COMPUTER SCIENCE TRIPOS Part IB – 2016 – Paper 5

1 Computer Design (SWM)

Below is a functionally and syntactically correct mysterious module written in SystemVerilog.

typedef enum { opNone, opIn, opOut } operationT;

module mystery
# (parameter depth, parameter width)
(
input clk,
input rst,
input operationT op,
input logic [width-1:0] dataIn,
output logic [width-1:0] dataOut,
output logic empty,
output logic full,
output logic error);

logic [width-1:0] mem[depth-1:0];
reg [clog2(depth-1)+1:0] head;
// where $clog2(x) = ceiling(log_base_2(x))

always_comb
begin
full = head>=depth;
empty = head==0;
error = ((op==opIn) && full) || ((op==opOut) && empty);
dataOut = empty ? -1 : mem[head-1];
end

always @(posedge clk)
if(rst)
head <= 0;
else
if(!error)
case (op)
opIn: begin head <= head+1; mem[head] <= dataIn; end
opOut: head <= head-1;
endcase // case (op)
endmodule

(a) What is the function of the mystery module? Include in your answer the behaviour when the module is full (full==1) or empty (empty==1). What does dataOut output? What does input op do? [8 marks]

(b) What is production test and how does it differ from functional test? [2 marks]

(c) What are the key challenges in functionally testing the mystery module? [5 marks]

(d) What are the challenges in undertaking a production test of the mystery module and how do these challenges compare with those for functional test? [5 marks]