Topics in Concurrency

(a) Carefully state and prove Tarski’s fixed-point theorem for the maximum fixed point $\nu X.\varphi(X)$ of a monotonic function $\varphi$ on the powerset $\mathcal{P}(A)$ of a set $A$. [6 marks]

(b) Let $S \subseteq A$. Prove

$$S \subseteq \nu X.\varphi(X) \iff S \subseteq \varphi(\nu X.(S \cup \varphi(X)))$$

[7 marks]

(c) Describe the syntax and semantics of the modal mu-calculus. Describe a model checking algorithm which uses the fact in part (b) to decide whether an assertion of the modal mu-calculus holds of a state in a finite transition system. [7 marks]