

**Department of Applied Mathematics**  
**DTU**  
**Database Management System (MC 302)**  
**Assignment 1**

Q1. Neeta has a large DVD movie collection. Her friends like to borrow her DVD's, and she needs a way to keep track of who has what. She maintains a list of friends, identified by unique FID's (friend's identifier) and a list of DVD's identified by DVDID's (DVD's identifier). With each friend is the Name and all-important telephone numbers which she can call to get the DVD back. With each DVD is the star actor and actress name and movie title. Whenever a friend borrows a Neeta will enter the fact into database along with the date borrowed. Whenever the DVD gets returned, the fact too gets noted along with the date returned. Neeta wants to keep a complete history of her friend's borrowing habits. Draw the ER diagram for this situation. Specify the entities, relationships, attributes of entities and relationships, cardinality and participation constraints and also the Primary Keys. Specify clearly any assumptions that you have made. Suppose in the above question Neeta has a large collection of music DVDs as well, where each music DVD is identified by Unique DVDID and has an album\_name. Neeta also lends her music DVDs to her friends and records the borrowed date and returned date as well. What changes in the ER diagram are required to include these facts?  
Map the given ER schema into a relational schema. Specify all the primary and foreign keys.

Q2. What role ER model plays in the Database Design Process?

Q3. What two courses of actions are available to a database designer when he encounters multi valued attribute? Explain with an example of your own and also discuss their advantages and disadvantages.

Q4. Define redundancy with respect to data storage. How can the database approach help in controlling redundancy?

Q5. What is meant by Data Independence?

Q6. State the advantages of using a DB Management System.

Q7. Consider the relation schema  $R(A, B, C, D, E, F)$  with functional dependencies  $AC \rightarrow B$ ,  $BD \rightarrow F$  and  $F \rightarrow CE$ .

1. How many candidate keys does  $R$  have?
2. List all the candidate keys of  $R$ . If a candidate key is composite then use parenthesis  
e.g.  $(A, B)$ .
3. Is  $R$  in 3NF? If yes, justify. If no, specify at least one FD which violates the definition?
4. Which FD(s) (if any) of  $R$  violates BCNF?
5. Consider the decomposition of  $R$  into  $R_1(A, B, C)$ ,  $R_2(C, E, F)$  and  $R_3(A, D, F)$ .  
Give YES/NO answers for the following:
  - i. Is this decomposition lossless?
  - ii. Is this decomposition dependency preserving?
  - iii. Is this decomposition in BCNF (i.e. are  $R_1$ ,  $R_2$  and  $R_3$  all in BCNF)?

Q8. Consider the following legal instance of a relational schema  $S$  with attributes  $ABC$ :

A	B	C
$\alpha$	9	T
$\alpha$	16	F
$\beta$	20	F

Which of the following dependencies are *violated* by the instances of  $S$ ?

- i)  $A \rightarrow B$  is violated.
- ii)  $B \rightarrow A$  is violated.
- iii)  $C \rightarrow A$  is violated.
- iv)  $AC \rightarrow B$  is violated.
- v)  $B \rightarrow AC$  is violated.

Q9. Consider the relational schema  $r = \{P, Q, R, S, T, U, V\}$  and the set of functional dependencies FD:

$P \rightarrow Q$        $Q \rightarrow R$        $PS \rightarrow TRV$        $QT \rightarrow UR$        $S \rightarrow V$

a) Which of the following is a minimum cover of the FD?

- i) The given FD is a minimum cover.

- ii)  $\{P \rightarrow Q, Q \rightarrow R, PS \rightarrow T, QT \rightarrow UR, S \rightarrow V\}$
- iii)  $\{P \rightarrow Q, Q \rightarrow R, P \rightarrow T, Q \rightarrow U, S \rightarrow V\}$
- iv)  $\{P \rightarrow Q, Q \rightarrow R, PS \rightarrow T, QT \rightarrow U, S \rightarrow V\}$
- v) none of the above - the cover is \_\_\_\_\_

(b) Which of the following functional dependencies can be deduced, from the above set of functional dependencies?

- i)  $P \rightarrow R$
- ii)  $PS \rightarrow U$
- iii)  $QS \rightarrow U$
- iv)  $QST \rightarrow P$

c) The attribute closure  $\{Q\}^+$  is \_\_\_\_\_.

d) The attribute closure  $\{PS\}^+$  is \_\_\_\_\_.

Q10. Consider the relation with attributes,  $S = \{A, B, C, D, E, F\}$ , Let the following functional dependencies  $FD$  be defined over the relation S:

$$A \rightarrow D \qquad A \rightarrow E \qquad D \rightarrow C \qquad D \rightarrow F$$

- a) Provide the attribute closure of  $\{AB\}$ .
- b) Identify whether the decomposition  $ABC, CDE, EFA$  is lossless and dependency preserving?
- c) Identify whether the decomposition  $ABCE, ADC, ADEF$  is lossless and dependency-preserving?

Q11. Consider the relation with attributes,  $S = \{A, B, C, D, E\}$ . Let the following functional dependencies be defined over the relation S,

$$A \rightarrow BC \qquad CD \rightarrow E \qquad B \rightarrow D \qquad E \rightarrow A$$

- a) Identify whether this relationship in 3NF and/or BCNF?
- b) Give a BCNF decomposition of S that is lossless.
- c) Is your BCNF decomposition dependency preserving?
- d) Give a 3NF decomposition of S that is lossless and dependency preserving.