CRN	No	Full Name	Signature		1	2	3	4	Total
12303 (TU) 12305 (ŞÖ)					/25	/25	/20	/30	/100

No questions are allowed. Answer the questions to the best of your understanding. If you need to make extra assumptions, state them clearly. Make sure that all your answers are sufficiently explained.

(1) Alice has a large DVD movie collection. Her friends like to borrow her DVDs, and she needs a way to keep track of who has borrowed which DVD. She maintains a list of friends, identified by FID's (friend identifiers) and a list of DVD's, identified by DVDID's (DVD identifiers). For each friend, she stores the name and the all-important telephone numbers which she can call to get the DVD back. For each DVD, she stores the name of the star actor (only one actor) and the title. Whenever a friend borrows a DVD, Alice will enter that fact into her database along with the date borrowed. Whenever the DVD gets returned, it gets noted along with the date returned. Alice wants to keep a complete history of her friends' borrowing habits so that she can ask favors of the heavy borrowers (or perhaps refuse to make further loans to those who habitually don't return them quickly). Below is an E-R diagram for a database to help Alice out. Provide appropriate names for all entities, attributes, relationships and cardinality constraints by filling in the blanks below. (*Note*: Cardinality constraints specify the minimal and maximal allowed numbers of the relevant participants in the relationship.)
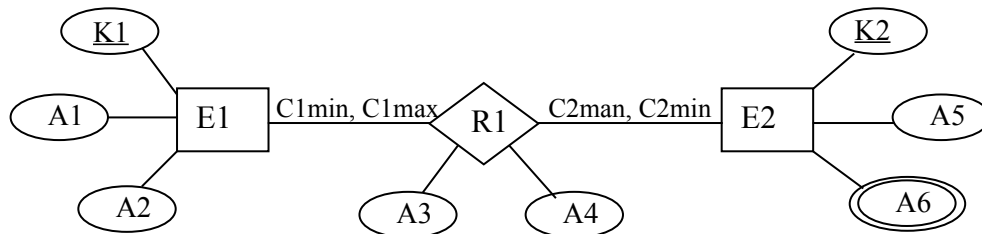
Entity E1: _____ Key K1: _____ Attribute A1: _____ Attribute A2: _____

Entity E2: _____ Key K2: _____ Attribute A5: _____ Attribute A6: _____

Relationship R1: _____   Attribute A3: _____ Attribute A4: _____

Cardinality C1min: _____ C1max: _____ C2max: _____ C2min: _____

(2) Consider two E-R models. Model A consists of two entities and one relationship joining them. The entities are **LECTURER** and **COURSE** and the relationship is **TEACHES.** The second model consists of three entities; the first and the third are the same as above but the second entity is called **LECTURE.** The first and second entities are joined by a relationship called **GIVES** while the second and the third entities are joined by a relationship called **OF**.

a) Draw the E/R diagrams for both models.

        Model A   Model B

b) Which of the following statements are correct? Briefly justify your answers to all statements. You will not receive marks for answers without explanation.

    i. Both models allow a course to have more than one lecture from the same lecturer.

    ii. Model B is more appropriate if information about all lectures, past and present, is to be stored.

    iii. Model A does not allow lecture date and time to be stored.

    iv. Model B leads to more tables than Model A does when translated to the relational model.

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(3) Consider the following cases for recovery. Briefly justify your answers. You will not receive marks for answers without explanation.

a) If the buffer pool is large enough that uncommitted data are never forced to disk, is UNDO still necessary? How about REDO?

b) If updates are always forced to disk when a transaction commits, is UNDO still necessary? How about REDO?

ANYTHING WRITTEN BELOW THIS LINE WILL NOT BE TAKEN INTO CONSIDERATION WHEN GRADING.

(4) Assume that the database recovery log contains the events listed in the table given below.

Event	Column 2
T1 STARTS	
T1 reads item B	
T1 writes item B: old value 11, new value 12	
T2 STARTS	
T2 reads item B	
T2 writes item B: with old value 12, new value 13	
T3 STARTS	
T3 reads item A	
T3 writes item A: old value 29, new value 30	
T2 reads item A	
T2 writes item A: old value 30, new value 31	
T2 COMMITS	
T1 reads item D	
T1 writes item D: old value 44, new value 45	
T3 COMMITS	
T1 COMMITS	

a) Which serial schedules would produce the same result as this log? If none, explain why.

b) Is this schedule consistent with two phase locking? If your answer is yes, then in column 2, insert into the schedule a minimal set of additional operations that will make the schedule no longer consistent with two phase locking. Do not introduce any new transactions. If your answer is no, then in column 2, remove from the schedule a minimal set of operations, so that the revised schedule is consistent with two phase locking.