Assignment 2

Subject: Computer Architecture.

Unit 2

1. What is micro operation? Explain the different types of micro-operations.
2. Explain the 8-bits binary adder circuit with example.
3. Explain the 6 bit binary subtrator circuit for expression B-A.
4. How can we explain the single circuit as binary adder and subtrator circuit?
5. Explain 8 bits binary decrementer circuit with example?
6. State and explain 4 bit arithmetic circuit with neat diagram. Also, list its function table.
7. What do you mean by Logic micro operations? How Logic micro operations can be implemented with hardware? Explain with its applications.
8. What do you mean by shift micro-operations? Explain its types.
9. Is there a possibility of overflow during arithmetic shift? If yes, how can it be detected?
10. Explain the arithmetic logic shift unit with suitable truth table.
11. Draw the circuits for the following RTL:

    $XY+YZ+W$: $A \leftarrow A+C$, where A and C are 8-bit registers.

12. Starting from an initial value of R=11011101, determine the sequence of binary values in R after a logical shift-left, followed by a circular shift-right, followed by a logical shift-right and a circular shift-left.
13.

Design an arithmetic circuit with one selection variable S and two n-bit data inputs A and B. The circuit generates the following four arithmetic operations in conjunction with the input carry C_{in}. Draw the logic diagram for the first two stages.

S	$C_{in} = 0$	$C_{in} = 1$
0	$D = A + B$ (add)	$D = A + 1$ (increment)
1	$D = A - 1$ (decrement)	$D = A + \overline{B} + 1$ (subtract)

14.

Assume that the 4-bit arithmetic circuit of Fig. 4-9 is enclosed in one IC package. Show the connections among two such ICs to form an 8-bit arithmetic circuit.

15.

Design a 4-bit combinational circuit decrementer using four full-adder circuits.

16.

The adder-subtractor circuit of Fig. 4-7 has the following values for input mode M and data inputs A and B. In each case, determine the values of the outputs: S_3, S_2, S_1, S_0, and C_4.

	M	A	B
a.	0	0111	0110
b.	0	1000	1001
c.	1	1100	1000
d.	1	0101	1010
e.	1	0000	0001

17.

Register A holds the 8-bit binary 11011001. Determine the B operand and the logic microoperation to be performed in order to change the value in A to:

a. 01101101

b. 11111101

18.

The 8-bit registers AR, BR, CR, and DR initially have the following values:

$$
\begin{aligned}
AR &= 11110010 \\
BR &= 11111111 \\
CR &= 10111001 \\
DR &= 11101010
\end{aligned}
$$

Determine the 8-bit values in each register after the execution of the following sequence of microoperations.

$AR \leftarrow AR + BR$	Add BR to AR
$CR \leftarrow CR \wedge DR$, $BR \leftarrow BR + 1$	AND DR to CR, increment BR
$AR \leftarrow AR - CR$	Subtract CR from AR

19.

An 8-bit register contains the binary value 10011100. What is the register value after an arithmetic shift right? Starting from the initial number 10011100, determine the register value after an arithmetic shift left, and state whether there is an overflow.

Unit 3

1. Define instruction and instruction format. Explain the stored program concept of basic computer.
2. What is memory? Explain memory hierarchy.
3. Define Effective address. Differentiate between direct and indirect addressing.
4. Explain the Common Bus system of Basic computer with the help of diagram. Also draw its function table.
5. Differentiate the hardwired and Micro programmed control unit.
6. How basic computer translates machine instructions to control signals using hardwired Control? Explain with block diagram. Draw a timing diagram assuming that SC is cleared to 0 at time T6 if control signal D1 is active.

   $D_1 T_6: SC \leftarrow 0$

7. Define instruction cycle. Explain the fetch and decode phases of basic computer with neat diagram and proper RTL.
8. How would we determine the type of instruction used in basic computer with flowchart? Explain
9. Explain the Input-output configuration of basic computer.
10. Define interrupt and explain its various types.
11. Write the RTL for interrupt cycle and explain the interrupt cycle of basic computer.
12. What do you mean by the completeness of instruction set of basic computer? Draw the complete flowchart of basic computer.
13. A computer uses a memory unit with 256K words of 32 bits each. A binary instruction code is stored in one word of memory. The instruction has four parts: an indirect bit, an operation code, a register code part to specify one of 64 registers, and an address part.
    a. How many bits are there in the operation code, the register code part, and the address part?
    b. Draw the instruction word format and indicate the number of bits in each part.
    c. How many bits are there in the data and address inputs of the memory?
14.

An instruction at address 021 in the basic computer has $I = 0$, an operation code of the AND instruction, and an address part equal to 083 (all numbers are in hexadecimal). The memory word at address 083 contains the operand B8F2 and the content of AC is A937. Go over the instruction cycle and determine the contents of the following registers at the end of the execute phase: PC, AR, DR, AC, and IR. Repeat the problem six more times starting with an operation code of another memory-reference instruction.

15.

Show the complete logic of the interrupt flip-flops R in the basic computer. Use a JK flip-flop and minimize the number of gates.

Unit 4

1. Define control unit. Explain the concept of microprogram control with block diagram.
2. Explain address sequencing concept with the help of diagram.
3. What is the role of mapping in control unit? Prompt an example.
4. Explain microprogram with example used for computer hardware configuration.
5. Draw the microinstruction format for control unit and explain each field.
6. Define symbolic microprogram. For the following fetch routine, write the symbolic microprogram and binary microprogram as well.

$AR \leftarrow PC$

$DR \leftarrow M[AR],\ PC \leftarrow PC + 1$

$AR \leftarrow DR(0\text{-}10),\ CAR(2\text{-}5) \leftarrow DR(11\text{-}14),\ CAR(0,1,6) \leftarrow 0$

7. Explain F-field Decoding of design of control unit.
8. Explain microprogram sequencer for a control memory.
9.

What is the difference between a microprocessor and a microprogram? Is it possible to design a microprocessor without a microprogram? Are all microprogrammed computers also microprocessors?

10.

Explain the difference between hardwired control and microprogrammed control. Is it possible to have a hardwired control associated with a control memory?

11.

The system shown in Fig. 7-2 uses a control memory of 1024 words of 32 bits each. The microinstruction has three fields as shown in the diagram. The microoperations field has 16 bits.

a. How many bits are there in the branch address field and the select field?

b. If there are 16 status bits in the system, how many bits of the branch logic are used to select a status bit?

c. How many bits are left to select an input for the multiplexers?

12.

The control memory in Fig. 7-2 has 4096 words of 24 bits each.

a. How many bits are there in the control address register?

b. How many bits are there in each of the four inputs shown going into the multiplexers?

c. What are the number of inputs in each multiplexer and how many multiplexers are needed?

13.

Using the mapping procedure described in Fig. 7-3, give the first microinstruction address for the following operation code: (a) 0010; (b) 1011; (c) 1111.

14.

Formulate a mapping procedure that provides eight consecutive microinstructions for each routine. The operation code has six bits and the control memory has 2048 words.