CENG 352 Database Management Systems

MIDTERM EXAM PRACTICE QUESTIONS

(collected from previous years' exams)

Q1. (20 pts.) Consider the relation R(A, B, C, D, E, F, G) with functional dependencies

F={AB → C, B → F, E → G, A → DE }.

(a) Find all keys of this relation. Do not report a superkey that is not a (minimal) key. (**3 points**)

(b) Is R in 3NF? Justify your answer. (**2 points**)

(c) Decompose R into a collection of BCNF relations and state whether the decomposition is lossless-join and dependency preserving. (**15 points**)

Q2. (20 pts.) Consider a relation R with attributes {A, B, C, D, E, F, G, H} and the set of functional dependencies F = {G $\rightarrow$ FD, E $\rightarrow$ D, GD $\rightarrow$ CE, BD $\rightarrow$ A }

a) Find the minimal cover of the given set of functional dependencies F. (**10 points**)
b) Decompose the relation into a collection of 3NF relations using the minimal cover found in part a). (**5 points**)
c) Is your decomposition also BCNF, lossless-join and dependency preserving as well? Explain. (**3 points**)
d) In designing a relational database schema why might we choose a non BCNF but 3NF design? (**2 points**)

Q3. (8 pts.) Consider the relation R(A,B,C,D,E) with multi-valued dependencies MD = { A$\rightarrow\!\!\rightarrow$ B, AB$\rightarrow\!\!\rightarrow$ C} and functional dependencies FD = {A $\rightarrow$D, AB$\rightarrow$ E}.

a) Find key(s) for the relation? (**3 points**)
b) Decompose the relation into a collection of relation schemas in 4NF. (**5 points**)

Q4. (12 pts.) For each of the following schedules determine whether it is conflict-serializable and/or view-serializable. Justify your answers.

a) $W_3(C)\ W_2(B)R_2(B)R_3(C)W_1(C)R_2(C)$

Is it conflict-serializable? Why or why not? If it is give the equivalent serial schedule.

Is it view-serializable? Why or why not? If it is give the equivalent serial schedule.

b) $R_2(C)\ W_1(C)W_2(C)R_1(B)W_3(C)$

Is it conflict-serializable? Why or why not? If it is, give the equivalent serial schedule.

Is it view-serializable? Why or why not? If it is, give the equivalent serial schedule.

Q5. (20 pts.) Consider the following schedule involving three transactions T1, T2 and T3:

Time	**T1**	**T2**	**T3**
1	R(C)		
2			R(B)
3	R(A)		
4		R(C)	
5			W(B)
6	W(A)		
7		R(B)	
8			R(A)
9		W(C)	
10		W(B)	
11	Commit		
12		Commit	
13			Commit

a) Is this schedule a recoverable schedule? Justify your answer. (**5 points**)

b) Describe how the strict two-phase locking with deadlock detection would handle the schedule. (**10 points**)

c) Assuming T1 is the oldest and T3 is the youngest transaction, describe how the **strict two-phase locking with wait-die deadlock prevention scheme would handle the schedule.** (**5 points**)

Q6 (20 pts.) Consider the following relational table:

Enroll(student_id, course_no, status)

a) You want to ensure that the number of courses that a student is enrolled should not be more than 7. Define an assertion to achieve this.

b) Define a trigger to achieve the same constraint in part a).

c) Suppose there is a functional dependency such that student_id → status. Write an assertion to enforce this functional dependency.

Q7. (25 pts.) Consider a database with data items {A, B, C, D}. The system has the following log records. Note that an entry <T, X, old, new> means transaction T changes the value of X from old to new. In the following log, DPT represents the Dirty Page Table and TT represents the Transaction Table.

1. <T2, C, 10, 11>
2. <T2 commit>
3. <T1, B, 20, 21>
4. <begin checkpoint>
   DPT = (B, 3)
   TT = (T1, running, 3)
   <end checkpoint>
5. <T3, D, 30, 31>
6. <T4, C, 11, 41>
7. <T4 commit>
8. <T3, A, 50, 51>
9. <T1, D, 31, 32>
10. <T5, A, 51, 52>
11. <T3 commit>
12. <T6, B, 21, 33>
13. <T5 commit>
    CRASH

a) What is the smallest Log sequence number (LSN) accessed during the Analysis phase? (2 pts.)
Answer: _____

b) Fill in the contents of the **Dirty Page Table** and the **Transaction Table** at the end of the Analysis phase. (8 pts.)

DPT

PageID	RecLSN

TT

XID	Status	LastLSN

c) What is the first Log sequence number (LSN) to be redone during the Redo phase? (2 pts.)
Answer: _____

d) List all possible values of A, B, C and D on disk at the time of crash (after action 13)? Assume 3 buffer pages are available. (4 points)

e) What log entries are written to the log during Undo phase? (5 points)

f) What are the values of A, B, C, D on disk at the end of crash recovery? (4 points)