

1. (a) Write down the candidate keys and primary key for each of the following relations and then draw the referential integrity diagram connecting them:  
Students(IDNO, Name, CGPA, DOB,...)  
Courses(Comp\_code, course\_no, course\_title, units)  
Date\_Hour(Date, hour, day, semester, acad\_year)  
Attendance(IDNO, Comp\_code, Date, hour, Lecture\_practical\_tutorial)  
(b) What are the advantages of having a layered architecture for an RDBMS? Give the architecture of an RDBMS and annotate it to show the different levels of abstractions. Also mention how these abstractions are achieved. [5+5]
  2. (a) Define the closure  $F^+$  of a set  $F$  of functional dependencies on a relation  $R$ . Where do we need the concept of  $F^+$ ? Do we need to find  $F^+$  for any purpose? Justify your answer.  
(b) Mathematically define the canonical cover  $F_c$  of a set  $F$  of functional dependencies on a relation  $R$ . What are the advantages of finding the canonical cover? [5+5]
  3. (a) What are the advantages of using bags or multisets in RDBMSs? Illustrate by giving examples. Is it possible to replace them by sets? Justify your answer.  
(b) Among the following algebraic laws, find out which holds for either sets or bags or both:  
(i)  $R \cup (S \cap T) = (R \cup S) \cap (R \cup T)$   
(ii)  $(R \cap S) - T = R \cap (S - T)$   
Justify your answer. [5+5]
  4. Given a relation  $R(A,B,C,D,E)$  and a set of FDs,  $F$ . Write all the steps needed to normalize the relation  $R$  to BCNF. Assume that  $R$  is in 1NF. Give your answer in tabular form having schema:  
Normalization\_steps (Step#, Step description, How the step is carried out?) [10]
  5. The concepts of FDs and normalization is central to RDBMs, but these concepts are not supported directly in commercial RDBMSs. If you were to design an RDBMS, what kind of support for FDs and normalization you would provide for the end user. Give sample DDL using an example schema,  $R(A,B,C,D,E,F)$ . [10]
  6. (a) Explain how taking projections early helps in executing a query efficiently.  
(b) Explain how views can help in providing logical data independence (LDI)? By LDI, we mean that if the logical schema is changed, the user queries/applications are not affected. Illustrate by giving a simple example.  
(c) Apart from providing logical data independence, what are the other advantages of having views? [4+4+3]
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