60-315 WINTER 2018
Midterm 2 (solution)
Examiner: Dr. C. I. Ezeife Given: Thursday, March 8, 2018

Student Name:_____

Student Number:_____

INSTRUCTIONS (Please Read Carefully)
Examination Period is 1 hours 20 minutes
Answer all questions. Write your answers in the spaces provided in the question paper. This is closed book and closed notes test.
Total Marks =50. Total number of sections = 2
Please read questions carefully! Misinterpreting a question intentionally or unintentionally results in getting a "ZERO" for that question. Good Luck!!!

CONFIDENTIALITY AGREEMENT & STATEMENT OF HONESTY
I confirm that I will keep the content of this examination confidential.
I confirm that I have not received any unauthorized assistance in preparing for or writing this examination. I confirm knowing that a mark of 0 may be assigned for copied JOB.

_____ _____
Student Signature Student Name (please print)

_____ _____
Student I.D. Number Date

For marking purposes only (This part not to be filled by students)

Question	Mark
Section A (10 marks for 10 multiple choice questions)	/10
Section B	
Que 1 (10 marks)	/10
Que 2 (15 marks)	/15
Que 3 (15 marks)	/15
Total	/50

Section A

10 marks for 10 Multiple Choice Questions. Each question in this section is worth 1 mark.

For Questions 1 – 10, circle the correct answer.

Consider a relation *R(A,B,C,D,E)* with the following functional dependencies:
AB -> {C, D, E}
D -> E

1. The relation *R(A,B,C,D,E) above is not in 3NF:*

    a. TRUE
    b. FALSE
    c. MAY BE
    d. ALL OF THE ABOVE
    e. NONE OF THE ABOV

Given a relation *R1(A,C,B)* with the following functional dependencies:
AC -> B

2. Relation *R1(A,C,B)* is in BCNF:
    a. TRUE
    b. FALSE
    c. MAY BE
    d. ALL OF THE ABOVE
    e. NONE OF THE ABOVE

Given the following relation Database state with tables ORDER and DEPARTMENT, where Ordid is the primary key and Dnum refers to Dnum in relation DEPARTMENT, use it to answer the next few applicable questions.

ORDER

Oname	Ordid	location	Dnum
Milk	1	London	7
Cheese	2	Windsor	7
Butter	3	Toronto	7
Carrot	10	Ottawa	4
Bread	20	Chatham	1
Green beans	30	Ottawa	4

DEPARTMENT

Dnum	Dname
1	Bakery
4	Vegetables
7	Dairy

3. Which of the following statements is correct about the table ORDER?

   a. It contains update anomaly

   b. It contains insert anomaly

   c. It contains delete anomaly

   d. All of the above
   e. None of the above

4. The result of the cross product of the two relations ORDER and DEPARTMENT has cardinality (number of tuples) _____.

   a. 3

   b. 6

   c. 24

   d. 18

   e. None of the above

5. **The effect of the following SQL instruction on the ORDER table, when the only known Dnum instances in the DEPARTMENT table are 1, 4 and 7 is _____ .**

   INSERT INTO ORDER VALUES(‘Rice’, 4, ‘Windsor’, 8);

   a. Insert an additional tuple in the ORDER table with values specified.
   b. Update the second tuple of the ORDER table to have the values specified.
   c. Raise an exception to indicate that there is a referential integrity violation.
   d. Raise an exception to indicate that there is a primary key constraint violation.
   e. None of the above.

6. Looking at the table **ORDER**, is it normalized and in at least 3NF?

   a. **YES**
   b. **NO**
   c. **MAY BE**
   d. **DON'T KNOW**
   e. **None of the above**

7. A basic SQL retrieval query to get all **ORDER**s located in Toronto is:

   a. **Select * where location =** 'Toronto'**;**
   b. **Select * from ORDER O where O.location =** 'Toronto'**;**
   c. **Select * from ORDER where location =** Toronto
   d. **All of the above**
   e. **None of the above**

8. To retrieve the number of **ORDER** items handled by each Dnum in the table **ORDER**, we can use the query:

   a. **Select Dnum, count(*) from ORDER group by Dnum;**
   b. **Select min(*) from ORDER group by Dnum;**
   c. **Select Dnum, sum(*) from ORDER group by Dnum;**
   d. **Select max(*) from ORDER group by Dnum;**
   e. **None of the above**

9. The result of the following query on the table **ORDER** is _____ showing just the tuples.
   Select Oname, Dname from **ORDER, DEPARTMENT** where Dnum=4;

   a. **Carrot Vegetables**
   b. **Carrot Vegetables**
      Green beans Vegetables
   c. **Milk Dairy**
   d. **All of the above**
   e. **None of the above**

10. **The following SQL instruction can be used to add an extra attribute called Number_items of type integer to the relation DEPARTMENT.**

    a. **UPDATE TABLE DEPARTMENT ADD Number_items NUMBER(5);**
    b. **CREATE TABLE DEPARTMENT ADD Number_items NUMBER(5);**
    c. **ALTER TABLE DEPARTMENT ADD COLUMN Number_items NUMBER(5);**
    d. **All of the above**
    c. **None of the above.**

Section B (40 marks):
This section has 3 questions:

1. **(10 marks)** Given the following relation schema T, with attribute D as the primary key, answer the questions below.

T Relation

A	B	C	D
a1	b1	c1	d1
a1	b1	c2	d2
a2	b1	c1	d3
a2	b1	c3	d4

(i) What functional dependencies FD can you see exist in this relation above?
(ii) What update, (iii) delete and (iv) insertion anomalies may or not be present in this T relation above. Explain with examples using this database.

Que 1 (2.5 marks for each of i to iv)

(i) FDs (2.5 marks)	FD1: D -> {A, B, C} FD2: A -> B; FD3: C -> B; Since for for FD2, every tuple with A value a1, its B value is b1 and every tuple with A value a2, its B value is b1. Also, for FD3, for every tuple with C value of c1, it has a B value of b1. This indicates that the primary key does not fully functionally determine all attributes and thus, this table is not in 2NF or 3NF and may contain anomalies. (give -0.5 for each of the missing FDs, -2.5 none is correct)
(ii) Update anomalies (2.5 marks)	Since A -> B, if there is need to change the A value (e.g. a1 now has b1 value for B attribute and we want to change it's A value to a3, as must change all other tuples with A value a1 to a3 and have all their B values remain b1), thus several tuples having the A value a1 in the table will have to be updated or there is a violation of the functional dependency (A -> B) in the database that must exist. This is update anomaly. (give -2.5 for poor explanation of update anomaly with either redundant multiple update or violation of FD due to update; -1.5 for only decent explanation)
(iii) Delete anomalies (2.5 marks)	In the table above, if we delete the 2 tuples with A values of a2, we no longer know what B values are associated with an A value of a2. This is delete anomaly. (give -2.5 for poor explanation of delete anomaly with loss of data relationships through delet or using FD information; -1.5 for only decent explanation)

(iv) Insertion anomalies (2.5 marks)	If a new tuple is inserted whose A and B values are not yet known, we might not be able to insert this tuple until we can assign them an A and B values that maintains the FD (A -> B). This is insert anomaly. (give -2.5 for poor explanation of insert anomaly with inability to insert data of one entity (D) when other values determined by violating FDs (e.g., A and B) are unknown; -1.5 for only decent explanation)

2. **(15 marks)** Given the following six relations for a flight record database application in an airline:
Traveler(Tid, Tname, Title, Tpoints)
Flight(Fid, From, To, Date)
Pilot(Pid, Pname, salary)
Aircraft(Aid, Maker, capacity)
Flies(Tid, Fid, points)
Operates(Pid, Aid, Fid, time)

Here, the primary key for each relation is underlined. The attributes Tid stands for traveler id, Fid is flight id, Pid is pilot id, Aid is aircraft id, Tpoints is traveler total points while points is for current flight. Maker is aircraft manufacturer. All other attributes are self explanatory.
A small database state of this database is:

TRAVELER

Tid	Tname	Title	Tpoints
1111	John Smith	Mr	5000
2222	Mary Pert	Mrs	2000

FLIGHT

Fid	From	To	FDate
AC725	Windsor	Toronto	33-jan-18
PD825	Ottawa	Toronto	25-jan-18

PILOT

Pid	Pname	salary
23567	Rusty Odo	80000
55555	Katy Mill	Null

AIRCRAFT

Aid	Maker	capacity
BO70	Boeing	250
BB92	Bombardier	100

FLIES

Tid	Fid	points
1111	AC725	215
1111	PD825	300
2222	AC725	215

OPERATES

Pid	Aid	Fid	Time
23567	BO70	AC725	9:00am
55555	BB92	PD825	5:00pm

a. Write the SQL DDL instructions to create at least three tables (including at least a relationship table (eg. FLIES, OPERATES) with foreign key constraints) of the above database in the Oracle DBMS on our cs server specifying all constraints such as Key, entity and foreign key constraints. (**5 marks**)
b. Write the SQL instructions to load all the data in at least 3 tables you created using only the database state above. (**5 marks**)
c. Write the SQL query for the following query posed on this database, also write the results of the queries and the tables involved in answering the query.

Print all flights (Fid, From, To, Date) taken by traveler 'Mary Pert'.
(**5 marks**)

Que 2a (5 marks): Creating Tables

Marking scheme details: Give 1.5 for each of the 3 tables created well; -0.5 for each incorrect constraint or attribute; -2 if a relationship table (eg FLIES or OPERATES) is not one of the 3 tables.

```
CREATE TABLE TRAVELER
    (TID   VARCHAR2(10) NOT NULL,
    Tname VARCHAR2(15),
    TitleVARCHAR2(15),
    Tpoints NUMBER(6, 2),
    PRIMARY KEY(Tid));

CREATE TABLE FLIGHT
     (FID VARCHAR2(10) NOT NULL,
    From VARCHAR2(15),
    To VARCHAR2(15),
    Fdate   Date,
    PRIMARY KEY(FID));

CREATE TABLE PILOT
     (PID VARCHAR2(10) NOT NULL,
    Pname  VARCHAR2(15),
    Salary NUMBER(8,2),
    PRIMARY KEY(PID));

CREATE TABLE AIRCRAFT
     (AID VARCHAR2(10) NOT NULL,
    maker VARCHAR2(15),
    Capacity NUMBER(4),
    PRIMARY KEY(AID));

CREATE TABLE  FLIES
```

```
        (TID   VARCHAR2(10) NOT NULL,
        FID VARCHAR2(10) NOT NULL,
        POINTS  NUMBER(5),
        PRIMARY KEY(Tid, Fid),
        FOREIGN KEY (Tid) REFERENCES TRAVELER(Tid),
        FOREIGN KEY (Fid) REFERENCES FLIGHT(Fid));

    CREATE TABLE  OPERATES
        (PID   VARCHAR2(10) NOT NULL,
        AID  VARCHAR2(10) NOT NULL,
        FID VARCHAR2(10) NOT NULL,
        PRIMARY KEY(Pid, Aid, Fid),
        FOREIGN KEY (Pid) REFERENCES PILOT(Pid),
        FOREIGN KEY (Aid) REFERENCES AIRCRAFT(Aid),
        FOREIGN KEY (Fid) REFERENCES FLIGHT(Fid));

COMMIT;
```

Que 2b (5 marks): Inserting Data into the Database Tables

Solution (b) (For just inserting data into table Student, Course, and Enrolled)

Marking scheme details: Give 1.5 for each table with all its data loaded well; -0.5 for any line of data with error or any line of data missing.

```
INSERT INTO TRAVELER
VALUES ('1111', 'John Smith', 'MR', 5000);
COMMIT;

INSERT INTO TRAVELER
VALUES ('2222', 'Mary Pert', 'MRS', 2000);
COMMIT;

INSERT INTO FLIGHT
VALUES ('AC725', 'Windsor', 'Toronto', '22-Jan-18');
COMMIT;

INSERT INTO FLIGHT
VALUES ('PD825', 'Ottawa', 'Toronto', '25-Jan-18');
COMMIT;

INSERT INTO PILOT
VALUES ('23567', 'Rusty Odo', 80000);
COMMIT;
```

```
INSERT INTO PILOT
VALUES ('55555', 'Katy Mill', Null);
COMMIT;

INSERT INTO AIRCRAFT
VALUES ('BO70', 'BOEING', 250);
COMMIT;

INSERT INTO AIRCRAFT
VALUES ('BB92', 'BOMBADIER', 100);
COMMIT;

INSERT INTO FLIES
VALUES ('1111', 'AC725', 200);
COMMIT;


INSERT INTO FLIES
VALUES ('1111', 'PD825', 300);
COMMIT;

INSERT INTO FLIES
VALUES ('2222', 'AC725', 200);
COMMIT;

INSERT INTO OPERATES
VALUES ('23567', 'BO70', AC725);
COMMIT;

INSERT INTO OPERATES
VALUES ('55555', 'BB92', PD825);
COMMIT;
```

Question	Query	Tables needed to answer query and Result
2c (5 marks)	**Marking scheme details: Give 3 marks for each SQL query, 1 mark for tables, 1 mark for correct result. For query, split as 1 mark for projection list, from list, where condition with join conditions.** Print all flights (Fid, From, To, Date) taken by traveler 'Mary Pert'	FLIGHT, FLIES, TRAVELER Result: Fid From To Date AC725 Windsor Toronto 22-Jan-18

	Select Flight.Fid, Flight.From, Flight.To, Flight.Date From FLIGHT, FLIES,TRAVELER Where Flight.Fid = Flies.Fid And Flies.Tid = Traveler.Tid And Traveler.Tname = 'Mary Pert';	

3. (15 marks)

Given the following Parttime_Emps relation schema, with Ssn as the primary key, answer the questions below.

Ssn	name	lot	rating	wage	hours
123-22-3666	Attishoo	48	8	10	40
231-31-5368	Smiley	22	8	10	30
131-24-3650	Smethurst	35	5	7	30
434-26-3751	Guldu	35	5	7	32
612-67-4134	Madayan	35	8	10	40

a. If this table is not in 3NF, normalize it into 3NF showing all the tables in your new decomposed database. **(6 marks)**

b. Provide one valid tuple instance that can be inserted into this original database. **(3 marks)**

c. Provide one SQL query for updating a record in the original table. **(3 marks)**

d. Provide one SQL query for deleting this original table schema from your database. **(3 marks)**

Question	Answers
a. (6 marks)	**Marking scheme details: Lose marks as appropriate. 1 mark for not knowing table is not in 3NF; 2 marks for not discussing well with FDs; 3 marks for correct decomposition in 3NF basedon violating FDs.** FD1: Ssn -> {name, lot, rating, wage, hours} FD2: rating -> wage Since for every tuple with rating value 5, its wage is 7 and every tuple with rating value 8, its wage is 10. This indicates that the primary key does not fully functionally determine all attributes and thus, this table is not in 2NF or 3NF and may contain anomalies. To decompose into 3NF relations, we need to remove the violating FD2 by deleting the attribute wage from the original relation and create a new relation with the FD2 to have the following two normalized relations. Parttime_Emps 1(Ssn, name, lot, rating, hours) Parttime_Emps 2(rating, wage) It can be seen that both FD1 and FD2 are preserved by this decomposition

	in this database.
b. (3 marks)	**Marking scheme details: Give -3 for any insertion causing anomaly based on the violating FDs.** Any tuple that is inserted has to conform to all the FDs in the database which are FD1 and FD2. Thus, a valid tuple that can be inserted into the original Hourly-Emps table is: 131-24-3651 Panterlo 37 5 7 50
c. (3 marks)	**Marking scheme details: Give -1 for missing each of the 3 pairs of Tablename, SET attributes, and where conditions.** UPDATE Parttime-Emps SET hours = 25 WHERE name = 'Smiley';
d. (3 marks)	DROP TABLE PARTTIME_EMPS CASCADE; **Marking scheme details: Give -3 marks for incorrect DROP. It can be without CASCADE.**