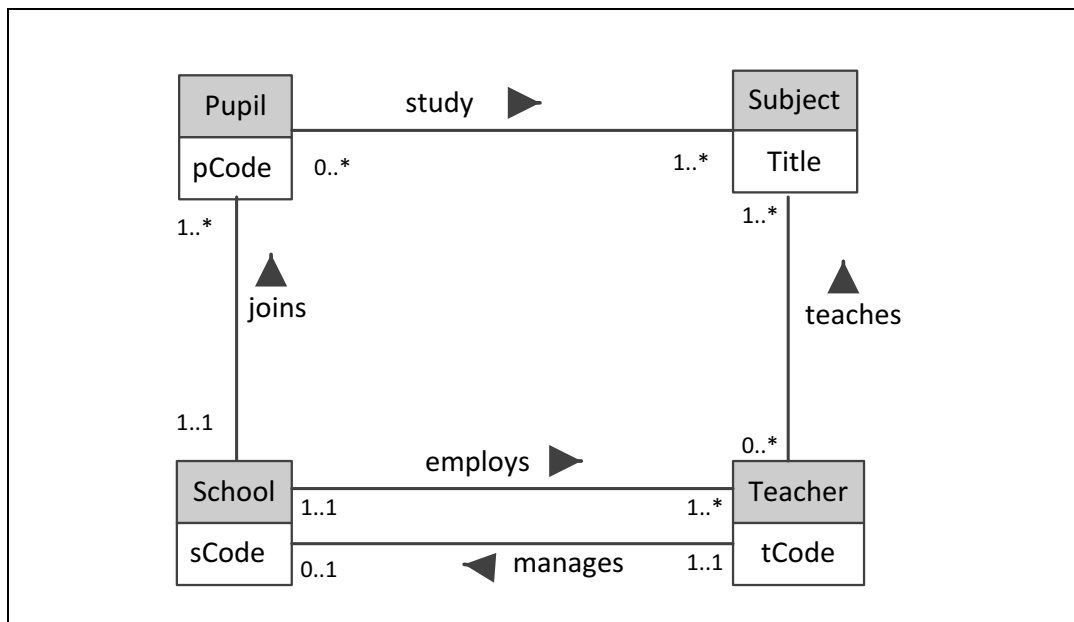


**QUESTION 1 (10 MARKS)**

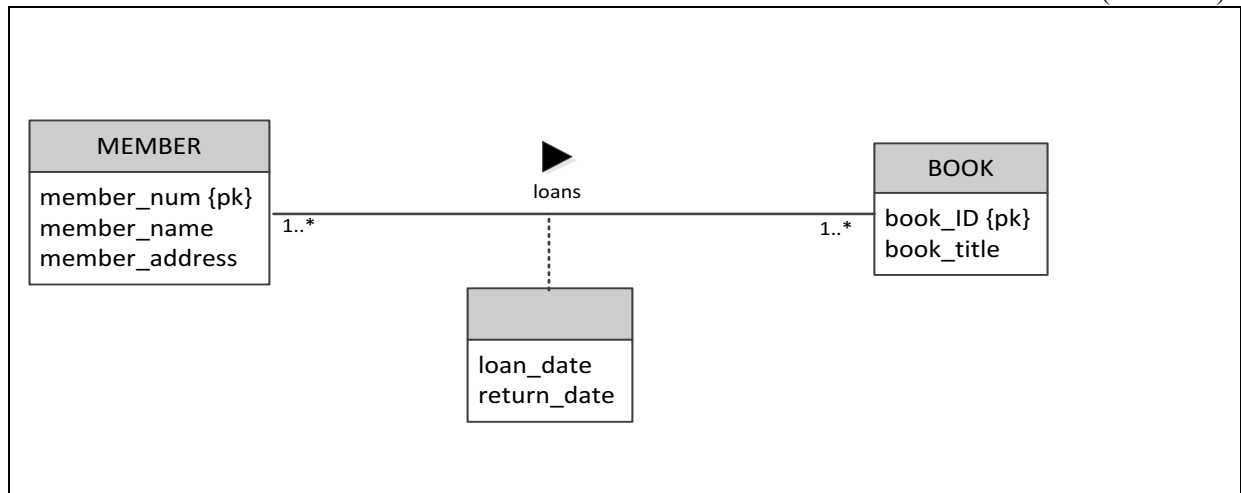
- a) Identify **FIVE (5)** types of attributes and describe each of these attributes. (5 Marks)
- b) Analyze the following conceptual entity relationship diagram (ERD) in **Figure 1**. Determine all possible business rules from the diagram. (5 Marks)

**Figure 1: Conceptual ERD**

## QUESTION 2 (15 MARKS)

a) Convert the Conceptual ERD in **Figure 2** to a Logical ERD.

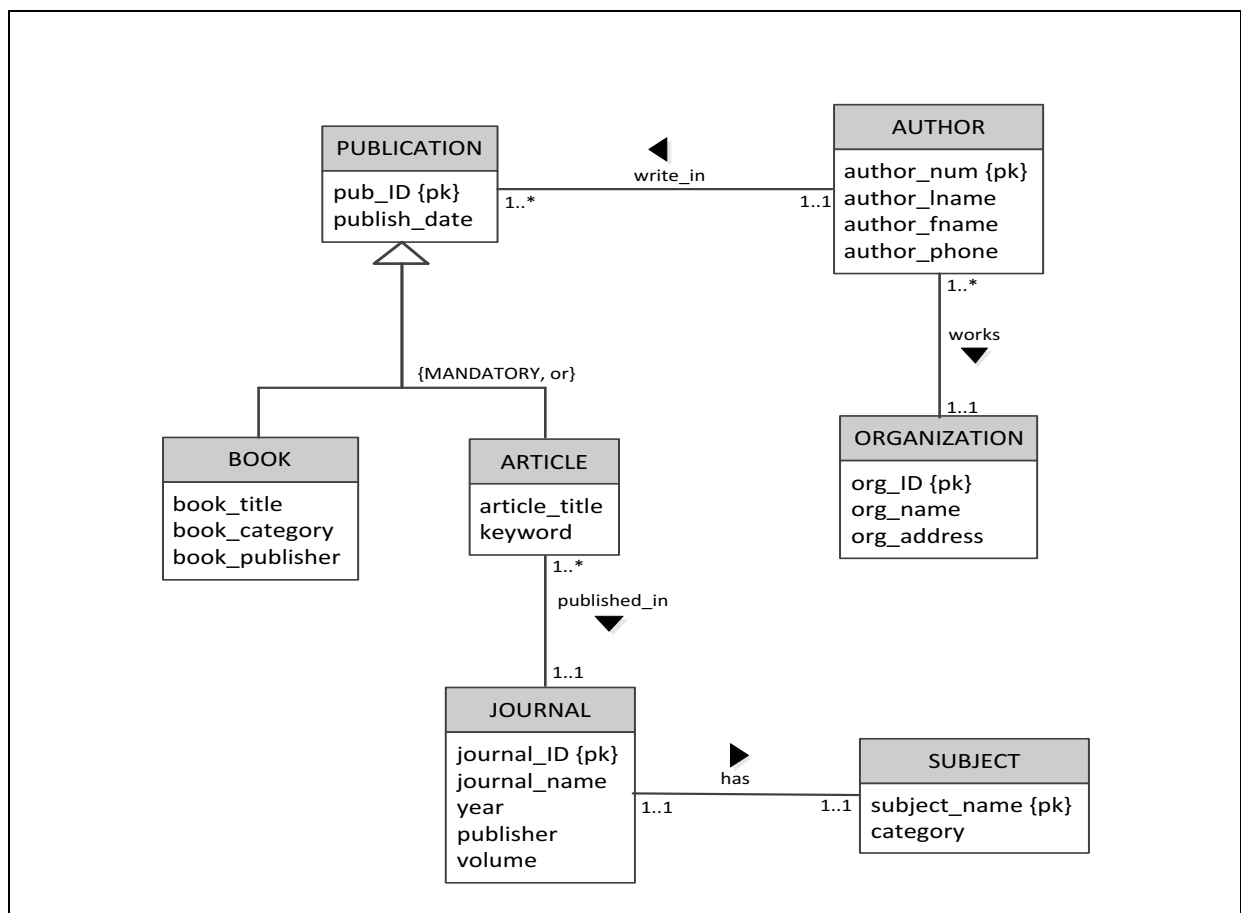
(5 Marks)



**Figure 2:** Conceptual ERD

b) Derive the relation schema from the ERD in **Figure 3**.

(10 Marks)



**Figure 3:** ERD

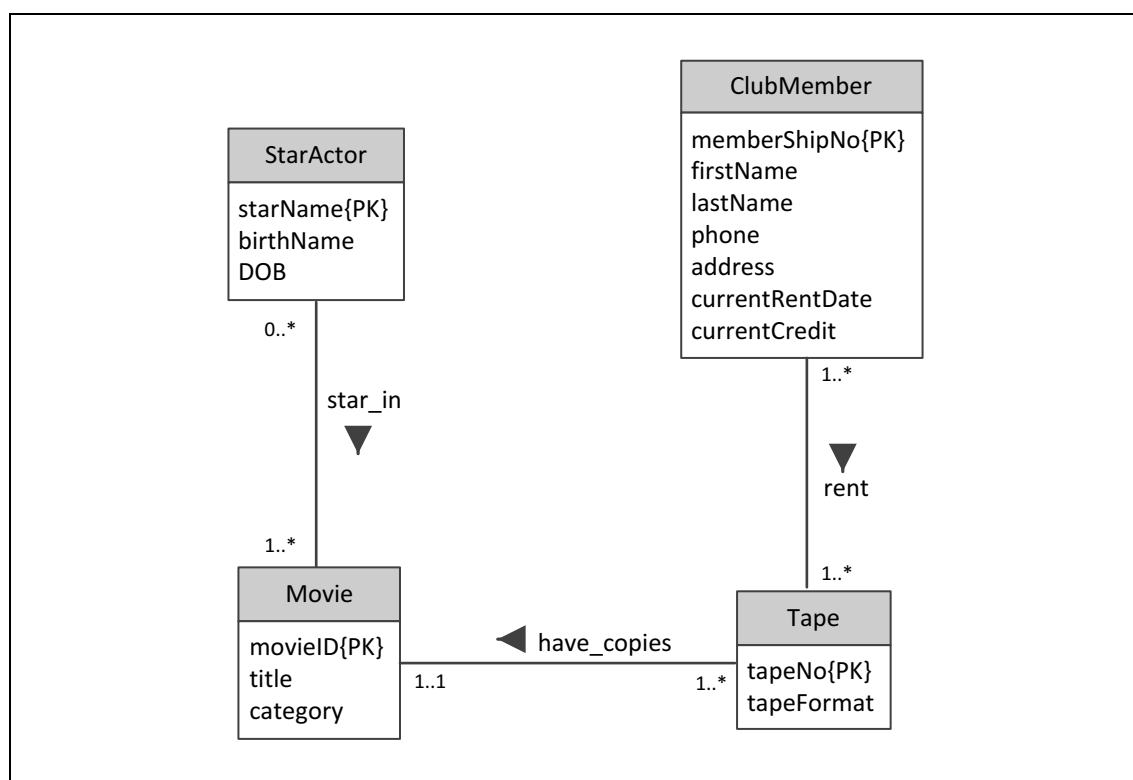
### QUESTION 3 (15 MARKS)

- a) In your opinion, explain **ONE (1)** reason why Enhance Entity Relationship Diagram (EERD) is needed in database design.

(2 Marks)

- b) Based on **Figure 4** and the business rules given, apply EERD concepts. **You may add a relationship and its multiplicity if it is required.**

(5 Marks)



**Figure 4:** Conceptual ERD

Business Rules:

- The majority of the movies are box office and each of the box office movies can be rented for special rate by the club member.
- A club member can rent a maximum of 3 box office movies, and the start rent date and return date must be recorded.

- c) Discuss **TWO (2)** differences between the logical database design and physical database design.

(2 Marks)

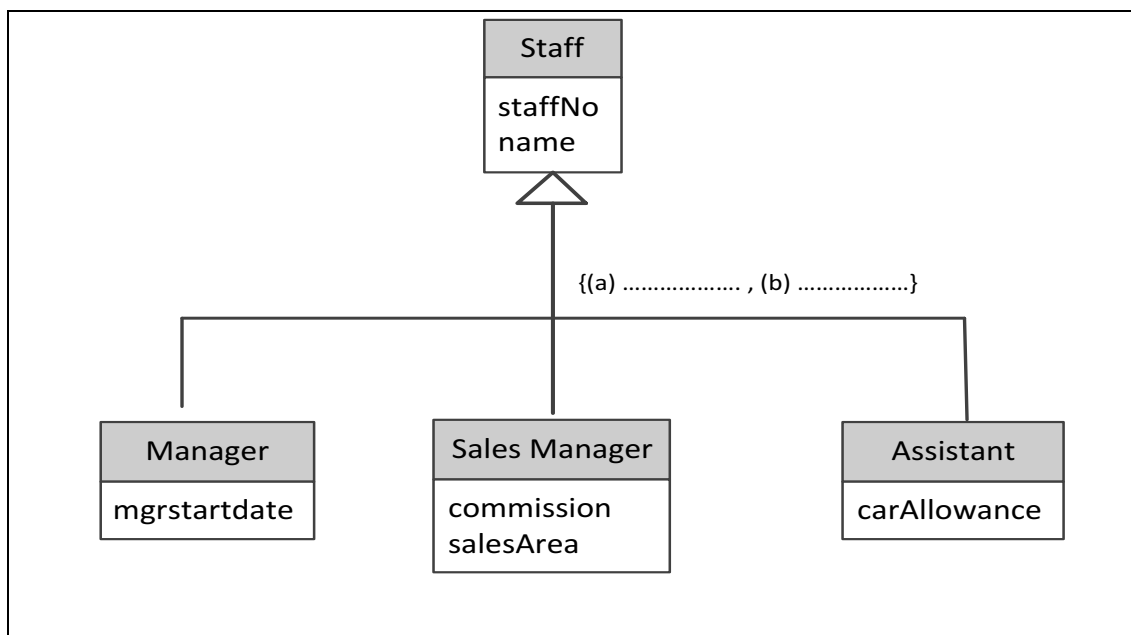
- d) In physical database design, there is a part where designer needs to determine optimal file organizations to store the base relations and the indexes that are required to achieve acceptable performance. State **THREE (3)** factors that may be used to measure efficiency.

(3 Marks)

- e) Based on the given information in **Table 1**, determine the participation and disjoint constraint of the superclass and subclass in **Figure 5**.

**Table 1:** Staff relation

StaffNo	Name	Position	MgrStartDate	Commission	Sales_Area	CarAllowance
PC100	Axelson	Manager	20/11/2016			
PC100	Ponsana	Assistant				300
PC100	Vittinggus	Sales manager	15/09/2016	3000	MEL04	
PC100	Pedersen	Assistant				150
MCM400	Mogensen	Assistant				600
MCM40	Issara	Manager	03/06/2016			
MCM300	Endo	Sales manager	13/01/2014	1500	SEL06	



**Figure 5:** Conceptual ERD

(3 Marks)

#### QUESTION 4 (20 MARKS)

**CUSTOMER** (**customer\_id**, store\_id, first\_name, last\_name, email, address, active)

**RENTAL** (**rental\_id**, rental\_date, inventory\_id, customer\_id, return\_date, staff\_id)

**INVENTORY** (**inventory\_id**, film\_id, store\_id)

**STORE** (**store\_id**, manager\_staff\_id, location)

**STAFF** (**staff\_id**, first\_name, last\_name, address, email, store\_id, salary)

**PAYMENT** (**payment\_id**, customer\_id, staff\_id, rental\_id, amount, payment\_date)

**FILM** (**film\_id**, title, description, rental\_duration, rental\_rate)

Based on the relations above, construct the SQL statements for:

- a) A list of all film titles, rental duration and their rental rate.  
(2 Marks)
- b) A list of all customers' details who are registered to store with the ID of ST\_001.  
(2 Marks)
- c) Insert a new film in the database which has the film ID 'F\_0099', title 'My Neighbour Totoro', description 'Is a 1998 Japanese animated fantasy film by Hayao Miyazaki', rental duration 14 days, and rental rate RM8.  
(2 Marks)
- d) A list of the first name, last name, address, and salary of all store managers.  
(2 Marks)
- e) A list of films which has the word 'girl' in their title and their rental rate. Sort the list by their rental rate in ascending order.  
(2 Marks)
- f) Update the salaries of all store managers to RM8000.  
(2 Marks)

- g) The SQL query below returns an error. Revise the SQL query.

```
SELECT film_id, title, AVG(rental_rate)
FROM FILM
WHERE AVG(rental_rate) < 50
GROUP BY film_id;
```

(2 Marks)

- h) A list of stores which has more than 100 inactive customers (the value in active attribute is either YES or NO).

(3 Marks)

- i) List all the customer\_id, staff\_id, amount and payment date of all paid rentals. Include the staff\_id and first\_name of staff that have yet to handle payment.

(3 Marks)

**QUESTION 5 (15 MARKS)**

- a) What update anomalies occur in the **EMP\_PROJ** relation given in **Table 2**? For each update anomalies identified, provide **ONE (1)** example.

**Table 2: EMP\_PROJ**

Ename	Ssn	Bdate	Address	Dnumber	Dname	Dmgr_ssn
Smith, John B.	123456789	1965-01-09	731 Fondren, Houston, TX	5	Research	333445555
Wong, Franklin T.	333445555	1955-12-08	638 Voss, Houston, TX	5	Research	333445555
Zelaya, Alicia J.	999887777	1968-07-19	3321 Castle, Spring, TX	4	Administration	987654321
Wallace, Jennifer S.	987654321	1941-06-20	291 Berry, Bellaire, TX	4	Administration	987654321
Narayan, Ramesh K.	666884444	1962-09-15	975 FireOak, Humble, TX	5	Research	333445555
English, Joyce A.	453453453	1972-07-31	5631 Rice, Houston, TX	5	Research	333445555
Jabbar, Ahmad V.	987987987	1969-03-29	980 Dallas, Houston, TX	4	Administration	987654321
Borg, James E.	888665555	1937-11-10	450 Stone, Houston, TX	1	Headquarters	888665555

(3 Marks)

- b) Consider the relation schema LOTS shown in **Table 3**, which describes parcels of land for sale in various counties of a state. Suppose that there are two candidate keys: PropertyID and {County, LotNo}; that is, lot numbers are unique only within each county, but PropertyID numbers are unique across counties for the entire state. PropertyID is chosen as the primary key, and it is underlined in **Table 3**.

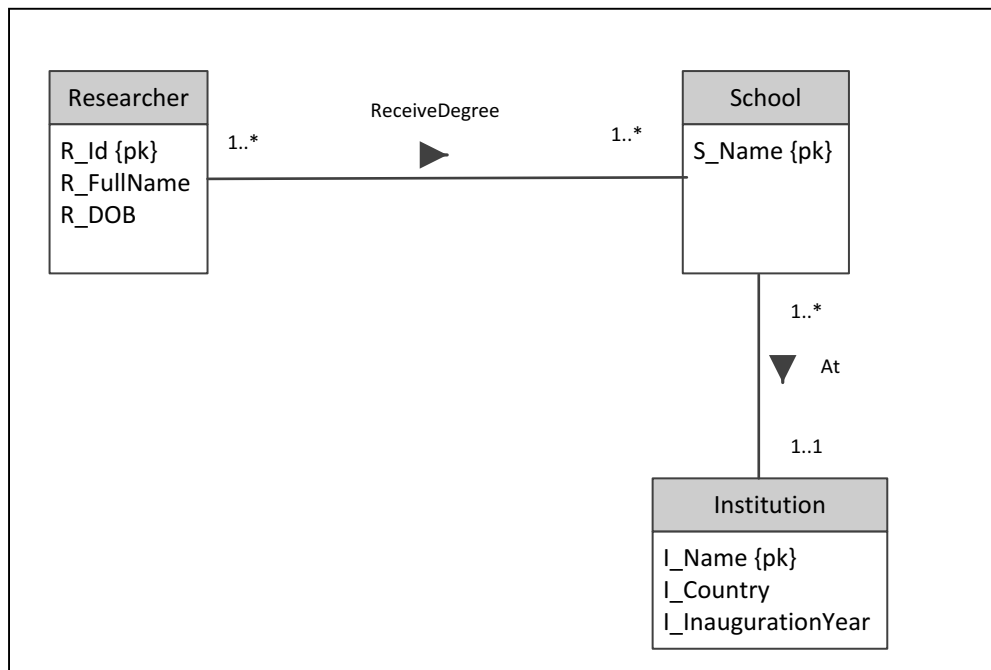
**Table 3: LOTS relation**

<u>PropertyID</u>	County	LotNo	Area (Acre)	Price (USD)	TaxRate
P00121	Shawnee	LN02	0.5	500,000	5.5
P05155	Lyon	LN02	1.2	800,000	7.5
P01215	Shawnee	LN21	0.5	500,000	5.5
P20110	Lyon	LN31	1.4	1,000,000	7.5
P50551	Shawnee	LN52	0.6	600,000	5.5
P11111	Shawnee	LN31	0.7	700,000	5.5
P07123	Lyon	LN25	1.4	1,000,000	7.5

- (i) Identify all functional dependencies for relation LOTS. (2 Marks)
- (ii) Based on the general definition of normal form, in what normal form is LOTS currently in? Justify your answer. (2 Marks)
- (iii) Using the general definition of normal form, Normalize LOTS from its current normal form until the Boyce-Codd Normal Form (BCNF). Show LOTS decomposition for each normal form level. (8 marks)

## CASE STUDY

As a junior database designer, a Project Manager has assigned you to check an initial data model that contains information on researchers, academic school and institutions, as shown in **Figure 6**.



**Figure 6:** Initial ERD

Due to his heavy workload, the Project Manager wants you to redesign the data model based on the business rules given **below**.

- A researcher can either be employed (i.e., not compulsory) as a professor or a lab assistant. They can be identified through his/her identification number. Other information, such as full name, and date of birth also need to be stored. There is additional information of expertise for professors and laboratory name for the lab assistant. There are also three kinds of professor positions: assistant, associate, and full professors.
- For each professor, information on research projects (title, start date, and end date) he/she is involved in, and the total amount of research project money for which he/she was the main researcher need to be stored in the database. Each professor must hold at least one research project at one time and there is a unique project id to determine which research project belongs to that particular of professor.
- For each institution, its name, country, and inauguration year should also be stored. Assume that institution name is unique within a country. There are several schools

that are attached under each institution; however a school only belongs to exactly one institution. Example for the names of schools is School of Law, School of Business, and School of Computing.

- For each researcher, information on his/her highest degree (BSc, MSc or PhD), including who was the main supervisor, the degree name, year graduated and at what school need to be stored. Here, some schools are connected to more than one researcher (i.e., depends on the researcher's highest degree that they were received) while a few researchers has received more than one highest degrees.

a) Re-draw the ERD in **Figure 6** by considering the business rules as given above. Be sure to indicate :

- primary keys (if there's any) .
- multiplicity for every entity in a relationship
- participation constraint for every entity involved in a relationship
- constraint on specialization and generalization (if there's any)

(15 Marks)

b) Derive the relevant of relational schema (s) mapped from your answer in (a). Be sure to indicate all keys (if there's any).

(10 Marks)