1.264 Midterm Exam
Fall, 2004

Name: _____

Exam guidelines:
1. 80 minutes are allowed to complete the exam.
2. Open notes, open book.
3. No laptop computers or calculators are allowed.
4. No cell phones or messaging devices are allowed. Please turn off any that you have brought.
5. Short answer questions: Your answers are limited to a maximum of 2-4 sentences or phrases. Two sentences or phrases are completely adequate to answer any of these questions; 4 sentences are not necessary. Demonstrate that you understand the principles and key points. You will receive full credit for an answer if you make the principal observation(s) that the question is asking for. Details are not necessary.

1. Software process. (33 points)

Chris was in charge of version 1 of MIT's new chemical inventory system, MITCIS. After a serious accident that made page 1 of the newspapers, MIT realized that its system of monitoring and disposing of chemicals had to change. Chris had a general idea of the capabilities necessary from the first meeting of the MIT steering committee for the project. At the end of that first meeting Dave, the head of the committee, asked "Chris, how long is MITCIS going to take?" "I think it will take about 9 months, but that's just a rough estimate at this point," Chris said.

Dave said, "3 or 4 months is really the maximum time we can risk without the new system. We absolutely must have MITCIS within 6 months, at the absolute worst. You know how serious this problem is, don't you? Five people nearly died. Can you do it in 6 months?" "I'm not sure," Chris said, "but I'll try as hard as I can." "Treat 6 months as a deadline, then," Dave said.

Chris' team made progress but requirements gathering took much longer than they had hoped. Every lab and department had a different way of doing things, and it took a long time to understand their needs and to reach agreement on a common approach in some, but not all, areas of the system. Chris didn't feel he could be very assertive. They were now at month 3 in what was supposed to be a 6-month project, and the project was larger than he'd first thought due to the variability across labs and departments. "We can't do the rest of the work we have to do in 3 months," he told Dave. He told Dave he needed a 2-month extension and rescheduled the project to take 8 months. He felt it could be done in 10 or 11 months, but he didn't feel he could present those times to Dave.

In month 4, Chris realized that the designs for the database, Web pages and interfaces to external systems weren't proceeding as quickly as he had hoped either, because of the delays in requirements. "Implement the parts you can do easily, based on simple designs" he told the team. "We'll worry about the rest of the parts when we get to them." The data model was incomplete, as were the designs for the Web pages.

Chris met with the MIT steering committee. "We're now 7 months into our 8-month project. We're making good progress but we can't complete the project in 8 months." Chris announced his second schedule slip to 10 months. Dave grumbled loudly.

At the 9-month mark, the team had still not begun development on interfaces to MIT's procurement system. It was clear that the team couldn't make the 10-month schedule either. Chris announced the third schedule slip, to 12 months. Dave's face turned red when Chris announced the slip, and the pressure from the MIT committee became more intense.

Coding proceeded fairly well, but the interface to the procurement system needed redesign and recoding. The team hadn't coordinated design details among the Web page, database and external interface sub-teams well, and some of the implementations conflicted. There had been many data model changes.

At the 11-month steering committee meeting, Chris announced the fourth schedule slip, to 14 months. Dave went crazy. "Do you have any idea of what you're doing?" he yelled. "You obviously don't have any idea when the project is going to be done! I'll tell you when the project will be done! It's going to be done by the 12-month mark, or you're going to be out of a job! You and your team are going to work 80 hours per week until you deliver!" Chris felt his blood pressure rise, especially since Dave had backed him into an unrealistic schedule in the first place. But he knew that with four schedule slips, he had no credibility left.

Chris told his team about the meeting. They worked hard and managed to deliver the software in just over 13 months. System quality was very shaky, with many bugs.

a. List at least 5 errors made by this development team in their execution of this project.

b. Outline the key steps in the resource estimation that the team should have used to avoid these errors/problems. List at least 5 steps; describe each in 1-2 sentences or phrases.

c. Outline the key stages in the software development process that the team should have used to avoid these errors/problems, and roughly how long each stage should take. List at least 5 actions; describe each in 1-2 sentences or phrases. Give a rough timeline to reach a shippable system at the 6 month point.

2. **Data model (34 points)**

You are given the following set of business rules for MIT's new chemical information system, MITCIS.

a. MITCIS supports 150 laboratories at MIT in departments, research centers and administration (support). Information is maintained for lab name, phone number, address and email. Each lab has a unique ID. Each lab is in one of 5 'regions' at MIT based on its location; the regions are named Central, East, West, North and Northwest.
b. Each lab belongs to one organization. Each organization has a unique ID, type (department, research center or administration), name, address and phone number.
c. There are two storage locations where chemical inventory is kept at MIT. Location X1 serves Central and West. Location T5 serves Central, East, North and Northwest. The locations have an address and phone.
d. MIT has employees who distribute and monitor chemical products. Each employee is assigned to one region. Each employee has a name, unique employee ID, email and address.
e. A lab is served by at least one support person and usually by multiple support persons. Each employee supporting a lab has a role: primary support, backup support or specialist. An employee may support multiple labs. Not all roles are filled for all labs. (For example, a lab may not have a specialist or backup support.)

There are other tables containing chemical products, etc. but you don't need to model them.

You must draw a data model that corresponds to this set of business rules. Follow these steps. You only need to turn in one drawing that includes all the elements listed in steps a-e.

a. **Draw a box for each entity: give each an appropriate name (8 points)**

b. **List the attributes in the box for each entity (8 points)**

c. **Indicate the primary key for each entity by placing the phrase (PK) next to its name. (4 points)**

d. **Draw all relationships between the entities in the model. Indicate foreign keys by placing the phrase (FK) next to attributes that are foreign keys. (8 points)**

e. **Indicate the cardinality of the relationship: many-many, many-one or one-one. Use crows-foot notation; if you use another notation, define it. (7 points)**

To repeat: You only need to turn in one drawing that includes all the elements listed in steps a-e above.

3. **Database. (33 points)**

Based on the data model in question 2, you construct a database where the tables, attributes and relationships correspond exactly to the data model structure. You are now asked to write the following SQL queries against your database. You may use either implicit or SQL-92 syntax. Indicate which you are using. Briefly define any variable you use that isn't obvious.

a. **List the laboratory names that each employee supports, for all employees. Display the employee ID, employee role and lab name. Order by employee ID (11 points)**

b. **Delete employees that are supporting no laboratories (i.e., whose employee IDs are not present in the laboratory-employee table).**

c. **List the storage location names and phone numbers that can supply each lab. List the lab name being supplied.**