**Vending Machine Design and Simulation using Verilog**

`timescale 1ns / 1ps

module vending\_machine (

input clk,

input reset,

input [3:0] money\_in, // Money inserted (1 to 15)

input [2:0] product\_code, // Product selection (3-bit code)

output reg dispense,

output reg [3:0] change

);

// Product prices

reg [3:0] product\_price;

always @(\*) begin

case (product\_code)

3'b000: product\_price = 4; // Product A = ₹4

3'b001: product\_price = 5; // Product B = ₹5

3'b010: product\_price = 7; // Product C = ₹7

3'b011: product\_price = 3; // Product D = ₹3

default: product\_price = 15; // Invalid or out of stock

endcase

end

always @(posedge clk or posedge reset) begin

if (reset) begin

dispense <= 0;

change <= 0;

end else begin

if (money\_in >= product\_price) begin

dispense <= 1;

change <= money\_in - product\_price;

end else begin

dispense <= 0;

change <= money\_in; // Return all money if not enough

end

end

end

**Testbench:**

`timescale 1ns / 1ps

module tb\_vending\_machine;

reg clk;

reg reset;

reg [3:0] money\_in;

reg [2:0] product\_code;

wire dispense;

wire [3:0] change;

// Instantiate the DUT

vending\_machine uut (

.clk(clk),

.reset(reset),

.money\_in(money\_in),

.product\_code(product\_code),

.dispense(dispense),

.change(change)

);

// Clock generation

always #5 clk = ~clk;

initial begin

$display("\n VENDING MACHINE TEST STARTED \n");

clk = 0;

reset = 1;

#10 reset = 0;

// ---------- TEST CASE 1 ----------

$display("Test Case 1: Buy Product A (Rs.4) with Rs.5");

money\_in = 5;

product\_code = 3'b000; // Product A

#10;

$display("Dispensed: %b, Change Returned: Rs.%0d\n", dispense,change);

// ---------- TEST CASE 2 ----------

$display("Test Case 2: Buy Product C (Rs.7) with Rs.10");

money\_in = 10;

product\_code = 3'b010; // Product C

#10;

$display("Dispensed: %b, Change Returned: Rs.%0d\n", dispense,change);

// ---------- TEST CASE 3 ----------

$display("Test Case 3: Buy Product D (Rs.3) with Rs.2 - Not Enough Money");

money\_in = 2;

product\_code = 3'b011; // Product D

#10;

$display("Dispensed: %b, Change Returned: Rs.%0d\n", dispense, change);

// ---------- TEST CASE 4 ----------

$display("Test Case 4: Invalid Product Code with Rs.8");

money\_in = 8;

product\_code = 3'b111; // Invalid

#10;

$display("Dispensed: %b, Change Returned: Rs.%0d\n", dispense,change);

$display(" VENDING MACHINE TEST ENDED \n");

$stop;

end

endmodule