



UNIVERSITY of LIMERICK

OLLSCOIL LUIMNIGH

FACULTY of SCIENCE and ENGINEERING
Department of Computer Science and Information Systems

End-of-Semester Exam

Academic Year:	2008/2009
Semester:	Spring
Module Titles:	Database Systems Development of Information Systems 2
Module Codes:	CS4416 and CS5122
Exam Duration:	2½ Hours
Total Marks:	65 (65% of the final grade)
Lecturer:	Dr. N. S. Nikolov

Instructions to Candidates:

**By answering all questions you can achieve up to 70 marks.
However, any result above 65 will be truncated to 65.**

Please write **ALL** answers in the answer booklet.
State clearly any assumptions you make.

Q1. (15 marks)

A music company needs to have the following information stored in a database:

- Names of artists, the year each artist signed a contract with the company and the length of the contract (number of years).
- Number of albums planned to be released by an artist and the proposed year of release for each of them.
- The title and the actual year of release for each album which has been released.
- Date, time and venue for each gig of an artist.

Assume that the artists have unique names and no two gigs at the same venue and on the same date can be scheduled at the same time. Assume also that no NULL values are allowed in the database. Feel free to introduce id numbers for artists, albums and gigs if necessary.

- a. Design a relational schema for the described database. That is: (10 marks)
- list all relations and their attributes.
 - underline the key attributes for each relation.
 - list the FD's for each table.
 - Check whether your tables are in Third Normal Form (3NF) and if it they are not then decompose them to tables in 3NF preserving all FD's.
- b. Write SQL statements for creating the tables. Include all definitions of primary keys and foreign keys as well as the following constraint: the number of albums planned to be released by an artist should not be larger than the length of the contract for that artist. (5 marks)

Q2.**(20 marks)**

Consider the relation R(ABCDEF) with the following FD's:

$A \rightarrow C$
 $B \rightarrow A$
 $C \rightarrow F$
 $BC \rightarrow A$
 $EF \rightarrow B$
 $ABC \rightarrow D$

- Find the closure of attribute B. **(2 marks)**
- Find all keys of R. **(8 marks)**
- Explain why R is not in Third Normal Form (3NF). Decompose R into relations in 3NF preserving all FD's. **(10 marks)**

Q3.**(25 marks)**

Consider the relations:

Product(maker, model, type)
 PC(model, speed, ram, hd, price)
 Laptop(model, speed, ram, hd, screen, price)

and the following example data:

Product		
maker	model	type
A	1001	pc
A	1002	pc
A	1003	pc
A	2004	laptop
A	2005	laptop
A	2006	laptop
B	1004	pc
B	1005	pc
B	1006	pc
B	2007	laptop
C	1007	pc
D	1008	pc
D	1009	pc
D	1010	pc
E	1011	pc
E	1012	pc
E	1013	pc
E	2001	laptop
E	2002	laptop
E	2003	laptop
F	2008	laptop
F	2009	laptop
G	2010	laptop

PC

model	speed	ram	hd	price
1001	2.66	1024	250	2114
1002	2.1	512	250	995
1003	1.42	512	80	478
1004	2.8	1024	250	649
1005	3.2	512	250	630
1006	3.2	1024	320	1049
1007	2.2	1024	200	510
1008	2.2	2048	250	770
1009	2	1024	250	650
1010	2.8	2048	300	770
1011	1.86	2048	160	959
1012	2.8	1024	160	649
1013	3.06	512	80	529

Laptop

model	speed	ram	hd	screen	price
2001	2	2048	240	20.1	3673
2002	1.73	1024	80	17	949
2003	1.8	512	60	15.4	549
2004	2	512	60	13.3	1150
2005	2.16	1024	120	17	2500
2006	2	2048	80	15.4	1700
2007	1.83	1024	120	13.3	1429
2008	1.6	1024	100	15.4	900
2009	1.6	512	80	14.1	680

Write:

- a. a relational algebra expression to answer the query: **Find the model number and price of all PC's and laptops made by maker B.** Use only the operators: *projection, selection, product, set union* and *set difference*. Assume that all operations are performed on sets. (5 marks)
- b. a relational algebra expression to answer the query: **Find those ram sizes that occur in two or more PC models.** Use only the operators: *projection, selection, product, set union* and *set difference*. Assume that all operations are performed on sets. (5 marks)
- c. an SQL statement to answer the query: **Find all details about those laptop models that are the only laptop model by their maker.** (5 marks)
- d. an SQL statement to answer the query: **Find those PC models that are made by makers who make laptops with the fastest speed.** (5 marks)
- e. an SQL statement to answer the query: **Find the makers who make at least four PC models with ram > 1024.** (5 marks)

Q4. (10 marks)

Consider relations $R(\underline{A}, B)$ and $S(\underline{A}, C)$ where all attributes are numbers. Write a procedure that modifies each row (x,y) in relation R by subtracting from y the maximum value of attribute C in the rows with $A=x$ in relation S .

For example, if R and S contain the following data:

R	
A	B
1	3
1	4
1	3
2	5

S	
A	C
1	5
1	6
2	7
2	8

then after the execution of your procedure, R should be changed to

R	
A	B
1	-3
1	-2
1	-3
2	-3

You can choose to write a stored procedure in either PL/SQL or SQL/PSM. Alternatively, you can choose to write either a Java or a PHP fragment assuming a connection to a database has been established.

END OF EXAM