SINGAPORE POLYTECHNIC

2020/2021 SEMESTER TWO TEST

DIPLOMA IN INFORMATION TECHNOLOGY
SECOND YEAR FULL TIME

**DATA ENGINEERING** Time allowed: 1.5 Hours

---

Instruction to Candidates

1. This paper comprises **4** questions.
2. This test paper consists of **6** pages (inclusive of cover page).
3. Answer **ALL** questions.
4. All answers should be written in the answer booklet.
5. Start each question on a new page.

1. (a) The following Product table holds details of spectacle frames available in SingPoly Optometry Centre:

**Product**

| Product Code | ProductName | Supplier Number | Model Number | Size | Colour | Quantity |
|---|---|---|---|---|---|---|
| 123456 | Titanium Frame Black | S1111 | IZ241 | 48 | 409 | 10 |
| 123457 | Titanium Frame Chrome | S1111 | IZ241 | 48 | 509 | 5 |
| 123458 | Titanium Frame Black | S1111 | IZ241 | 52 | 409 | 1 |
| 123459 | Titanium Frame Red | S1111 | IZ241 | 52 | 609 | 0 |
| 126666 | Plastic Frame Blue | S1111 | TH20035 | 43 | 212 | 4 |
| 126667 | Plastic Frame Pink | S1111 | TH20035 | 48 | 212 | 3 |
| 128888 | Plastic Frame Pink | S2222 | CZ209 | 48 | 301 | 6 |

| Attribute | Description |
|---|---|
| ProductCode | Unique identifier of a product |
| ProductName | Name of product |
| SupplierNumber | Unique identifier of a supplier |
| ModelNumber | Model number of a spectacle frame. Model numbers are unique within suppliers but different suppliers may use the same model number |
| Size | Size of a spectacle frame |
| Colour | Colour code of a spectacle frame. Different suppliers may use the same colour code |
| Quantity | Quantity of spectacle frame in the store |

(i) List **two** candidate keys for the Product table. (4 marks)

(ii) Which of the two candidate keys stated in (i) would you use as a primary key for the Product table? Explain **two** reasons for your choice. (6 marks)

(iii) If you use ProductName as a primary key, you would violate a relational integrity rule. What is the name of this rule? (2 marks)

(b) Fill in the blanks for the following statements:

(i) A(n) _____ relationship is established when a foreign key in a relation references a primary key within the same relation as the foreign key. (1 mark)

(ii) _____ integrity is violated when a value in the foreign key attribute cannot match a value in its referenced primary key. (1 mark)

(iii) Each cell in a relation can contain only _____value(s). (1 mark)

2. Refer to the Rental relation as follows:

**Rental**

| Rental UnitNo | Bed Rooms | Bath Rooms | Lease Term | Distance | Rent | Owner | Tenant |
|---|---|---|---|---|---|---|---|
| 101 | 4 | 3 | 3 | 0.25 | 2425.00 | Allan | NULL |
| 103 | 3 | 2 | 12 | 3.00 | 1850.00 | Anders | Lee |
| 106 | 6 | 5 | 9 | 1.50 | 5775.00 | Anders | NULL |
| 109 | 2 | 1 | 6 | 0.75 | 525.00 | Kindall | Ali |
| 111 | 4 | 2 | 12 | 2.00 | 1300.00 | Anders | NULL |
| 113 | 2 | 1 | 9 | 1.00 | 675.00 | Allan | Cary |
| 117 | 5 | 3 | 9 | 1.50 | 2875.00 | Allan | NULL |
| 123 | 3 | 2 | 12 | 3.00 | 1000.00 | Anders | NULL |
| 134 | 4 | 2 | 3 | 5.00 | 3400.00 | Kindall | Mil |
| 144 | 1 | 1 | 6 | 2.00 | 575.00 | Kindall | NULL |

**Legend**

| Attribute | Description | Data Type |
|---|---|---|
| RentalUnitNo | Unique number to identify a rental unit | CHAR(3) |
| BedRooms | Number of bedrooms in the rental unit | INTEGER |
| BathRooms | Number of bathrooms in the rental unit | INTEGER |
| LeaseTerm | Lease term of the rental unit in years | INTEGER |
| Distance | Distance in kilometer from the nearest MRT | DECIMAL(4,2) |
| Rent | Amount of rent per month for the rental unit in Singapore dollars | DECIMAL(7,2) |
| Owner | Name of the person who owns the rental unit | VARCHAR(30) |
| Tenant | Name of the tenant who is currently renting the unit. The absence of a value would indicate that the rental unit is still available for renting | VARCHAR(30) |

Note: All attributes are mandatory fields except for Tenant.

(a) Write the SQL statement to display the RentalUnitNo and 'Rent with GST' as column header, the record are sorted in descending order of 'Rent with GST'. GST is computed as 7% of the rent.
Retrieve only those rental units that satisfy **all** the following criteria:
- the unit must have at least 3 bedrooms or it must have at least 2 bathrooms,
- the rent ranges from S$1000, inclusive, to S$3400, inclusive,
- the unit must not be already rented out, and
- the owner's name must begin with A.

(16 marks)

(b) Write an SQL statement to calculate the total amount of rent each owner would get, whether or not the rental unit is rented out. Include only those owners that would get a total amount of more than S$5000 for all the units. Name the total amount of rent as 'Total Rent'. (7 marks)

(c) Write an SQL statement to list the rental unit number and their tenants. If there is no tenant renting the unit, indicate with 'No Tenant'. (3 marks)

(d) The following incorrect SQL statement is written to insert the following new rental unit into the Rental relation. Identify four errors.

| Rental UnitNo | Bed Rooms | Bath Rooms | Lease Term | Distance | Rent | Owner |
|---|---|---|---|---|---|---|
| 211 | 2 | 1 | 4 | 0.4 | 1425.00 | Mike |

```
INSERT Rental ('211','2',1,4,0.4,'1425.00','Mike')
```

(4 marks)

3. Raffles Cove Medical Clinic is planning to develop a database system to manage the appointment booking between patients and doctors, with the following business rules.

- A patient is identified by a unique patient identifier and can make many appointments with one or more doctors in the clinic.
- A doctor is also identified by a unique doctor identifier and can accept appointments with many patients.
- However, each appointment is made with only one doctor and one patient. Doctor and patients' names (in the form of first name followed by last name) are kept, along with the date and time for the appointment.
- Emergency cases do not require an appointment. However, for appointment management purposes, an emergency is entered in the appointment book as "unscheduled" type.
- If an appointment is kept (i.e. the patient turns up for the appointment), it yields a visit with the doctor specified in the appointment. The visit yields a diagnosis and a treatment, along with a visiting time which could be a later time as compared to the appointment time.
- With each visit, the patient's records are to be updated & maintained to provide a patient medical history. The clinic can search the patient's medical history to find out how many patients does the clinic have seen on a specific appointment date.

Draw a single Entity Relationship Diagram (ERD) to model the data requirements for the medical clinic. You are to include the following in your diagram:

- Entity types and their primary key attributes (underline primary keys)
- Relationships with cardinalities and participation constraints
- Generalization hierarchies, if applicable
- Attributes of subtypes or relationships, if applicable

(30 marks)

4. Royal Agency Pte Ltd supplies part-time staffs to hotels in Singapore. The following relation lists the time spent by the agency's staffs working at the various hotels.

**Staff_Contract_Hotel**

| ContractNo | Hotel | Location | Hours | StaffNo | Name |
|---|---|---|---|---|---|
| C1024 | Hilton | Orchard | 16 | 1135 | Smith Jone |
| | | | 24 | 1057 | Celine Wong |
| C1025 | Fullerton | Marina Bay | 28 | 1068 | David Tan |
| | | | 15 | 1135 | Smith Jone |

| Attribute | Description |
|---|---|
| ContractNo | Contract Number – a unique identifier for a contract with a specific hotel |
| Hotel | The name of the hotel that a staff is assigned to. |
| Location | The general location of the hotel |
| Hours | The number of hours that a staff has worked for a particular hotel |
| StaffNo | A unique identifier for a staff |
| Name | The name of a staff |

Using the above relation, answer the following questions:

(a) The Staff_Contract_Hotel relation is susceptible to anomalies. Provide an example for:
   (i) Insert anomaly (4 marks)
   (ii) Delete anomaly. (4 marks)
   (iii) Update anomaly. (4 marks)

(b) Derive the first normal form relation from the given Staff_Contract_Hotel relation. (3 marks)

(c) Derive a set of second normal form relations from the set of first normal form relations produced in (b). (5 marks)

(d) Derive a set of third normal form relations from the set of second normal form relations produced in (c). Show the 3NF relations in relational heading format. (5 marks)

**- End of Paper -**