Course Name:	Advance Database Concepts	Course Code:	CS4064
Degree Program:	BS (Computer Science)	Semester:	Spring 2023
Exam Duration:	60 Minutes	Total Marks:	30
Paper Date:	Tue 28-Feb-2023	Weight	15%
Section:	All	Page(s):	1
Exam Type:	Midterm-1	Total Questions:	4

Instruction/Notes:

Solve the questions in the given order.

You will not get any credit if you do not show proper working, reasoning and steps as asked in question statements.

Q1. *(5 points)* Consider the following schedule:

$$S: r_1(W); r_2(X); w_3(X); w_1(Y); r_2(Y); r_2(Z); r_3(Y); w_1(Z).$$

Draw the serializability (precedence) graph for this schedule. State whether this schedule is conflict-serializable or not. If the schedule is conflict-serializable, write down the equivalent serial schedule(s) otherwise explain why it is not.

Q2. *(5 points)* Determine whether each schedule is strict, cascadeless, recoverable, or non-recoverable. Provide proper reason.

$S1: r_1(X); w_3(X); w_2(Y); r_1(Y); r_1(Z); r_3(Y); c_2; c_3; c_1.$

$S2: r_1(X); w_3(X); r_1(Y); r_1(Z); r_3(Y); w_2(Y); c_2; c_3; c_1.$

Q3. *(1+4+3+2= 10 points)* Consider the following log at point of crash. Assume that the dirty page table and transaction table were empty before the start of the log. Use ARIES recovery algorithm to answer the following questions.

LSN	Last_LSN	Trans_ID	Type	Page_ID	Other_Info
101	begin checkpoint				...
102	end checkpoint				...
103	0	T1	update	X	...
104	0	T2	update	Y	
105	103	T1	commit		
106	0	T3	update	Z	...
107	104	T2	update	X	...
108	107	T2	commit		...
109	0	T4	update	Y	...
110	106	T3	update	Z	...
111	110	T3	commit		...
112	109	T4	update	X	...

a. What is the value of the LSN stored in the master log record (a special file)?
b. What is done during Analysis? Be precise about the points at which Analysis begins and ends and show the contents of transaction and dirty page table reconstructed in this phase.
c. What is done during Redo? Be precise about the points at which Redo begins and ends.
d. What is done during Undo? Be precise about the points at which Undo begins and ends.

Q4. *(10 points)* Consider the following schedule of actions, listed in the order they are submitted to the DBMS:

$$S: r_1(W); r_2(X); w_3(X); w_1(Y); r_2(Y); r_2(Z); r_3(Y); c_3; c_2; w_1(Z); c_1.$$

For each of the following concurrency control mechanisms, describe how the concurrency control mechanism handles the schedule. Assume that the timestamp of transaction T_i is i. For lock-based concurrency control mechanisms, add lock and unlock requests to the above schedule of actions as per the locking protocol. The DBMS processes actions in the order shown. If a transaction is blocked, assume that all its actions are queued until it is resumed; the DBMS continues with the next action (according to the listed schedule) of an unblocked transaction.

a. Rigorous 2PL with timestamps used for deadlock detection (Use wait-for-graph to deal with deadlock)
b. Basic Timestamp Ordering (Assume T1 < T2 < T3)