Database Management Final Practice 1

Q1. Consider the following set of simplified requirements for a *System-info* database that is used to keep track of the usages of (software) systems in a company.

1. Each department has a unique name and a unique number. A department may use several systems. The database keeps track of the number of hours per week that a department uses each system.
2. Each system has a unique name, a unique number, and a particular administrator who manages the system. A system may be used by a number of departments.
3. The database stores each administrator’s name, unique identifier and e-mail address. Each administrator must manage at least one system.
4. (8%) Draw an ER (Entity-Relationship) schema diagram for this application. You need to clearly indicate the cardinality ratio (1:1, 1:N, or M:N) and participation constraints (total or partial) of each relationship. (State clearly any additional assumptions you make)
5. (6%) Map the ER schema into the corresponding relational database schema diagram. Specify all primary keys and foreign keys.

Suppose that it is also necessary to keep track of different types of systems (Internet systems and Intranet systems), in which an Internet system may serve several customers (cooperative companies). Each customer has a unique name, a unique identifier, and an address. A customer may be served by several Internet systems. Notably, a system may be a member of Internet systems, Intranet systems or both. Every system in the company is a member of Internet or Intranet systems.

1. (4%) Modify the ER schema in (a) according to the above requirements, using ER and Enhanced ER concepts of specialization and generalization. You need to clearly indicate the disjointness and completeness constraints. (State clearly any additional assumptions you make)

Q2.

1. (4%) Mapping the EER diagram of the following Figure to relations by using option 8d.

BUILDING

APARTMENT

VILLA

FACTORY\_FOOD

FACTORY\_CHEMISTRY

d

d

RESIDENCE

Floor

1. (4%) Draw the set diagram of the following figure.

Q3.

1. (4%) Explain the differences between superclass/subclass and category in EER model regarding the subclass’s inheritance of attributes/relationships from its superclasses.
2. (3%) Describe the drawbacks for the mapping of superclass/subclass with overlapping constraints to relations by using the approach of multiple relations for subclass relations only.
3. (3%) Explain how to derive the primary key of the relation mapping from a weak entity type.

Q4. (10%) Consider the following ER diagram for part of a Department database. Each department can employ several full-time teachers, and each full-time teacher can teach several courses. Each student can take several courses, and each course can have several registered students. (1) Specify the cardinality ratio of each relationship type in this ER diagram. (2) Derive the relational database schema from this ER diagram using ER-to-Relational Mapping.



**Q5.** Suppose that we have an ordered file with r = 80000 record stored on a disk with block size,

B = 1024 bytes. File records are of fixed size with record length R = 100 bytes.

(a)(6%)

(1)What's the blocking factor for the file? What's the number of blocks needed for file?

(2)How many block accesses would be needed to do a binary search for ordering field on the data file?

(3)How many block accesses in average would be needed to do a linear search for non-ordering field on the data file?

(b)(2%) Assume that we have constructed a primary index for the file that the ordering key field of the file is 12 bytes long and a block pointer that is 8 bytes long.

How many block accesses would be needed to search for a record using the primary index?

(c)(6%) Assume that we have constructed a secondary index on a non-ordering key field of the file that is 12 bytes long and a block pointer that is 8 bytes long.

(1) What's the total number of index entries for the file? What's the total number of blocks needed for the index?

(2) How many block accesses would be needed to search for a record using the secondary index?

The above index, which is constructed based on a non-ordering key field, is called a first level index. Assume that a second-level index has been constructed based on the first-level index to create a multi-level index.

(3) (2%) What's the total number of index entries for the second-level index.

(4) (2%) How many block accesses would be needed to search for a record using the multilevel index?

**Q6.** Explain the flowing.

1. (3%) What is the desirable property of a search tree that can have better search performance? Give an example to illustrate the property.
2. (3%) Given the same tree height of B-tree and B+tree, which one can be used to index more data records? Why ?
3. (2%) Heap file
4. (3%) Open addressing for collision resolution in internal hashing.
5. (3%) Use an example to explain how to recover the missing data based on the parity available from the remaining disks when one disk fails for RAID level 5.

**Q7.**

1. (4%) Give an example to illustrate to explain the concept of transaction states - partially committed and committed.
2. (4%) Explain how to perform data recovery according to the system log.
3. (2%) Briefly explain the interleaved processing and parallel processing, respectively.