FACHHOCHSCHULE STUTTGART- HOCHSCHULE FÜR TECHNIK
UNIVERSITY OF APPLIED SCIENCES

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

EXAMINATION in **WINTER-SEMESTER 2004/05**

MODULE: **Databases** NAME:

DATE: **21 January 2005** SEMESTER:

TIME: **9.00 - 11.00 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**	Σ
Maximum points	6	8	8	12	12	24	12	8	8	8	6	112
Achieved points												
Grade												

Problem 1. (6 points)

Briefly explain one important criterion which can be used as the basis for deciding whether using a DBMS for a given application is useful or whether it is not useful to use any DBMS.

Problem 2. (8 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 3. (8 points)

Consider the following situation: You are newly hired in a company where you have to take care of a relational database containing a lot of data supporting several important applications that use the database night and day. The person who designed the database is no longer with the company. The other employees do not know anything about the design. You find out that the database design is not normalized at all. Briefly explain a good way to deal with this situation.

Problem 4. (12 points)

Consider the following table in a relational database. A is the primary key.

A	B	C	D
da	1	100	NULL
ta	2	200	0
ba	3	300	1
se	4	400	2
bla	5	500	3

a) (6 points)
List all non-trivial full functional dependencies that can be derived from the given information.

b) (6 points)
Identify any other attributes or attribute combinations that could possibly serve as a candidate key besides A and explain for each of your choices why it is a candidate or under which conditions it could be one. Also explain if you exclude some possibilities.

Problem 5. (12 points)

A university stores the following data in a relational database:
- data about exchange semesters spent by students at another university abroad
- and data about practical training periods spent by students at companies.

For simplicity, we assume here that a semester in one course program abroad or a practical training in one company always lasts exactly the time of one semester.
A student can spend more than one semester abroad and/or more than one practical training semester.
The system has the following schema:

Student (matNr, sName, program)
(Program is the student's course program at his/her home university)

CourseProgram (pNr, progName, university, country, contact)
(Describes course programs at *other* universities, where students can go abroad.
Example tuple: (1, Mathematics, TU Wien, Österreich, matheinfo@tu-wien.at))

Exchange (matNr, pNr, semester, stipend)
(Which student spends which semester in which course program abroad, financed by which stipend. We assume that for a semester abroad, one may have either one stipend or none at all).

Company (cName, country, contact)
(Example tuple: (IBM, USA, training@ibm.com))

Training (matNr, cName, semester)
(Which student works at which company for practical training in which semester).

Your task:
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 6. (6 times 4 points = 24 points)

This problem uses the relational database schema in the previous problem.
Express the following **3** queries
- in ***relational algebra***
- and in ***SQL***:

a) List the matriculation numbers of all students who have done one or more semesters abroad and one or more semesters of practical training.

b) List the names of those students who did a semester of studies abroad *without* a stipend. (They may or may not have had a stipend for a different semester abroad).

c) Some students did a practical training semester in the same country in which they also spent a (different) semester in a university's course program. List the matriculation numbers of these students.

Problem 7. (12 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.
Use your own words. A piece of code is not sufficient or even needed!

Problem 8. (8 points)

Study the following example of SQL and MySQL code, run in a MySQL session using the universityDB. Completely list all tuples with their values that are present in the table named *Bar* after the last statement of this session. Briefly explain your answer.

```
CREATE TABLE Foo (x INT, y INT, PRIMARY KEY(x)) TYPE = InnoDB;

CREATE TABLE Bar (a INT, b INT, PRIMARY KEY (a), INDEX bIndex (b),
FOREIGN KEY (b) REFERENCES Foo (x)
ON UPDATE CASCADE ON DELETE SET NULL) TYPE = InnoDB;

INSERT INTO Foo VALUES (1,1), (2,2);
INSERT INTO Bar VALUES (100, 1), (200, 1), (300, 1), (400, 2), (500, 2);

DELETE FROM Foo WHERE x=2;
UPDATE Foo SET x=10 WHERE x=1;
```

Problem 9. (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 10. (8 points)

Are checkpoints more important
- for recovery in a case of media failure **or**
- for recovery in a case of a software failure where the disk is not affected?

Briefly explain your answer. Points are only given for an explanation.

Problem 11. (6 points)

Consider the basic nested transaction structure and a 2 Phase Commit protocol. Sibling transactions (i.e. subtransactions of the same parent transaction) may use each other's intermediate results. Briefly explain why this violation of isolation does not lead to the problem of having to rollback a committed (sub)transaction.