Motilal Nehru National Institute of Technology Allahabad
Department of Computer Science and Engineering
MCA-IV Sem, End-Sem Exam, May 2018
Database Management Systems (CA 3403)

Time 3 hrs **M.M. 60**

All questions are compulsory. Assume any missing data and mention it at the top of answer.

Q1 a) Consider relation R = (A, B, C, D, E, F) and the set of functional dependencies: 5*3=15
   a) AB → C
   b) BC → A
   c) BC → D
   d) D → E
   e) CF → B
   List the Candidate Keys of R.

   b) Do the above functional dependencies imply AB → E? If yes, for each step be sure to indicate which axioms and other functional dependencies you are using.

   c) Is relation R in BCNF? If yes, say why. If not, then decompose R into two or more relations that are all in BCNF. Your decomposition must be lossless, but does not need to preserve dependencies.

Q2 a) In general, is it possible to have a deadlock when the regular two-phase-locking (i.e., non-strict) protocol is obeyed? If yes, give an example. If not, explain briefly. What happens with strict two-phase locking and rigorous two-phase locking? 5+(5+5)

   b) For each of the following schedules:
   Sa = r1(A);w1(B);r2(B);w2(C);r3(C);w3(A);
   Sb = r1(A);r2(A);r1(B);r2(B);r3(A);r4(B);w1(A);w2(B);
   Here, ri denotes read operation by a transaction i and wi denotes write operation by a transaction i. For example, r1 denotes read operation by transaction T1. Similarly, w1 denotes write operation by transaction T1. Answer the following questions:
      i. What are the precedence graphs for the schedules?
      ii. Is the schedule conflict-serializable? If so, what are all the equivalent serial schedules?

Q3 Design an ER-model of a flight reservation system. The model should include: 10
   a) A plane (with a unique ID) is assigned to each flight. The assignment can be different each day. A flight that flies on Monday and Wednesday can be using different planes on each day.
   b) Planes have a bunch of seats, usually identified by a seat number.
   c) A particular flight number can only be used once a day.
   d) A particular fight number can have different Source/ Destination on different date. For example, flight number "UA111" can be assigned to "Los Angeles to Oakland" on Monday and then changed to "San Francisco to Boston" on Tuesday.
   e) A passenger reserves a seat for a particular flight.
   f) Some passengers are frequent flyers, and therefore have account numbers and accumulated miles.
   g) Flights are assigned to a gate which is located in one terminal.
   h) A gate can handle multiple flights each day and different flights on various days.
   i) There are terminals (usually identified by letters) which contain the gates (usually identified by numbers).

Q4 Consider a disk with a sector size of 512 bytes, 2000 tracks per surface, 50 sectors per track, five double-sided platters, and average seek time of 10 msec. 5*2=10
   a) What is the capacity of a track in bytes?
   b) What is the capacity of each surface?
   c) What is the capacity of the disk?
   d) How many cylinders does the disk have?
   e) If the disk platters rotate at 5400 rpm (revolutions per minute), what is the maximum rotational delay?

Q5 Draw the resulting B+Tree in each step. Assume that each page can hold (at most) 4 index entries (or, equivalently, 5 pointers to its children).The leaf nodes have same structure as non-leaf nodes. 10

a) Bulk load the B+Tree with values 10, 23, 29, 30, 34, 40, 46, 49, 54, 59, 70, 75
b) Insert 80
c) Remove 70
d) Go back to the original bulk loaded B+Tree (step a) and Remove 70
e) Delete 59
f) Delete 54
g) How many I/O to find 80?
h) How many I/O to find out 79 is not in index?
i) How many I/O to find 40?
j) How many I/O to find 10?