FACHHOCHSCHULE STUTTGART- HOCHSCHULE FÜR TECHNIK
UNIVERSITY OF APPLIED SCIENCES

MASTER'S COURSE **S** OFTWARE **T** ECHNOLOGY

EXAMINATION in **WINTER-SEMESTER 2005/06**

MODULE: **Databases** NAME:

DATE: **17 January 2006** SEMESTER:

TIME: **8.30 - 10.30 Uhr**

EXAMINER: **Prof. D. Koch**

ALLOWED AIDS: All materials that were distributed in class and in the Blackboard, all your own notes, two text books of your choice, plus an English dictionary.
NOT ALLOWED: Mobile Phones and other communication devices
ANNEXES: None

Please write your name on each sheet that you turn in.

Turn in the problem sheets as well!

Problem	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	Σ
Maximum points	6	6	6	8	12	12	12	8	10	8	8	10	106
Achieved points													
Grade													

Problem 1. (6 points)

Briefly explain the goal and the most important consequence of having a three layer database architecture with a physical, a conceptual, and a logical layer.

Problem 2. (6 points)

Briefly explain an important advantage of using stored procedures in a database.

Problem 3. (6 points)

Briefly explain an important advantage of using integrity constraints in a database system.

Problem 4. (2 times 4 points = 8 points)

Consider a situation where you join a company where you are given the task of administrator of one database for some technical application.
Briefly explain two things you could do to decide whether the database will profit from design changes or not.

Problem 5. (2 times 6 points = 12 points)

You are given the following table with information about product parts in a relational database. The primary key is the attribute partNr. There is no further information about this table.

partNr	CAD	imageLib	usage
1311	100	105	NULL
4711	200	205	0
2012	300	305	1
2013	400	405	2
2014	500	505	3

a) (6 points)
List all non-trivial full functional dependencies that can safely be derived from the given information without making additional assumptions.
In which normal form is this relation?

b) (6 points)
Identify any other attributes or attribute combinations that are candidate keys besides A and explain why. Also explain if you exclude some attributes or attribute combinations.

Problem 6. (12 points)

A database stores information about people's family relationships.

For simplicity, the following assumptions are made here:
- Only biological children are considered; each child has exactly one mother and exactly one father.
- Each couple is married to each other only once in their life.

The system has the following schema:

Person (<u>pNr</u>, name, birthDate, deathDate)

Offspring (<u>childNr</u>, motherNr, fatherNr)
(All attributes are foreign keys referencing pNr in Person).

Marriage (<u>wifeNr</u>, <u>husNr</u>, startDate, endDate)
(wifeNr and husNr are foreign keys referencing pNr in Person. wifeNr refers to the wife, husNr to the husband. startDate and endDate describe the time interval in which the marriage persists).

<u>Your task:</u>
Design a suitable entity relationship model that would result in the above relational schema after applying the algorithm described in class for transforming an ERM to a relational schema.

Problem 7. (2 times 6 points = 12 points)

This problem uses the relational database schema in the previous problem.
Express the following queries in SQL:

a) List the names of all people who have never been married.

b) List the names of all direct and indirect offspring (children, grandchildren, grand-grandchildren, etc.) of the person with pNr=15.

Problem 8. (8 points)

Design a relation for the following application:

A company stores in a central database data records that are sent on a case by case basis from different partner companies.

Each transmitted data record is sent as a tuple of String values, along with the respective attribute names.
It is never known beforehand which attributes the next transmitted record will contain. Also, the set of possible attributes in a record is not predefined and not restricted to a certain number of attributes.

Example:
The following data records may be transmitted:

- customerNr: 1345, familyName: Koch, order: laundry machine, address: München
- customerNr: 4711, familyName: Schmidt, order: television
- familyName: Schmidt, customerNr: 1212, order: table, creditworthiness: good, address: Hamburg
- customerNr: 4321, address: Stuttgart, newsletter: yes

Remember: Data records that will be transmitted in the future may contain additional attributes that are not currently known yet.

Define the schema of <u>one</u> relational table in which such data records can be stored. The relation must allow that

- Any transmitted tuple (with attribute names and attribute values) can be stored, no matter how many additional, previously unknown pairs of "attribute name : value" it contains.
- It is recognizable which data records where transmitted and which attribute name / value pairs belong to each record.

Problem 9. (10 points)

A SELECT query in SQL can generally return

- any number of tuples
- with any number of columns
- of any data type the system provides.

Briefly explain the concepts by which JDBC enables a programmer to write a Java application that can handle the returned information of an arbitrary SELECT query, without the programmer having to know the query text at programming time. Which two standard Java classes (actually they are interfaces) are especially relevant?

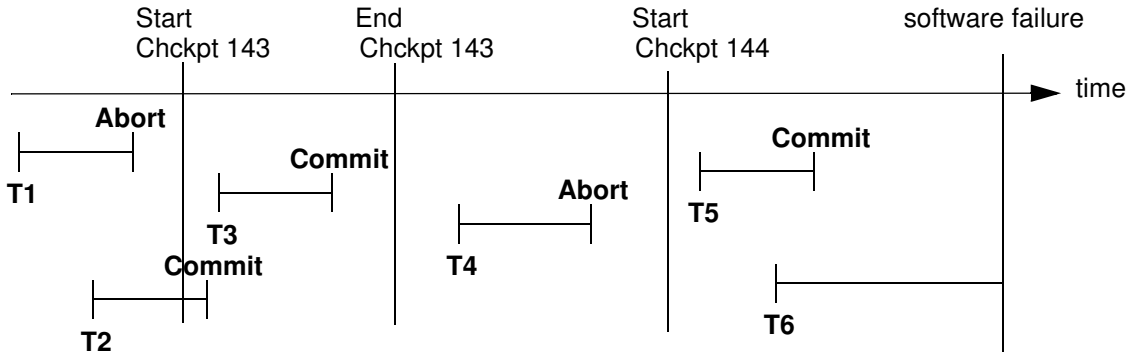
<u>Use your own words</u>. Programming code is not necessary and will not earn any points!

Problem 10. (8 points)

Assume that in a DBMS the Force at Commit Rule for the log file is not applied. Describe and explain an execution scenario that shows how this can lead to a problem.

Problem 11. (8 points)

Consider the following scenario with a log file where fuzzy checkpointing is used:



List which transactions the recovery manager must undo and which ones it must redo. Briefly explain your choice.

Problem 12. (2 times 5 points = 10 points)

a) Briefly describe an application scenario to show the problem of a phantom read.

b) Briefly describe an application where phantom reads can occur but are not a problem.