

2006 Paper 9 Question 15

Specification and Verification II

A JK flip-flop has inputs J, K and an output Q, which is driven by a stored value, and behaviour specified by the following table.

J	K	Q	Q _{next}
0	0	0	0
0	0	1	1
0	1	X	0
1	0	X	1
1	1	0	1
1	1	1	0

Assume that the stored value is initially 0.

- (a) Describe the sequence of outputs on Q if the J and K inputs are always 1. [2 marks]
- (b) Define a predicate JK such that $JK(j, k, q)$ models the behaviour of a JK flip-flop. Describe and justify the logical type of JK. [6 marks]
- (c) Write down a formal specification of a device COUNT such that the output at time t is $t \bmod 4$. [2 marks]
- (d) Design an implementation of COUNT using JK flip-flops, describe how it works and draw a diagram of your design. [4 marks]
- (e) How you would prove that your design meets its specification? [6 marks]