1995 Paper 8 Question 4

Concurrency Theory

Explain how the relation of *observational congruence* ($=$) between CCS agents is defined in terms of observation equivalence ($\approx$). [2 marks]

Say that an agent *can deadlock* if it can perform a sequence of actions to become an agent observationally congruent to 0. For any agent P, show that $P = 0$ if and only if P can do no action. Hence write down a process logic proposition Φ such that P satisfies Φ if and only if P can deadlock. [6 marks]

Let

$$C \stackrel{def}{=} g_0.g_1.p_0.p_1.C \qquad D \stackrel{def}{=} g_1.g_0.p_1.p_0.D$$
$$S_0 \stackrel{def}{=} \overline{g}_0.\overline{p}_0.S_0 \qquad S_1 \stackrel{def}{=} \overline{g}_1.\overline{p}_1.S_1$$

For each of the following agents, determine whether or not it can deadlock:

(a) $(C|C|S_0|S_1) \setminus \{g_0, p_0, g_1, p_1\}$

(b) $(C|D|S_0|S_1) \setminus \{g_0, p_0, g_1, p_1\}$ [5 marks]

Prove that $T \approx 0$, where $T \stackrel{def}{=} \tau.T$. Hence, or otherwise, show that it is possible for an agent that can deadlock to be observationally congruent to one that cannot deadlock. [7 marks]