

**Name:**\_\_\_\_\_

**Student ID:**\_\_\_\_\_

**Signature:**\_\_\_\_\_

**MIDTERM EXAM 2, Fall 2006**

**CS 564 Introduction to Database Management Systems**

**Department of Computer Science**

**University of Wisconsin-Madison**

**Exam Rules:**

- 1) Close book and notes, 60 minutes
- 2) Please write down your name and student ID number NOW.
- 3) Please wait until being told to start reading and working on the exam.
- 4) If you think a problem is ambiguous, write down your assumptions, argue that they are reasonable, then work on the problem using those assumptions.

**1. (20 points)** Consider a database with the following relations:

Project(pname, member, start-date, end-date, budget, dept-id)  
Department(id, head)  
Employee(ename, dept-id)

where Project.member is the name of employee, and Department.head is also the name of some employee.

(a) Write an algebra expression that finds the names of all employees who are the heads of departments in which there is at least one project with budget over 100K.

(b) Write a SQL query that finds the employees who are involved in at least one project in which their department head is not involved.

**2. (20 points)** Consider a database schema with the following relations:

Student (ssn, name)

Prof (ssn, name)

Course (number, instructor-ssn, title, credits, room#)

Enroll (student-ssn, course#)

Room (number, capacity)

- [illegible]

**3. (20 points)** Using the same schema, which we duplicate below:

Student (ssn, name)

Prof (ssn, name)

Course (number, instructor-ssn, title, credits, room#)

Enroll (student-ssn, course#)

Room (number, capacity)

- [illegible]

**4. (15 points) Consider the relation  $R(A,B,C,D,E)$  with the following functional dependencies:**

$A, B \rightarrow E$ ,  $C, D \rightarrow E$ ,  $A \rightarrow C$ ,  $C \rightarrow A$ .

Decompose  $R$  into relations that are in BCNF.

**5. (15 points)** For the following schema and set of FDs,

- (i) What are the keys of the relation?
- (ii) Decompose the relation, as necessary, into collections of BCNF relations.

$R(A,B,C,D)$  with FDs  $BC \rightarrow D$ ,  $C \rightarrow A$ ,  $AB \rightarrow C$

**6. (10 points)** A major goal of normalization is (circle all but one):

avoiding redundant data  
avoiding update anomalies  
efficient query processing