Indian Institute of Technology Kharagpur

AUTUMN Semester, 2019
COMPUTER SCIENCE AND ENGINEERING

Computer Organization Laboratory

Laboratory Test–1 (Version–1)

Full Marks: 20

Time allowed: 2 hours

INSTRUCTIONS: Every student should make one submission in the form of a single zipped folder containing your MIPS source code file, and your Verilog source code files(s) and Verilog testbench. Name your submitted zipped folder as `LT_1_Ver_1_<Roll_no>.zip`. Inside each submitted source and testbench files, there should be a clear header describing the name and roll number of the submitting student. Liberally comment your code to improve its comprehensibility.

1. [**Sum of Hexadecimal Digits Calculation Circuit**] Recall that the hexadecimal representation of an unsigned binary integer can be conveniently obtained by considering 4-bit nibbles of the binary representation, and replacing each of them by their hexadecimal equivalents. Design (using Verilog), synthesize and simulate (using a proper Verilog testbench) a **sum of hexadecimal digit calculation circuit for 32-bit unsigned integers**. As an example, the sum of digits of the 16-bit unsigned hexadecimal integer `0xa1fb` is 37. In every clock cycle, the circuit reads four bits at a time of an 32-bit input integer, and keeps on updating the sum of the equivalent hexadecimal digits read so far in an 7-bit register (an 7-bit register is sufficient to hold the sum of eight hexadecimal digits). The calculation ends after eight clock cycles. The interface of your design should be:
`module sum_of_hex_digits_ckt (input clk, input rst, input [31:0] num, output reg [6:0] sum_of_hex_digits);`. (10 marks)

2. [**Pair finding**] Write a complete MIPS-32 program which considers an unsorted array A containing sixteen integers (both positive and negative) with the array entries being provided as user inputs. In addition, user also supplies an integer x. Your program should find every pair of elements in array A whose sum is x. Print those pair(s) (possibility to have multiple pair, no pairs etc) on the console with a proper message. (10 marks)
