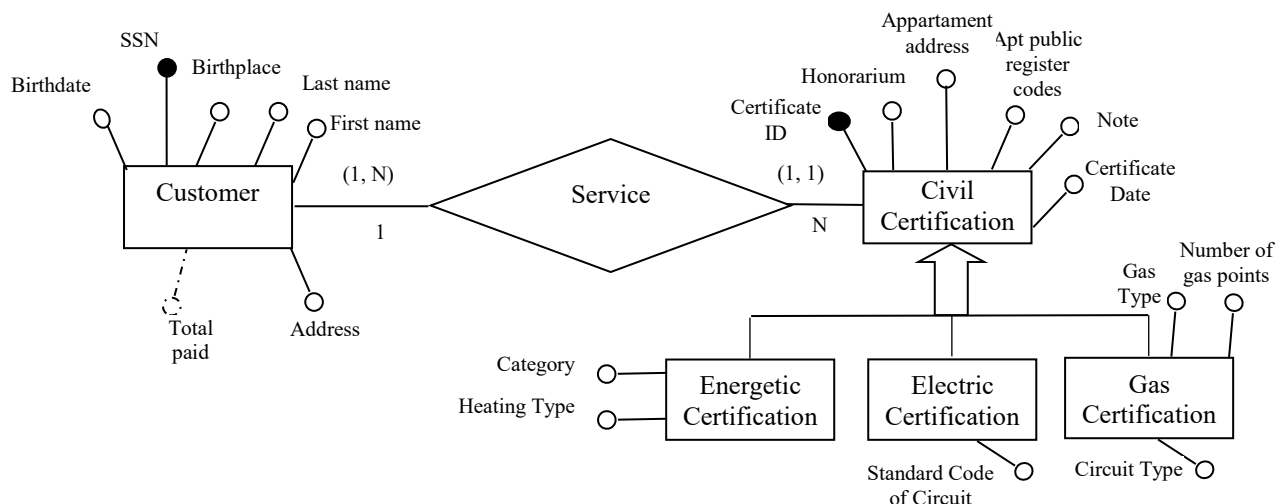


First and Last Name:

Matricola/Alias:

(Write in the space below each exercise. If needed, you can also use the page's rear. No other sheets will be accepted other than these.)

Given the following conceptual schema of a civil engineering firm's database:



The database stores data of the latest 5 years, during which the firm issues about 1.000 civil certifications, for a total of about 500 customers (on average each customer requests 2 certificates in 5 years). Moreover, 40% of certifications are energetic, 30% for electric circuit, and 20% for gas circuit. The operations to be executed on this database are 10, among which the 2 most frequent ones are:

OP1) New certificate request (from what said, only 50% of cases is for a new customer).

OP2) Monthly print of a report with customers' data, and the Total amount paid for certificates.

1. **Exercise1 (score 9 out of 30)** – Develop the workload (Volume, Operation, and Access tables), and based on it, restructure the conceptual schema, evaluating whether to keep or to eliminate the redundant attribute *TotalPaid*. Moreover, remove the generalization hierarchy, motivating the strategy chosen for the elimination.

Exercise2 (score 4 out of 30) – By applying mapping rules to the restructured schema of exercise 1, design the logic relational schema (avoiding redundant tables), graphically showing foreign keys and primary keys.

Exercise3 (score 5 out of 30) – Translate the schema of exercise 2 in the DDL of SQL, handling possible violations of referential integrity constraints through proper compensation actions.

Exercise4 (score 6 out of 30) – Write a query in Relational Algebra to extract the data of customers that have requested at least 2 certificates in the last 5 years.

Exercise5 (score 6 out of 30) – Rewrite the query of exercise 4 by using JDBC. In particular, given an integer X in input, extract the data of customers that have requested at least X certificates in the last 5 years, by showing the number of requests for each customer.