Indian Institute of Engineering Science and Technology, Shibpur

BTech (CST) 4th Semester Mid Semester Examination, April 2021

Computer Architecture and Organization I (CS-2202)

Full marks: 30 Time: 45 Minutes

Answer all questions

1. Consider a single-address 32-bit microprocessor with 32-bit address bus and 32-bit data bus. Its instructions composed of 1-byte opcode and 3-byte operand address. 10 (3+1+2+4)

a) How many bits are needed for the PC, DR, AR, and IR of the microprocessor?

b) What is the maximum memory address space that the microprocessor can access directly if a `16-bit memory module' is interfaced with the microprocessor ?

c) Write micro-programs for the instructions LOAD X and STORE X of the microprocessor.

d) The microprocessor executes instructions to load data (opcode 01h) to accumulator from memory location AB000000h and then store (opcode 02h) it to AB000001h. Show the contents of PC, DR, AR and IR during these operations.

2a) Show a logic design with CSAs that performs high speed addition of six 32-bit numbers. 4

b) Given y = 0101 (multiplicand) and x = 1010 (multiplier) in 2's complement representation. Show the computation of product $p = y * x$ following Booth's algorithm and find the number of additions/subtractions needed. If y = 1010 (multiplicand) and x = 0101 (multiplier), then how many additions/subtractions are needed to get the product p following Booth's algorithm? 6

3a) A CPU consists of four general purpose registers R0, R1, R2, and R3. Show a logic diagram that realizes implementation of data movement instruction MOVE Rx, Ry; for all Rx and Ry belong to the set of general purpose registers. 4

b) For a micro-programmed control unit (CU), implementing horizontal micro-instruction format, the micro-instructions stored in control memory have width of 24-bit. Each micro-instruction is divided into 3 fields: a control field of 13-bit, branch address field (A) and condition select field (S) to select 8 status bits that are input to the MUX of the CU. 6

i) How many bits are there in the A and S?

ii) Find out the number of words in the control memory and the number different control signals (micro-operations) considered in the design.

iii) Show block diagram of this micro-programmed control unit.