

## 2007 Paper 7 Question 7

### Specification and Verification II

- (a) Explain the use of the following when representing circuits in logic:
- (i) higher-order variables; [2 marks]
  - (ii) conjunction ( $\wedge$ ); [2 marks]
  - (iii) existential quantification ( $\exists$ ). [2 marks]
- (b) Describe a representation of binary words in logic and define a function that maps a word to the natural number it encodes in binary. [2 marks]
- (c) Describe how the following components are modelled in higher-order logic:
- (i) unit-delay; [2 marks]
  - (ii) clocked, edge-triggered D-type register. [2 marks]
- (d) Let  $[t, t']$  denote the closed interval starting at  $t$  and ending at  $t'$  ( $t \leq t'$  and both  $t$  and  $t'$  are included in the interval). Give definitions in higher-order logic of the predicates
- (i) Stable
  - (ii) Odd
- where: **Stable**  $f(t, t')$  is true if and only if the value of  $f$  is constant on the interval  $[t, t']$  and **Odd**  $f(t, t')$  is true if and only if  $f$  is true an odd number of times in the interval  $[t, t']$ . [2 + 4 marks]
- (e) Contrast the simple switch model of transistors with the difference switching model. [2 marks]