- The exam is open book. You may also use the class slides. Nothing else is allowed.
- The total number of points is 100.
- Answer all questions on the exam paper itself and in the space provided after each question.
- Do not write your answers before you have them well thought out. A good idea is to use pencil so that you can make corrections and produce a clear manuscript.
- You may use the last 3 white paper sheets as a draft paper. Please do not use any other paper as scratch paper.
- You are not allowed to share books or notes.
- No electronic device is allowed (cell phone, laptop, tablet etc.)

Name:_____

ID Number:_____

STATEMENT

On my honor, I pledge that I will not violate the provision of the NJIT Student Honor Code.

Signature:_____

1	2	3	4	5	Total

QUESTION 1   [15 points]

A car insurance company wants to store information about its customer who own one or more cars and accidents reported by those cars. The insurance company has hired you as a database designer. The requirements that you collected are as follows:

- Customers are characterized by driver_ID (unique), name, address.
- Each customer can own one or more cars.
- Cars are characterized by registration number (unique), model and year.
- A car can participate in one or more accidents.
- Accidents are characterized by report_ID(unique), location and date.
- For every car that participates in an accident, damage amount must be recorded.

Draw an ER diagram that captures this information about the car insurance company assuming that the entity types are CUSTOMER, CAR, and ACCIDENT. Specify also (a) keys, (b) participation constraints (single/double lines) and cardinality ratios (numbers across the diamond boxes) for every relationship type (c) (min, max) constraints on every participation of an entity type into a relationship type (d) roles (if this is necessary).

State clearly any additional constraints you impose. The additional constraints (if any) should not contradict with the collected specifications.

QUESTION 2 [15 points]

In class we have discussed four types of Integrity Constraints: Domain Constraint, Key Constraint, Entity Integrity Constraint and Referential Integrity Constraint.

Suppose that each of the following update operations is applied directly to the COMPANY database, whose schema and instance are shown in Figures 1 and 2 respectively.

Identify all the integrity constraints (if any) that will be violated if we perform the following operations. If a constraint is violated (a) explain briefly (2-3 lines) why this happens, and (b) suggest a reasonable action to be taken for correcting the cause of the violation of the constraint (2 lines).
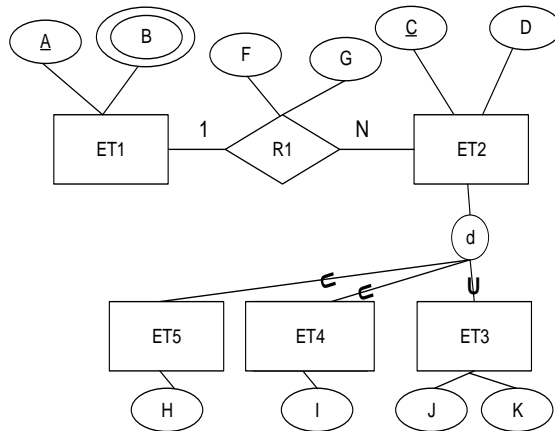
1. Delete the EMPLOYEE tuple(s) with SUPERSSN = '333445555'

2. Update the DNUMBER of the DEPARTMENT tuple(s) with DNAME = 'Research' to 23

3. Delete the PROJECT tuple(s) with PNAME = 'Computerization'
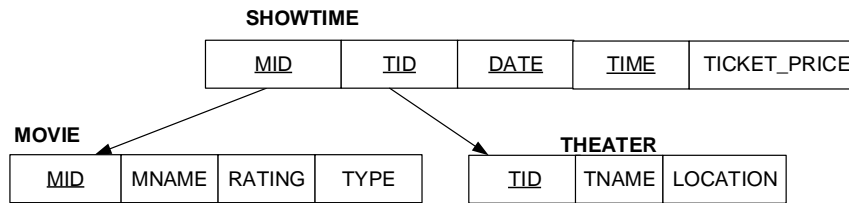
Map the following ER schema into a relational schema.

Specify: (a) relation schemas, (b) primary keys, (c) foreign keys.

Consider the following database schema:

SHOWTIME

MID	TID	DATE	TIME	TICKET_PRICE

MOVIE

MID	MNAME	RATING	TYPE

THEATER

TID	TNAME	LOCATION

The meaning of these relations is straightforward. Primary key attributes are underlined. Thus MID is the primary key for Movies, TID is the primary key for Theater, and attributes MID, TID, DATE and TIME of SHOWTIME together form the primary key of SHOWTIME. Arrows indicate foreign keys. We assume that NULL values are not allowed.
Write the following queries in Relational Algebra.

1. Find the names of the theaters which are playing a movie named 'Johnny English'.

2. Find the MIDs of movies which are played in a theater located in 'New Jersey' but not in any theater located in 'New York'.

3. Find the names of theaters that are playing movies which are of type 'Comedy' and are also playing movies which are of type 'Horror'.

4. Find all MIDs of movies which have a rating of 8 or are playing in a theater located in 'Trenton'.
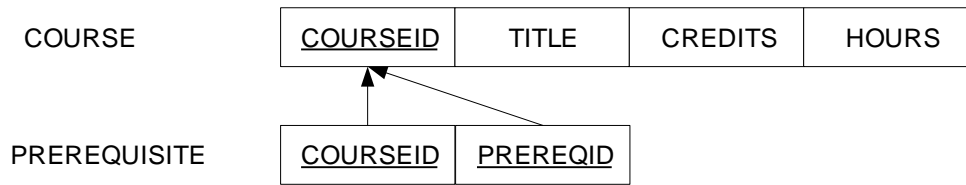
5. Find the names of the movies which are playing in all the theaters located in 'New York'.

6. Find the names of movies which are playing in more than ten theaters.

Write appropriate Data Definition Language SQL statements to declare the following database schema.

COURSE

COURSEID	TITLE	CREDITS	HOURS

PREREQUISITE
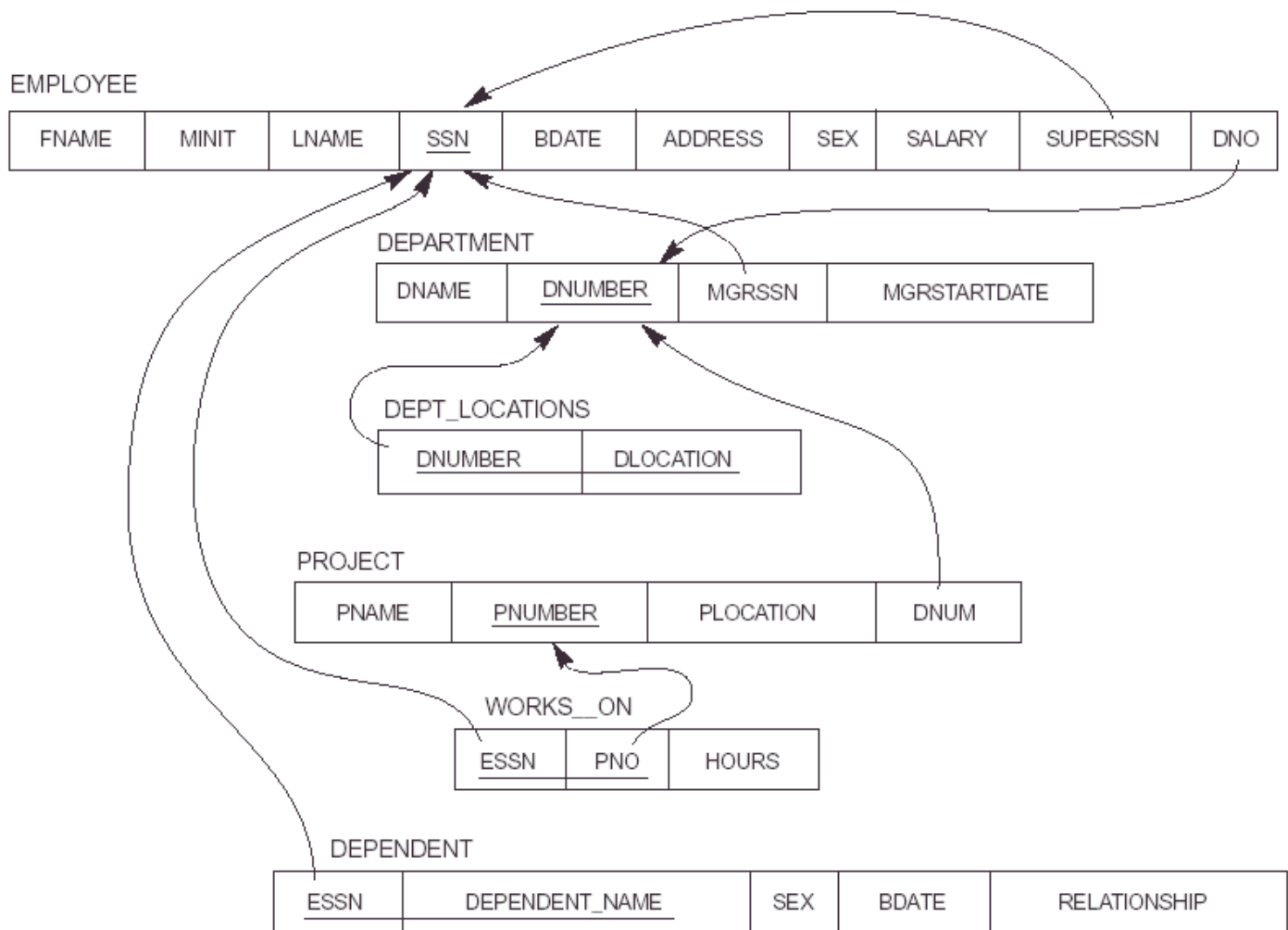
COURSEID	PREREQID

Specify: (a) Tables, attributes, domains, data types, NOT NULL constraints, DEFAULT values (if necessary).
(b) Primary keys
(c) Foreign keys
(d) Reasonable on-delete and on-update referential triggered actions for the foreign keys.

Figure 1: The COMPANY relational database schema.

EMPLOYEE	FNAME	MINIT	LNAME	SSN	BDATE	ADDRESS	SEX	SALARY	SUPERSSN	DNO
	John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5
	Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5
	Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
	Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
	Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5
	Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
	Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
	James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	null	1

DEPT_LOCATIONS	DNUMBER	DLOCATION
	1	Houston
	4	Stafford
	5	Bellaire
	5	Sugarland
	5	Houston

DEPARTMENT	DNAME	DNUMBER	MGRSSN	MGRSTARTDATE
	Research	5	333445555	1988-05-22
	Administration	4	987654321	1995-01-01
	Headquarters	1	888665555	1981-06-19

WORKS_ON	ESSN	PNO	HOURS
	123456789	1	32.5
	123456789	2	7.5
	666884444	3	40.0
	453453453	1	20.0
	453453453	2	20.0
	333445555	2	10.0
	333445555	3	10.0
	333445555	10	10.0
	333445555	20	10.0
	999887777	30	30.0
	999887777	10	10.0
	987987987	10	35.0
	987987987	30	5.0
	987654321	30	20.0
	987654321	20	15.0
	888665555	20	null

PROJECT	PNAME	PNUMBER	PLOCATION	DNUM
	ProductX	1	Bellaire	5
	ProductY	2	Sugarland	5
	ProductZ	3	Houston	5
	Computerization	10	Stafford	4
	Reorganization	20	Houston	1
	Newbenefits	30	Stafford	4

DEPENDENT	ESSN	DEPENDENT_NAME	SEX	BDATE	RELATIONSHIP
	333445555	Alice	F	1986-04-05	DAUGHTER
	333445555	Theodore	M	1983-10-25	SON
	333445555	Joy	F	1958-05-03	SPOUSE
	987654321	Abner	M	1942-02-28	SPOUSE
	123456789	Michael	M	1988-01-04	SON
	123456789	Alice	F	1988-12-30	DAUGHTER
	123456789	Elizabeth	F	1967-05-05	SPOUSE

Figure 2: An instance corresponding to the COMPANY schema.