Thursday, September 2, 2004 Roll Number_____

CS3400 Database Systems
Minor Exam I

1. This is a closed book exam. Only writing materials are allowed in the exam room. **No calculators, books, cell phones or any such appliances should be brought into the exam room.** There **will be no rest room break during this exam**.
2. Answer as many questions as possible.
3. Manage your time well; no extra time will be given. The time specified below is the maximum time you are expected to spend in answering a question.
4. Read all the questions very carefully before attempting any question, select and answer the questions to the best of your abilities.
5. No clarifications will be provided during the exam, make your own reasonable assumptions and proceed towards answering the questions.
6. *'Justify your answer'* means: at most three rational statements defending your answer.
7. Answer in the space provided.
8. Write your roll number on all pages of this test booklet and sign the statement below.
9. This test booklet has **eleven** pages.

Questions	Maximum Marks	Maximum Time to Allot (minutes)	Marks Secured
1	25	30	
2	20	15	
3	20	15	
4,5	35	30	
Total	100	90	

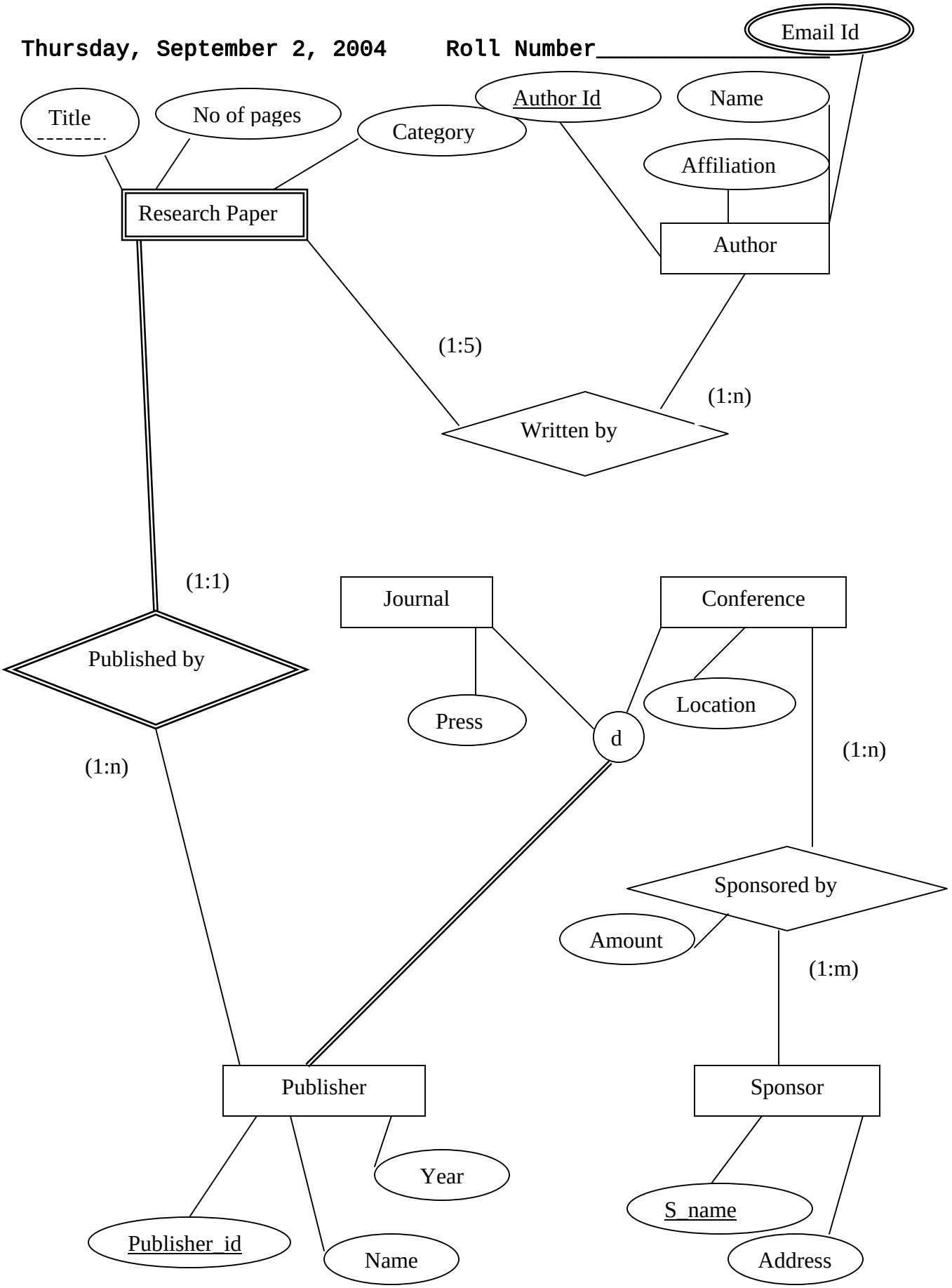
******* Good Luck *******

I. ER Model (25 Marks)

Consider a Research community.

- A research paper has title, Number of pages and Category.
- An Author has unique author id, Name, Affiliation and multiple Email Id's.
- Each publisher has unique id, name and year.
- Publisher can be either conference or journal. For conference we store location where it is conducted. For Journal Press address from which it is getting published is stored.
- A research paper cannot exist without a publisher.
- A Sponsor has unique name and address.
- A research paper can be published by only one publisher and a publisher can publish many research papers.
- An author can write many research papers, A research paper can be written by at least one and at most five authors.
- Many sponsors can sponsor conference and each sponsor can sponsor many conferences. The amount that each sponsor donates for the conference is also kept in track.

1. Draw the ER diagram for above the data requirements. Show all attributes, entity types and relationship types. Show all structural and participation constraints using (min, max) notation. Justify your model.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Publisher_id
Name
S_name
Address

II Mapping of ER Model to Relational Model (20 Marks)

2. Map The given ER model (that you have come up for Question No 1.) to the Relational Data model. List out the rules you have used while mapping.

(1) Author (Autor_id, Name, Affiliation)
(2) Author_contact (Author_id, Email_id)
(3) Publisher (Publisher_id, Name, Year)
(4) Conference (Publisher_id, Location)
(5) Journal (Publisher_id, Press)
(6) Sponsor (S_name, Address)
(7) Research Paper (Publisher_id, Title, no_of_pages, Category)
(8) Author_paper(Publisher_id, Title, Author_id)
(9) Publisher_sponsor (Publisher_id, S_name)

For (1) & (6) the rule is as follows

For each regular entity in the ER schema, create a relation R that includes all the simple attributes of E. Choose one of the key attributes of E as primary key for R.

For Multi-valued attributes (3)

For each multi valued attribute A, create a new relation R that includes an attribute corresponding to A plus the primary key attribute K (as a foreign key in R) of the relation that represents the entity type or relationship type that has A as an attribute.

For Binary relations Written by & sponsored By (8 & 9) The rule is

For each binary relationship type R in the ER schema, identify the relations S and T that correspond to the entity types participating in R.

For M:N relationship b/w S and T:: create a new relation P to represent R, and include as foreign key attributes in P the primary keys of the relations (i.e. of S and T) that represent the participating entity types.

For the Weak Entity type Research Paper (7)

For each weak entity type W in the ER schema with owner entity type E, create a relation R, and include all simple attributes of W as attributes of R, plus the primary key of E.

For Specialization (4, 5 & 6)

Convert Each specialization with m sub-classes {S1, S2 … Sm} and Super class C, where the attributes of C are {k , a1,a2,a3…an} and k is the key, into the following relation schema.

Create a relation L for C with attributes {k, a1, a2, an} and PK(L) = k. Create a relation Li for each subclass Si, 1<= I<=n, with attributes Attrs(Li) = {k}∪ {attributes of Si} and PK(Li) = k.

You can use any of the 4 methods available to map the specialization.

If you have not come up with the correct ER Model, The model you have come up is considered for mapping.

III. Relational Data Model Concepts. (20 Marks)

3. Consider the following database schema.

State each of the errors in the extension given below. Justify your answer.

Student

Roll_no	Name	Year_of_join	Phone_Number
12	Sandhya	1999	040-23531114
15	Sarat	2000	080-23791393
27	Mallik	2001	0592-8593821

Degree_Earned

Roll_no	Degree
12	B.Tech(CSE)
13	B.Tech(Civil)
27	{B.Tech(Mech), M.Tech(CSE)}

Course

Course_no	Course_name	Credits
CS3400	Database Systems	4
CS5405	DWDM	5
CS5400	ADBMS	4
CS3400	Introduction to database Systems	4

Faculty

Faculty_no	FName	LName	Designation
F1	Kamal	Karlapalem	Assoc. Prof
F2	Vikram	NULL	Asst. Prof
F3	Krishna Reddy	Polepalli	Assoc. Prof

Course_Offer

Course_offer_no	Faculty_no	Course_no
C12	F1	CS3400
C14	NULL	CS5400
C15	F2	CS5405
C16	F3	CS5400

The Errors are as follows.

Degree_Earned Relation

Second tuple is having roll number '13' which is not listed in the Student relation

Violating Reference Integrity Constraint – Whenever there is a foreign key (which is referring a unique key of some other relation) then the value of foreign key attribute should be either null or should be one of the values of the unique key attribute.

Tuple Having roll number '27' is having multiple values for the attribute Degree, which is not supported by Relational data model.

Violating domain constraint -- Each attribute A must be an atomic value from the domain dom(A) for that attribute

Course Relation

There are 2 tuples with the same course_no (which is a primary key). This is violating the key constraint

Faculty

The Second tuple is having Null value for ht attribute LName (Which is part of primary key)

Violating Entity –Integrity Constraint

Entity Integrity: The primary key attributes PK of each relation schema $R_i \in S$ cannot have null values any tuple of $r(R_i)$. This is because primary key values are used to identify the individual tuples. $t[PK] \neq$ null for any tuple t in $r(R_i)$

IV. Relational Algebra & Tuple Relational Calculus(35 Marks)

Consider the following Election Database Schema.

Constituency(Constituency_id, Constituency_name, District, No_of_voters)

Party (Party_id, Party_name, Office Address)

Party_Leader(Party_id, Year, Leader_id)

Contestants (Contestant_id, Contestant_name, Age, Qualification, City)

Party_Membership (Contestant_id, Year, Party_id)

Polled_votes (Constituency_id, Contestant_id, Year, No of votes)

The Leader is one of the contestants who is member of that party.

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4. Give Relational Algebra and Tuple calculus Expressions for the following.

   (i) Get all those contestants, name and Address whose age is at least 30 and qualification is “degree”.

Relational Algebra

$$\prod_{\text{Contestant\_name, City}} (\sigma_{\text{(Qualification = 'Degree' and Age >= 30)}} (\text{contestants}))$$

Tuple Calculus

{c.contestant_name, c.city | contestant(c) and c.Qualification = ‘Degree’ and c.Age >= 30 }

   (ii) Get all the contestant names, who contested for the same constituency in which they live and is Leader of the party for which he is representing during that year.

Relational Algebra

$$\prod_{\text{Contestant\_name}}((((\text{Contestants} \bowtie_{\text{(city= Constituency\_name)}} \text{Constituency})$$

* Polled_votes) ⋈ Party_Membership)
(contestant.contestant_id = party_membership.contestant_id and
Polled_votes.year = Party_membership.year)

⋈ Party_Leader)
(Party_Membership.Party_id = Party_Leader.Party_id and
contestants.contestant_id = Leader_id)

Tuple Calculus

{c.name | contestant(c) and ∃x ∃y ∃z ∃w (constituency(x) and
polled_votes(y) and party_membership(z) and Party_leader(w) and
c. city = x. constituency_name and
c.contestant_id = z.contestant_id and
y.year = z.year and
z.Party_id = w.Party_id and
c.contestant_id = w.Leader_id }

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5. Give Relational Algebra Expressions for the following.

(i) List out all the pairs of Constituency name, contestant name in which the contestant contested at least three times.

∏Contestant_name, Constituency_name(σ (
(count(*) >= 3)

Contestant_name, Constituency_name count(*) (contestant *

constituency)))

(ii) List out the district name, party name and the number of the Constituencies in which it has representation for each district in the election year '2004'.

District, Party_name count(constituency_id)

σ(Contestant *Polled_votes* Party_Membership * Party)
(polled_votes.year = 2004)