**Date:**

**Ahsanullah University of Science and Technology**

Department of Computer Science and Engineering

Third Year, First Semester Clearance/ Improvement/ Carry Over Examination, Fall 2015

Course No: **CSE 3109** Course Title: **Digital System Design**

Time: 3 Hours Full Marks: 70

**[ There are 7(Seven) questions. Answer any 5(Five) questions.]**

**[*Marks allotted are indicated in the right margin within ‘[ ]’.*]**

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| --- | --- | --- |
| 1.a) | What is Register? What are the differences between SRAM and DRAM? | [4] |
| b) | Describe the architecture of SAP-2. | [6] |
| c) | A combinational circuit is defined by the functions:  F1(A,B,C) = ∑ (3, 5, 6, 7)  F2(A,B,C) = ∑ (0, 2, 4, 7)  Implement the circuit with a PLA having three inputs, four product terms, and two outputs. | [4] |
| 2.a) | What is Arithmetic Logic Unit? | [2] |
| b) | What is PLA? What are the differences between PLA and ROM? | [4] |
| c) | What is Booth’s algorithm? Explain with example. | [4] |
| d) | Show the multiplication of the following 6 bit numbers using Modified Booth’s algorithm:  X= 10 Y = -16 | [4] |
| 3.a) | Draw the ADD and OUT routines of SAP-1 and their fetch and execution timing diagram. | [4] |
| b) | Translate the following program into SAP-I machine language.   |  |  | | --- | --- | | Address | Instruction | | 0H | LDA 9H | | 1H | ADD AH | | 2H | ADD BH | | 3H | SUB CH | | 4H | OUT | | 5H | HLT | | 9H | 01H | | AH | 02H | | BH | 03H | | CH | 04H | | [5] |
| c) | Middle C on a piano has a frequency of 261.63 Hz. Bit 5 of port 4 is connected to an amplifier which drives a loudspeaker. Write a program for SAP-2 that sends middle C to the loudspeaker. | [5] |
| 4.a) | What is Ring Counter? Draw the symbol and clock and timing signals of a Ring Counter. | [3] |
| b) | Design a 4-bit binary counter by using J-K flip flops. | [4] |
| c) | Deign an arithmetic circuit with two selection variables S1 and S0, that generates the following arithmetic operations. Draw the logic diagram of one typical stage.   |  |  |  |  | | --- | --- | --- | --- | | S1 | S0 | Cin = 0 | Cin = 1 | | 0 | 0 | F = A | F = A + 1 | | 0 | 1 | F = A – B – 1 | F = A – B | | 1 | 0 | F = B – A – 1 | F = B – A | | 1 | 1 | F = A + B | F = A + B +1 | | [7] |
| 5. | The register configuration and flow chart of a digital system that multiplies two unsigned binary numbers by repeated addition method is shown in **Figure 1**.  **Figure 1 :** Multiplication by successive addition.  **B**  **A**  Initial state  x = 1  qm =1  Multiplicand Multiplier  P 0 00  Control  Logic  qm  **P**  A  = 0 x  Product  ≠ 0  P P+B  A A-1 |  |
| a) | Let A = 0100 and B = 0011. Going through the steps in the flowchart, show that the system returns to the initial state, with register P having the product 1100. | [4] |
| b) | Draw a state diagram for the control and list the register transfers to be executed in each control state. | [5] |
| c) | Draw the block diagram of the data-processor part. | [5] |
| 6.a) | What is the difference between hard-wired control and microprogram control? What are the advantage and disadvantage in each method? | [4] |
| b) | The straight binary subtraction F = A – B produces a correct difference if A ≥ B. What would be the result if A < B? Determine the relationship between the result obtained in F and a borrow in the most significant position. | [5] |
| c) | The inputs to each full-adder circuit of an arithmetic logic unit are according to the following Boolean functions:  Xi = AiBi + (s2s1’s0’)’Ai + s2s1s0’Bi  Yi = s0Bi + s1Bi’(s2s1s0’)’  Zi = s2’Ci  Determine the 12 functions of the ALU. | [5] |
| 7.a) | Prove that the multiplication of two **n-digit** numbers in any base **r** gives a product of no more than **2n** digits in length. | [4] |
| b) | **Figure 2:** control state diagram for problem 7 b)  x = 0  x = 1  x = 0 x = 0  y = 1 y = 0  x = 1, y = 0  x = 1 x = 1  y = 1 y = 0  x = 1, y = 1 | [10] |
|  | The state diagram of a control unit is shown in **Figure 2**. It has four states and two inputs x and y. Design the control by the sequence register and decoder method with two JK flip-flops G2 and G1.   1. Use the flip-flop outputs as conditions for the present states. 2. Use the decoder outputs as conditions for the present states.   Compare the two results and comment on the advantages and disadvantages in each case. |  |