**CS 457 – Data modeling and Implementation techniques Venue: Home**

**Time Duration: 8 am to 11 am**

**Date: April 24, 2022**

**Final exam: [Max: 75 points]**

1. [8 points] Define the following terms: (a) superclass of a subclass, (b) superclass/subclass relationship, (c) IS-A relationship, (d) specialization, e) generalization, f) category, g) specific attributes, and h) specific relationships.
2. [13 points] Consider a BANKER schema in Figure 3.21 of the textbook. Suppose that it is necessary to keep track of different types of ACCOUNTS (SAVINGS\_ACCTS, CHECKING\_ACCTS, ...) and LOANS (CAR\_LOANS, HOME\_LOANS, ...). Suppose that it is also desirable to keep track of each account's TRANSACTIONs (deposits, withdrawals, checks, ...) and each loan's PAYMENTs; both of these include the amount, date, time, ... Modify the BANK schema, using ER and EER concepts of specialization and generalization. State any assumptions you make about the additional requirements.
3. [3 points] Discuss how NULLS are treated in comparison operators in SQL. How are NULLS treated when aggregate functions are applied in an SQL query? How are NULLS treated if they exist in grouping attributes?
4. [16 points] Discuss how each of the following constructs is used in SQL, and specify what each construct is useful for: (a) Nested queries, (b) Joined tables and outer joins (c) Aggregate functions and grouping (d) SQL WITH clause e) SQL CASE construct (f) Views and their updatability (g) Schema change commands (h) Triggers.
5. [6 points] Consider the following relations for a database that keeps track of business trips of salespersons in a sales office.
   1. SALESPERSONS (ssn, name, start\_year, dept\_no)
   2. Trip (ssn, from\_city, to\_city, departure\_date, return\_date, trip\_id)
   3. Expense (trip\_id, account\_no, amount)

A trip can be charged to one or more accounts. Specify the foreign keys for this schema, stating any assumptions you may make.

1. [7 points] Consider the following relations for a database that keeps track of student enrolments in courses and the books adopted for each course:

STUDENT (ssn, name, major, bdate)

COURSE (course\_no, cname, dept)

ENROLL (ssn, course\_no, quarter, grade)

BOOK\_ADOPTION (course\_no, quarter, book\_isbn)

TEXT (book\_isbn, book\_title, publisher, author)

Specify the foreign keys for this schema, stating any assumptions you may make.

7. [6 points] State whether the following conclusion are true or false. Explain.

a. NOT (P(*x*) OR Q(*x*)) ⇒ (NOT (P(*x*)) AND (NOT (Q(*x*)))

b. NOT (∃ *x*) (P(*x*)) ⇒ ∀ *x* (NOT (P(*x*))

b. (∃ *x*) (P(*x*)) ⇒ ∀ *x* ((P(*x*))

8. [16 points] Show how you can specify the following relational algebra operations in both tuple and domain relational calculus.

(a) SELECT A=c (R(A, B, C)):

(b) PROJECT <A, B> (R(A, B, C)):

(c) R(A, B, C) NATURAL JOIN S(C, D, E):

(d) R(A, B, C) UNION S(A, B, C):

(e) R(A, B, C) INTERSECT S(A, B, C):

(f) R(A, B, C) MINUS S(A, B, C):

(g) R(A, B, C) CARTESIAN PRODUCT S(D, E, F):

(h) R(A, B) DIVIDE S(A):