

PAPER CODE NO.
COMP311

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THE UNIVERSITY
of LIVERPOOL

JANUARY 2006 EXAMINATIONS

Bachelor of Arts : Year 3
Bachelor of Science : Year 3
Bachelor of Science : Year 4
No qualification aimed for: Year 1

Semi-structured or Web-like Databases

TIME ALLOWED : Two Hours and a half

INSTRUCTIONS TO CANDIDATES

Answer **all** questions in Section A
Answer **only two** questions in Section B.

If you attempt to answer more questions than the required number of questions (in any section), the marks awarded for the excess questions will be discarded (starting with your lowest mark).



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SECTION A

Answer **ALL** Questions in this section.

1. Graphs, bracket expressions and systems of hyperset equations.

(a) Transform the following system of set equations (first “unnesting” them) into the corresponding graph.

```
US = {states:{state:s1, state:s2},
      cities:{city:c1,city:c2,city:c3}}
s1 = {sname:'Idaho', capital:c1, city-in:c2}
s2 = {sname:'Nevada', capital:c3}
c1 = {cname:'Boise', state-of:s1}
c2 = {cname:'Moscow'}
c3 = {cname:'CarsonCity', state-of:s2}
```

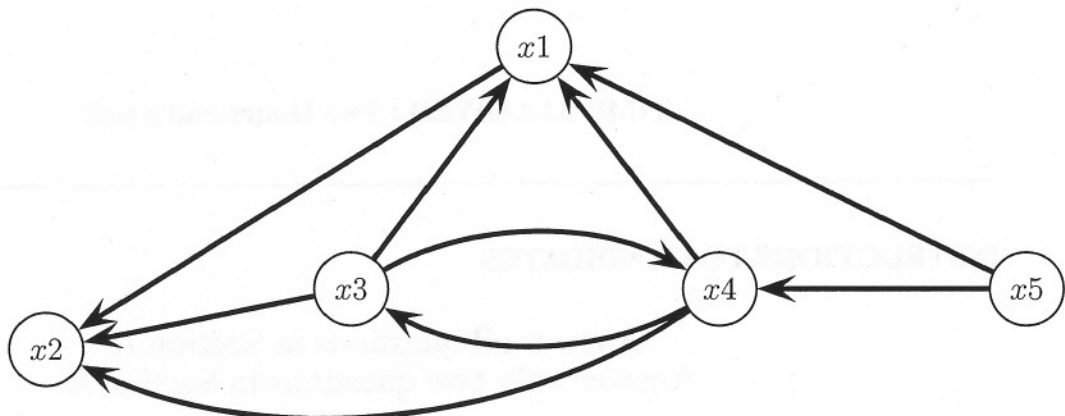
7 marks

(b) Represent straightforwardly the following bracket expression as an XML document.

5 marks

```
US:{states:{state:{sname:'Idaho', capital:'Boise', city-in:'Moscow'},
             state:{sname:'Nevada', capital:'CarsonCity'}},
     cities:{city:{cname:'Boise'},
            city:{cname:'Moscow'},
            city:{cname:'CarsonCity'}}}.
```

(c) Transform the following graph to an equivalent system of set equations. **4 marks**



(d) Derive which of the above hypersets x_1, x_2, x_3, x_4, x_5 are equal and which are not.

8 marks

(e) Simplify the system of equations obtained in 1 (c) by using 1 (d). Draw the resulting graph

5 marks



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2. WWW, HTML, XML and DTD.

- (a) Describe the *four* stages that a Web query system might use to execute general queries to the WWW or WDB, and compare this with traditional search engines. **5 marks**
- (b) What features do XML and HTML have in common, and what are their main differences? **5 marks**
- (c) Draw this XML document as a tree in two forms: (i) with labels on edges and (ii) with labels on vertices. **6 marks**

```
<part>
  <name>MyCar</name>
  <brand>Ford</brand>
  <part>
    <name>Radio</name>
    <brand>Sony</brand>
    <part>
      <name>Aerial</name>
      <brand>Philips</brand>
    </part>
  </part>
</part>
```

- (d) What is the difference between the concepts of a *well-formed* and *valid* XML document with respect to a document type definition DTD? **6 marks**
- (e) Construct any XML document which is valid with respect to the following DTD. Give necessary comments explaining the way you achieved validity.

```
<!ELEMENT family (person, person+)>
<!ELEMENT person (name)>
<!ELEMENT name (#PCDATA)>
  <!ATTLIST person id      ID      #REQUIRED
                  mother  IDREF  #IMPLIED
                  father  IDREF  #IMPLIED
                  children IDREFS #IMPLIED>
```

7 marks



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3. Transformation of XML to HTML documents by using XSL queries.

Consider the following XML document

```
<bib> <paper> <title> title1 </title> <author> author1 </author>
                                     <author> author2 </author>
</paper>

<book> <title> title2 </title> <author> author3 </author>
</book>

<paper> <title> title3 </title> <author> author4 </author>
                                     <author> author5 </author>
</paper>
</bib>
```

and XSL query

```
1  <xsl:template match="/">
2    <HTML><BODY><xsl:apply-templates/></BODY></HTML>
3  </xsl:template>
4  <xsl:template match="title">
5    <TD><xsl:value-of/></TD>
6  </xsl:template>
7  <xsl:template match="author">
8    <TD><xsl:value-of/></TD>
9  </xsl:template>
10 <xsl:template match="book">
11   <TR>
12     <xsl:apply-templates select="title"/>
13     <xsl:apply-templates select="author"/>
14   </TR>
15 </xsl:template>
16 <xsl:template match="paper">
17   <TR>
18     <xsl:apply-templates select="title"/>
19     <xsl:apply-templates select="author"/>
20   </TR>
21 </xsl:template>
22 <xsl:template match="bib">
23   <TABLE>
24     <TBODY>
25       <xsl:apply-templates select="book"/>
26       <xsl:apply-templates select="paper"/>
27     </TBODY>
28   </TABLE>
29 </xsl:template>
```



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- (a) Is it true that this XSL query will produce the following HTML table visible in an IE browser? If not, correct the result.

```
title3 author4 author5
title2 author3
title1 author1 author2
```

4 marks

- (b) Explain how to change this XSL query so that book rows will follow paper rows in the HTML table. **5 marks**
- (c) Explain how to change this XSL query so that title columns will follow author columns in the HTML table. **5 marks**
- (d) Explain how to change this XSL query so that each row in this table will start with the word BOOK or PAPER according to the data in the XML document. **6 marks**
- (e) Explain how to change this XSL query so that titles will be in **boldface** and authors will be in *italic*. **6 marks**



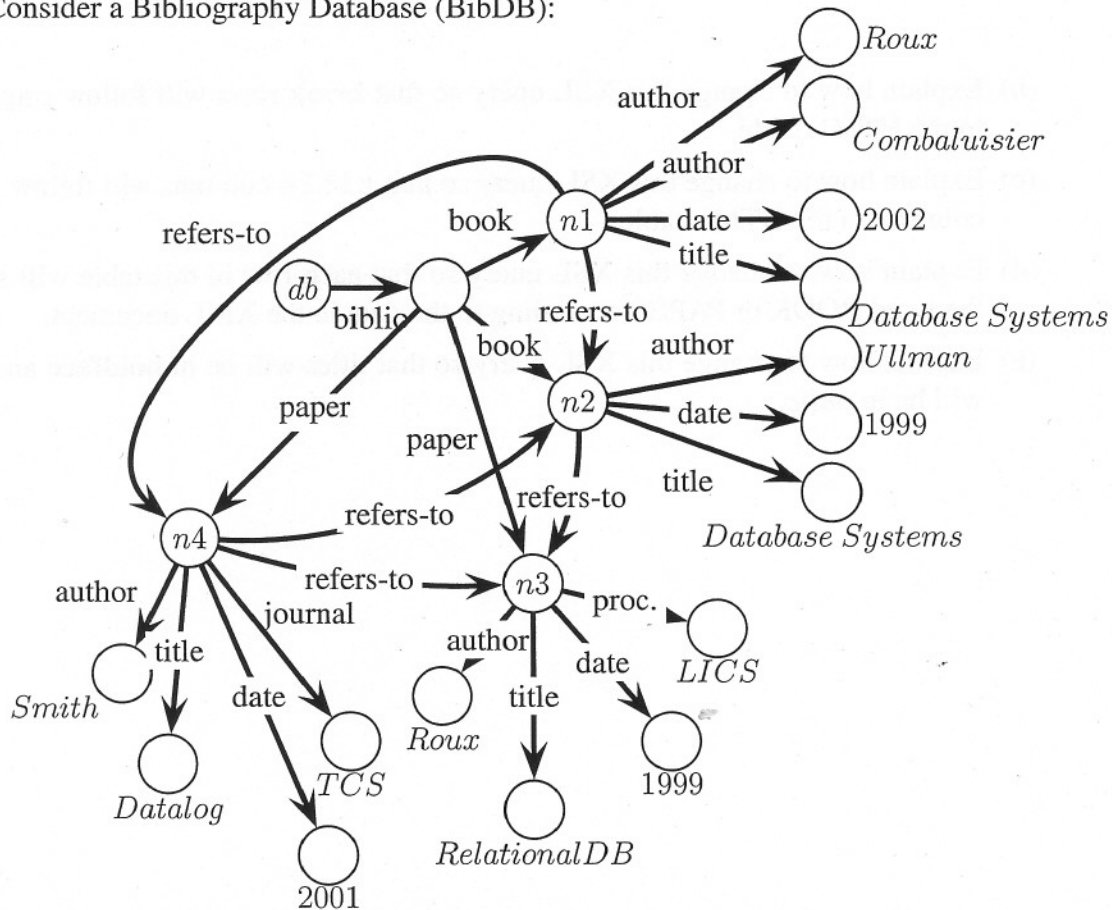
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SECTION B

Answer only **TWO** Questions from this section.

Credit will be given for the best two answers in Section B.

4. Consider a Bibliography Database (BibDB):



Express (i) in English and (ii) set-theoretically, the following query in the *core query language* and draw the corresponding answer first as bracket expression and then as graph.

```
select {author:A,has-publication:L}
from biblio.L X,
      X.author A
      biblio.book B,
      biblio.paper P,
      X.refers-to B,
      X.refers-to P,
```

8 marks

5. Define the syntax of the basic language Δ^* and explain its set-theoretic semantics. What role does this language play in the set-theoretic approach to Web-like Databases. **8 marks**
6. Which extension of the language Δ^* has a precise description of its expressive power in terms of complexity theory? Give this description and also definitions and formulations for the concepts in your answer. **8 marks**



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7. Consider a bibliography database in `www.a.b.c/bib.xml` of the form

```
<bib>
  <authorandpublications>
    <authors> L. Tolstoy </authors>
    <book> War and Peace </book>
    <book> Anna Karenina </book>
  </authorandpublications>
  <authorandpublications>
    <authors> Abiteboul, Buneman, Suciu </authors>
    <book> Semistrucrued Databases </book>
  </authorandpublications>
</bib>
```

Describe the informal meaning in English and give XML result of the following query in XML-QL:

```
<newbib>
where <authorandpublications> <authors> $A </> <book> $B </> </>
  in "www.a.b.c/bib.xml"
construct <book>
  <authors> $A </>
  <title> $B </>
</>
</newbib>
```

8 marks