1 Computer Design (SWM)

A novice SystemVerilog programmer has written the following decimal counter module which should zero the `decimal_count` on reset and then, when enabled, increment modulo 10 the `decimal_count` on every positive clock edge.

```verilog
module count_decimal_wrong(
    input logic clk;
    input logic reset;
    input logic enable;
    output logic decimal_count);

always_comb @(posedge clk or reset)
    if(enable)
        begin
            decimal_count = decimal_count+1;
            if(decimal_count>9)
                decimal_count = 0;
        end
    elsif(reset)
        decimal_count = 0;

endmodule // count_decimal_wrong
```

(a) What bugs exist in the code and how can they be rectified? [10 marks]

(b) SystemVerilog synthesis tools use a Boolean optimiser to simplify the implementation logic.

(i) Why are don’t care terms useful for Boolean optimisation? [3 marks]

(ii) How could the SystemVerilog be modified to introduce don’t care terms for unreachable states above 9? [3 marks]

(iii) For a modern FPGA with 6-input look-up tables (LUTs), will Boolean optimisation result in fewer resources being used for the corrected `count_decimal`? Justify your answer. [4 marks]