=' + str, true);
searchReq.onreadystatechange = handleSearchSuggest;
searchReq.send(null);
```

Explain the purpose of each line of code as well as what happens as a result of its execution.  

(8 marks)

(c) One of the fields in the header of an IP (Internet Protocol) datagram represents `time-to-live`. Explain how this field is used by IP.  

(6 marks)