

Written test of FRS 12/1/2021– Full Test

Duration of test: 120 minutes

1. Given the following regular expression:

$$(a + b + c^*); d$$

- a. show the Labelled Transition System associated to the term by the operational semantics;
- b. show the inference of all transitions **that start from the initial state**.
- c. show the denotational semantics of the expression.

2. Given the following CCS term:

$$a.nil \mid (c.nil + \bar{a}.b.d.nil) \setminus \{c, d\}$$

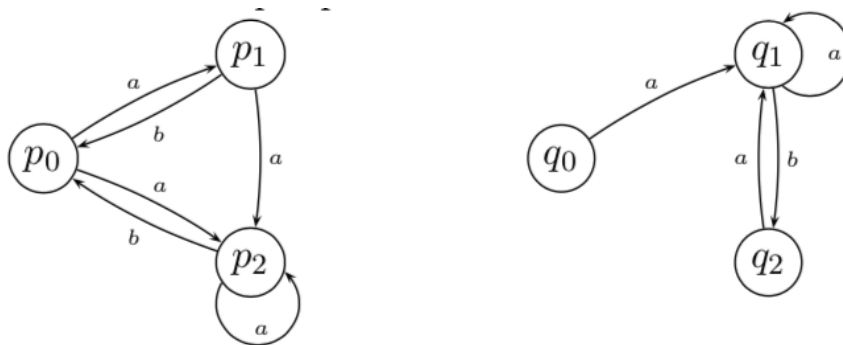
- a. show the Labelled Transition System associated to the term by the operational semantics;
- b. show the inference of all transitions **that start from the initial state**.

3. Given the following term using the *multiparty synchronization* operator:

$$(a.a.nil) \parallel [a] \parallel (b.a.nil) \parallel [a] \parallel (a.nil)$$

Show the Labelled Transition System associated to the term by the operational semantics.

4. Given the following Labelled Transition Systems, say if they are strong bisimilar, and explain why they are or are not equivalent.



5. Write a CCS term modelling a communication scenario where:
- a. the *Sender* sends three messages to a *Receiver* via a *Forwarder* that duplicates the messages;
 - b. given a message received from the *Sender*, the *Forwarder* sends two messages to the *Receiver* and then restarts in order to forward another message;
 - c. the *Receiver* receives the six messages from the *Medium*.