IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE

# EXAMINATIONS 2016

BEng Honours Degree in Computing Part I
MEng Honours Degrees in Computing Part I
for Internal Students of the Imperial College of Science, Technology and Medicine

*This paper is also taken for the relevant examinations for the Associateship of the City and Guilds of London Institute*

## PAPER C130

## DATABASES

Friday 29 April 2016, 10:00
Duration: 80 minutes

*Answer ALL TWO questions*

Paper contains 2 questions
Calculators not required

1 a The following relations model a bank example:

**branch** (branch_name, branch_city)

**customer** (customer_name, customer_street, customer_city)

**loan** (loan_number, branch_name, amount)

branch_name references branch.branch_name

**borrower** (customer_name, loan_number)

customer_name references customer.customer_name

loan_number references loan.loan_number

**account** (account_number, branch_name, balance)

branch_name references branch.branch_name

**depositor** (customer_name, account_number)

customer_name references customer.customer_name

account_number references account.account_number

A bank has several branches (branch). Customers (customer) can have an account (account) or can take loans (loan), meaning they borrow money from the branch. Both account and loan are associated with a branch (branch_name as foreign key in the tables account and loan). The table depositor connects the customer with an account and the borrower table does the same, i.e., it connects the borrower with the loan.

Given these relations, for each question below, write the according SQL query:

i) Print the names of all borrowers and the amount of their loan.

ii) Find all customers (return the customer_name only) of the bank who have an account but not a loan. Use **EXCEPT** for this query.

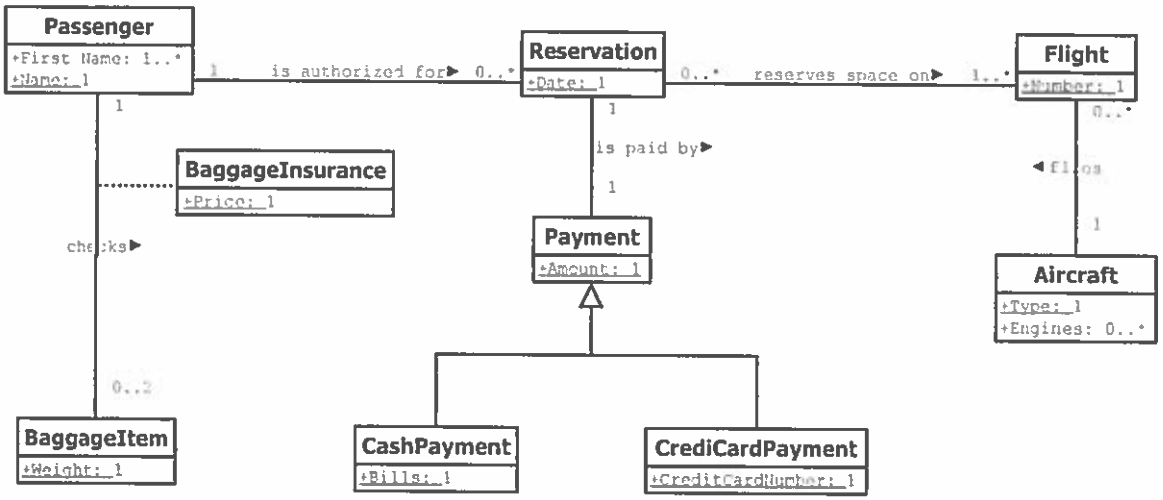
iii) Find the names of all branches with customers who have a loan from the bank and who live in London.

iv) Add up the amounts of all loans and print the result per city (where the customer lives, not where the branch is located).

v) Find all customers who have both an account and also a loan.

*All questions carry equal weight.*

b Given the following E-R Model:




Write the equivalent relational model including table names, column names, primary keys (underlined), foreign keys as well as triggers, e.g.:

table(column1, column2)

column2 **references** othertable.column3 **on delete cascade**

2 a Suppose that we decompose the schema $R = (A, B, C, D, E)$ into $(A, D)$, $(A, B)$, $(B, E)$, $(C, D, E)$ and $(A, E)$.

Show that this decomposition is a lossless-join decomposition if the following set F of functional dependencies holds:

$$A \rightarrow C$$
$$B \rightarrow C$$
$$C \rightarrow D$$
$$DE \rightarrow C$$
$$CE \rightarrow A$$

b Decompose the relation $R = (A, B, C, D, E, F, G, H, I, J)$ into the third normal form (3NF) based on the following set of functional dependencies:

$$AB \rightarrow C$$
$$A \rightarrow DE$$
$$B \rightarrow F$$

$$F \rightarrow GH$$
$$D \rightarrow IJ$$

c Given the relation (A, B, C), using the functional dependencies:

$$A \rightarrow BC$$
$$B \rightarrow C$$
$$A \rightarrow B$$
$$AB \rightarrow C$$

compute a canonical cover.

d Given the relation R(A B C D E), decompose it so it satisfies BCNF (if necessary) based on the following functional dependencies:

$$BC \rightarrow D$$
$$D \rightarrow E$$
$$A \rightarrow C$$
$$E \rightarrow B$$

*The four parts carry equal marks.*