CS3400 Database Management Systems
Midterm Examination I
(Duration 90 Minutes; Marks 180)

1. **Write your roll number on all pages of the exam booklet.**
2. **Answer as many questions as possible. Expect to spend at most one minute of time for answering at least two marks.**
3. There will **NOT** be partial marks for **Questions 3 & 5**. You will get either **ZERO or FULL marks, so answer them very carefully**.
4. Write your answers in space provided, and with legible handwriting.
5. READ ALL QUESTIONS CAREFULLY ***before*** ANSWERING ANY ONE OF THEM.

Questions	Maximum Marks	Marks Secured
1	70	
2, 3, & 4	70	
5	40	
TOTAL	180	

Copy this statement below and sign it

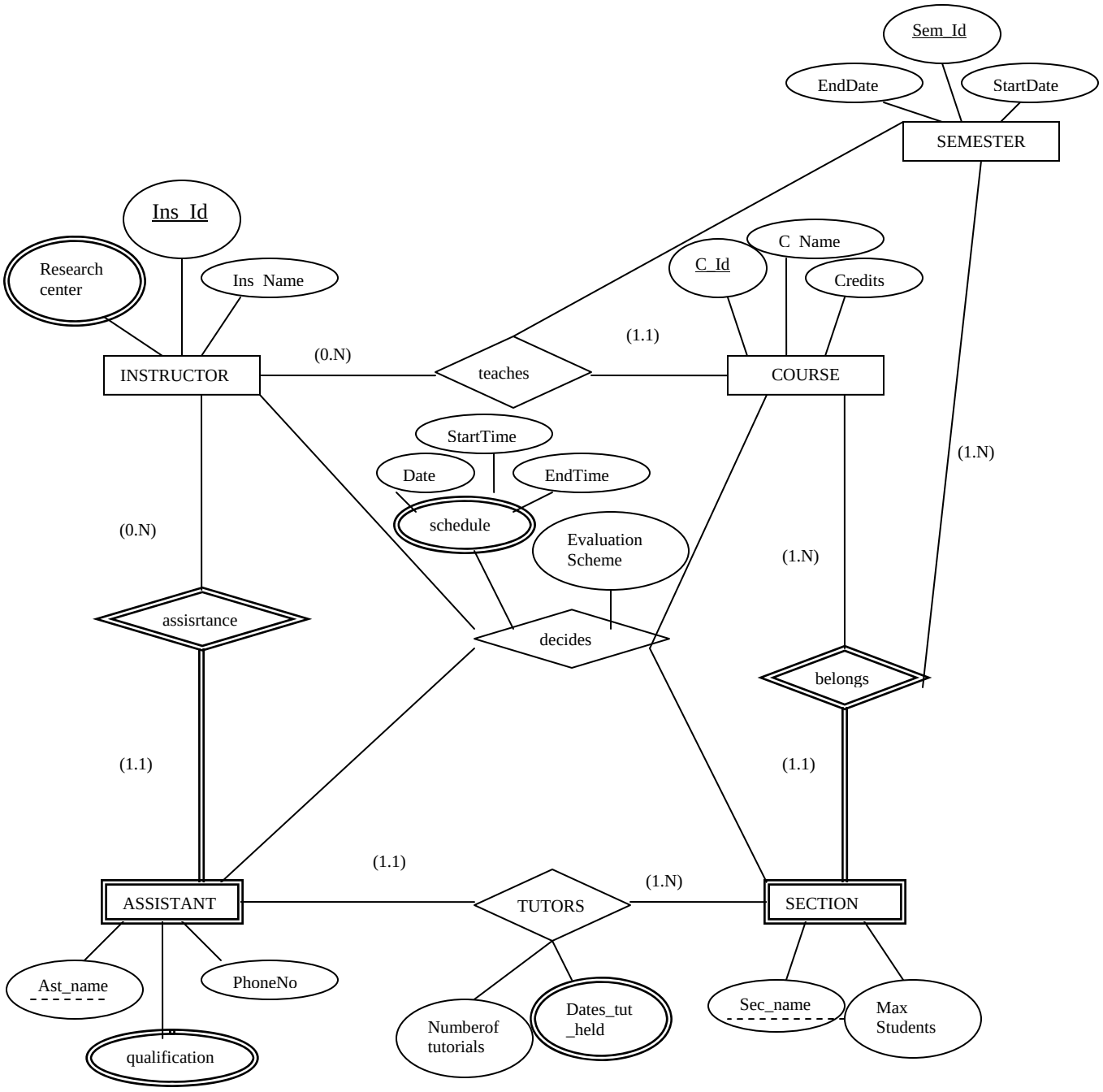
"I have not used any unfair means for answering this examination. In answering this examination I completely adhere to the academic honesty statement issued for this course"

Signature of Student*

* If you **do not copy the statement and sign it**, your exam paper **will not be graded**, and you will be given zero marks.

1. Given the following description of database requirements come up with an ER data model. Clearly show attributes, their types, keys, and cardinality participation constraints using (min, max) notation. (40 Marks)

   Instructor has a unique identifier, name, and is affiliated to one or more research centres.
   Course has a unique identifier, name, and credits.
   Semester has a unique identifier, start date, end date.
   Assistant depends for his/her existence on the instructor, and has a partial identifier name, qualifications, and phone number. An assistant has exactly one instructor, but an instructor has many assistants.
   A **section** is recognized by its relationship to a course and the semester it is offered, and has partial identifier section name, and maximum number of students that can register for the section.
   Any number of instructors can **teach** any number of courses in any number of semesters.
   The instructor and the assistant together **decide** on manner in which the course and its section are conducted. The instructor and assistant decide on the *schedule* of the course and *evaluation scheme* for the section.
   An assistant **tutors** for the sections. We store the information regarding number of tutorials, and dates on which tutorials were held. An assistant can tutor only one section, where as a section can have many assistants.


Sem_Id
EndDate
StartDate
SEMESTER
Ins_Id
Research center
Ins_Name
C_Name
C_Id
Credits
(1.1)
(0.N)
INSTRUCTOR
teaches
COURSE
StartTime
Date
EndTime
(1.N)
schedule
(0.N)
Evaluation Scheme
(1.N)
assisrtance
decides
belongs
(1.1)
(1.1)
(1.1)
(1.N)
ASSISTANT
TUTORS
SECTION
Ast_name
PhoneNo
Numberof tutorials
Dates_tut _held
Sec_name
Max Students
qualification

Map your ER model to relational data model. Show referential integrity constraints. Legibility of answer and showing the working of the steps taken to map the ER model to relational data model is required. (20 Marks)

- Instrctor (Ins Id, Ins Name)
- Instructor Affiliated (Inst_id, Research Center)
- course (Cid, Cname, Credits)
- semester (sem id , start date, end date)
- Assistant (Ins Id, Asst Name, Phone No, Cid, sem id, sec Name, No.of Tutorials)
- Asst Qual (Ins Id, Asst Name, Qualification)
- Section (Cid, sem id, sec Name, Max Students)
- Tutorials(Ins Id, Asst Name, Cid, sem id, sec Name, Date Tut held)
- Teaches(Ins Id, C id, Sem Id)
- Decides(Ins Id, A Ins Id, Asst Name, C id, S_C id, sem id, sec Name, Evaluation Scheme)
- Schedule(Ins Id, Asst Name, C id, sem id, sec Name, Date , start time, end time)

In the ER model description we assumed that an assistant has exactly one instructor. Suppose we allow the assistant to exist only if he/she is related to one or more instructors. How will your ER model change? Just show the changed part of the ER model by redrawing only that part and showing what has changed. Justify your answer. (10 Marks)

With this E-R Diagram this query cannot be answered.

2. Consider a relation R with one column named **Number** and *n* rows with values *{1, 2, …, n}*.
   a. What is the output of R*R*…*R? Where '*' is natural join. (5 Marks)

R*R*R =

1
2
3
.
.
.
.
n

   b. What is the output of $((((R \bowtie_{i<j} R) \bowtie_{i<j} R) \bowtie_{i<j} \ldots) \bowtie_{i<j} R)$? Where the (theta) Θ-join operator $\bowtie_{i<j}$ is applied $\underline{(n-1)}$ times. The Θ-join operator $(T \bowtie_{i<j} R)$ takes the right most column of T (renamed as column *'i'*) and performs Θ-join with Number column (renamed as column *'j'*) of R using the Θ-join condition '*i<j*'. (10 Marks)

1 2 3 4 ..... n

c. Write a relational algebra expression ***by using only join operator*** on relation R that gives a NULL result, if possible. If not, explain why not? (10 Marks)

$$R \bowtie_{R.Number < R.Number \text{ AND } R.Number > R.umber} R$$

3. Consider the following relations:
   Person(Name, age, gender)
   Father(FName, CName)
   Mother(MName, CName)

   NO PARTIAL MARKING FOR THIS QUESTION

   a. Write relational algebra expression to retrieve names of children who are older than either of their parents? (10 Marks)

   $FatherAge(fname, fage) \leftarrow \Pi_{fname, age, fname}(Person \bowtie_{name=fname} Father)$
   $PersonFather \leftarrow \Pi_{name, fname, age}(Person \bowtie_{name=cname} Father)$
   $AgeGreaterFather \leftarrow \Pi_{name}(\sigma_{age>fage}(PersonFather * FatherAge)$

   $MotherAge(fname, fage) \leftarrow \Pi_{fname, age, fname}(Person \bowtie_{name=fname} Mother)$
   $PersonMother \leftarrow \Pi_{name, fname, age}(Person \bowtie_{name=cname} Mother)$
   $AgeGreaterMother \leftarrow \Pi_{name}(\sigma_{age>fage}(PersonMother * MotherAge)$

   $Result \leftarrow AgeGreaterFather \cup AgeGreaterMother$

   b. Write relational algebra expression to retrieve names of parents who do not have any children? (10 Marks)

   With this schema this query cannot be answered.

c. Write relational algebra expression to retrieve names of youngest male child of the family? (15 Marks)

MaleChild1(name, age,parentname)$\leftarrow \Pi_{name,\ age,\ fname}$ (($\sigma_{gender='M'}$ (Person)) $\bowtie_{name=cname}$ (Father))

MaleChild2(name, age,parentname)$\leftarrow \Pi_{name,\ age,\ mname}$ (($\sigma_{gender='M'}$ (Person)) $\bowtie_{name=cname}$ (Mother))

MaleChild = MaleChild1 $\cup$ MaleChild2

ParentYoungestChild $\leftarrow$ parentname $\mathcal{F}$ Min_{age}(MaleChild)

YoungestMaleChild $\leftarrow$ Π_{name}(ParentYoungestChild)*(MaleChild)

4. Given two relations R(A1, A2, …, An) and S(A1, A2, …, An), show that $R*_{(A1,A2, \ldots An)}S = R \cap S$, where '*' is natural join and ∩ is the intersection operator. (10 Marks)

If There is a tuple t in R∩S then that means that t is common in both the relations. When we are doing a natural join on both the relations (since all the attribute names are same in both), the tuple will be output only when both the tuples in R and S are same

i.e

If $t \in (R \wedge S)$
then $t \in (R*S)$

$\Uparrow$
$\Downarrow$

If $t \in (R*S)$
then $t \in (R \wedge S)$

Note: Natural join on two relations X(A1,A2), Y (A3,A2) will output join of only those tuples whose X.A2 value is same as Y.A2 And the common attribute A2 will be reported only once in the result.

5. Consider the following relations:
   E(Eno, Name, Salary, Dno) – Eno works for Dno
   D(Dno, Name, Pno, MEno) – Mno manager of Dno, Dno controls Pno
   P(Pno, Name, Location)
   W(WEno, WPno, Hours) – WEno works on WPno

   NO PARTIAL MARKING FOR THIS QUESTION

   a. Write a SQL query to retrieve the names of the employees and names of the managers of the department they work in, such that salary of the employee is greater than salary of the manager. (10 Marks)

```
SELECT e1.Name, e2.Name
FROM E e1, E e2, D
WHERE e1.Dno = D.Dno AND e2.Eno = D.MEno
AND e1.Salary> e2.Salary
```

b. Write a SQL query to retrieve the name of the employee and names of the projects located in 'Hyderabad" such that the employee works on these projects for more than 40 hours. (10 Marks)

SELECT E.Name, P.Name from E, P, W
WHERE P.Location = "Hyderabad" and P.Pno = W.WPno
AND E.Eno = W.WEno AND W.Hours> 40;

c. Write a SQL query to retrieve the names of the employee, names of manager of department the employee works for, and names of projects, such that both employee and manager of the department the employee works for; – work on the same project but the manager works for more number of hours than the employee on that project. (20 Marks)

```
SELECT e1.Name, e2.Name, P.Name
FROM E as e1, e2, D, P, W as w1, w2
WHERE e1.Dno = D.Dno AND e2.Eno = D.MEno
AND e1.Eno = w1.WEno AND e2.Eno = w2.WEno
AND w1.Pno = w2.Pno AND w1.hours > w2.Hours
AND w1.Pno = P.Pno;
```

ROUGH WORK

ROUGH WORK