Uva Wellassa University, Sri Lanka

Faculty of Science and Technology

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Uva Wellassa University

CST 325-2/IIT411-2/CST425-2 Advanced Database Management Systems

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Instructions to Candidates

Read the instructions given for question carefully. Answer **All** questions. Each question carries **20** marks.

Question 1

I. Explain what are meant by a Database and Database Management Systems.
II. Express the advantages of DBMS over File Systems.
III. What is a Data Model?
IV. Briefly describe categories of data models.
V. What is an E-R model?
VI. Explain the terms Entity (Strong, Weak), Attribute (Simple, Composite, Multi-valued, Derived), Relationship and Key attribute
VII. A University System has been represented using its relational model as shown below.

STUDENT (Id, Name, Year)
LECTURER (Name, OfficeNo)
NEW-STUDENT (Id, Name, Year)
REPORT (StudentId, CourseNo, Marks)
COURSE (CourseNo, Title, LecturerName)

Using the above relations, write out the relational SQL queries that would derive the following results.

a. List the Id, Name, and Year of both new and current students who are in year 2012.
b. Generate a list containing, for all the current students only, their Ids, Names, Years, CourseNos and Marks for that course.
c. Find the number of the courses that each current student does not take. Result Should contain the student Name, CourseNo pair.
d. Find the OfficeNo of the lecturer who teaches course CST 425-2.

Question 2

Consider the following requirements for a university database:

- A Person has a NIC (unique), age and a name.
- Professor is a Person with the following attributes: rank and research specialty.
- Projects have a project number (unique), a sponsor, a starting date, ending date and a budget.
- Graduate students are also persons. Graduate students need to store information about the degree program (e.g. B.Sc., M.Sc. or PhD) that they are enrolled.
- Each project is managed by one professor (known as the project's principal investigator).
- A project must have a principal investigator.
- Each project is worked on by one or more professors (known as co-investigators).
- Professors can manage and/or work on multiple projects.
- Each project is worked on by one or more graduate students (known as project's research assistants).
- Graduate students can work on multiple projects.

Draw an E-ER diagram for the above requirements.

Question 3

Consider the following relational schema. An employee can work in more than one department; the *pct-time* field of the Works relation shows the percentage of time that a given employee works in a given department.

Emp(***eid:*** **integer,** ***ename:*** **string,** ***age:*** **integer,** ***salary:*** **real)**
Works(***eid:*** **integer,** ***did:*** **string,** ***pct-time:*** **integer)**
Dept(did: string, ***budget:*** **real,** ***managerid:*** **integer)**

Write the following queries in SQL:

I. Print the names and ages of each employee who works in both the Hardware department and the Software department.

II. Print the name of each employee whose salary exceeds the budget of all of the departments that he or she works in.

III. Find the ***managerids*** of managers who manage only departments with budgets greater than $1,000,000.

IV. Find the ***enames*** of managers who manage the departments with the largest budget.

V. If a manager manages more than one department, he or she ***controls*** the sum of all the budgets for those departments. Find the ***managerid*** of managers who control more than $5,000,000.

VI. Find the ***managerid*** of managers who control the largest amount.

Question 4

I. Briefly describe a transaction in the database context and its properties.

II. Explain why concurrent execution of transactions is desirable.

III. Answer the following with regard to *Strict Two Phase Locking Protocol* (also written as Strict 2PL).

a. Explain Strict 2PL Protocol.

b. What is meant by a *cascading abort*? What is the cause for a *cascading abort*? Give an example of a schedule with a cascading abort. How does Strict 2PL protocol *avoid cascading aborts*?

c. What is meant by an *unrecoverable* schedule? Give an example of a schedule with an *unrecoverable* schedule. How does Strict 2PL protocol ensure *recoverable* schedules?

Question 5

I. What are the steps in Query Processing? Explain each step.

II. What is the goal of Query optimization? Why is it important?

III. What types of information is stored in the system catalogs? Why?

IV. Consider the following schema:

Sailors(sid, sname, rating, age)
Boats(bid, bname, color)
Reserves(sid, bid, day)

Consider the following query:

```
SELECT S.sname
FROM Sailors S, Reserves R, Boats B
WHERE S.sid = R.sid AND R.bid = B.bid AND B.color = 'red'
```

a. Create the relational algebra expression for the query above.

b. Draw the graphical representation of the relational algebra expression