



### Assignment

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**SAP ID:** 1000012341

Assignment ID: <b>CS212A2</b>	Assignment Title: - <b>Unit 2 Assignment</b>	Submission Mode: - <b>Online</b>	Assessment Method: - <b>Online</b>	Group/ Individual: - <b>Individual</b>	Weightage: <b>5 Marks</b>	Date of Release: <b>7/11/20</b>	Submission Deadline: <b>12/11/2020</b>
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### Instructions (Sample provided below, please change as necessary):

- Assignment must be submitted by the **Due Date and Time** as mentioned above.
- Assignment submitted after **Due Date and Time** and before the next 48 hours will be marked late and will attract a penalty of X marks (out of the overall Y marks, and it will be evaluated out of Y-X marks only). Assignment will not be considered for evaluation subsequently (after 48 hours past due date and time), and a score of zero will be awarded.
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- Submitted assignment must have your Full Name and SAP ID in the space provided above this page in the Header.

### Submitting this Assignment

- You will submit (upload) this assignment in MS Teams.
- Email/paper submissions will not be accepted (except for UG students who are not yet registered in MS Teams).
- Questions must be answered in the given order.
- Submit a pdf version of this document.
- Name this document as A1\_CSD207\_Even2020\_John\_Doe.pdf in case your name is John Doe, and you are submitting Assignment 1 of the course whose code is CSD207, and it is offered in the Even Semester of the Year 2020.

**Assignment**

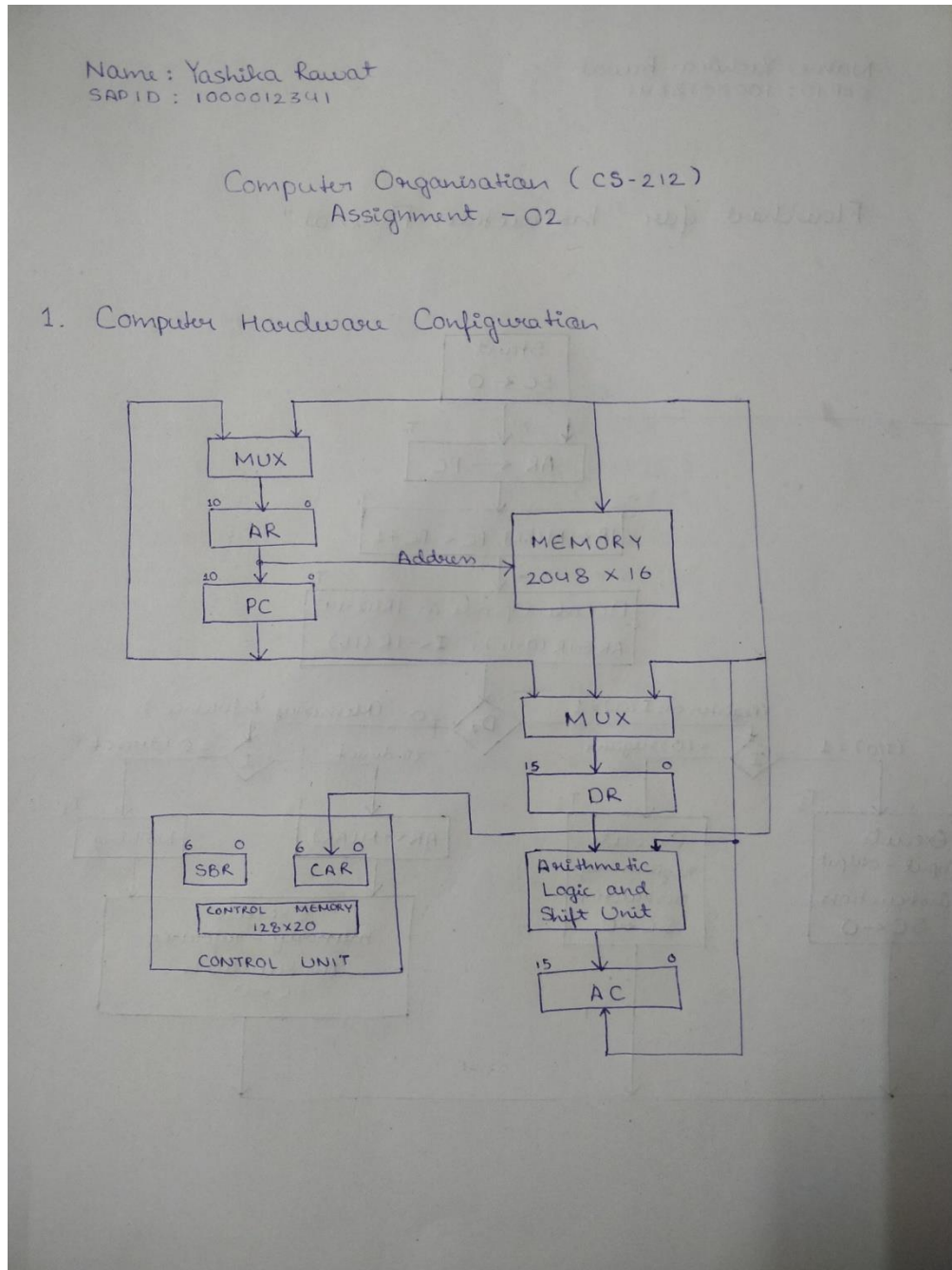
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**Problems:**

Q1. Describe microprogrammed control unit with its computer hardware configuration flowchart and microinstruction format.

**Solution:**



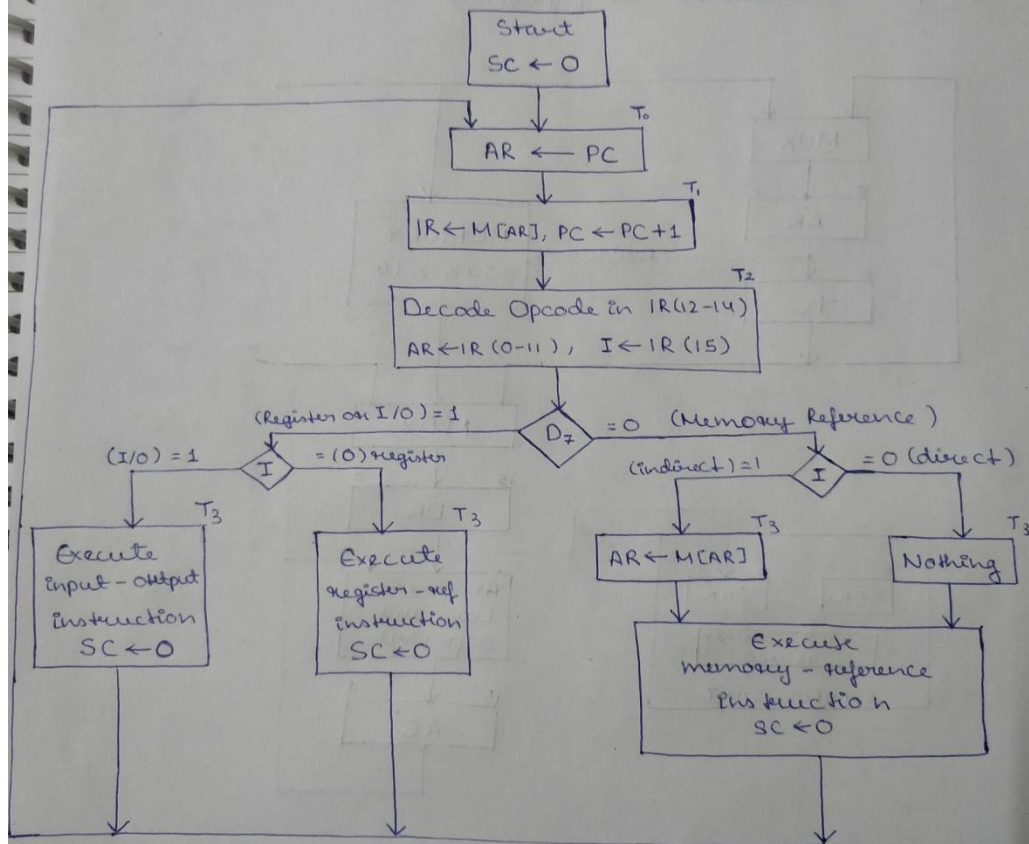
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Flowchart for "Instruction Format"



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Q2. Write a program to evaluate the following expression in

$$X = \frac{A - B + C * (D * E - F)}{G + H * K}$$

(i) One Address Instruction

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2 (i)  $X = \frac{A - B + C * (D * E - F)}{G + H * K}$

One Address Instructions :

Load D	[D]M → 12	AC ← M[D]	0, 12	VOM
MUL E	[E]M → 13	AC ← AC * M[E]	1, 13	JOM
SUB F	[F]M → 14	AC ← AC - M[F]	2, 14	JOB
MUL C	[C]M → 15	AC ← AC * M[C]	3, 15	JOM
ADD A	[A]M → 16	AC ← AC + M[A]	4, 16	JOA
SUB B	[B]M → 17	AC ← AC - M[B]	5, 17	JOB
STORE T	[T]M → 18	M[T] ← AC	6, 18	VOM
LOAD H	[H]M → 19	AC ← M[H]	7, 19	JOM
MUL K	[K]M → 20	AC ← AC * M[K]	8, 20	JOM
ADD G	[G]M → 21	AC ← AC + M[G]	9, 21	JOA
STORE U	[U]M → 22	M[U] ← AC	10, 22	VOM
LOAD T	[T]M → 23	AC ← M[T]	11, 23	JOM
DIV U	[U]M → 24	AC ← AC / M[U]	12, 24	JOM
STORE X	[X]M → 25	M[X] ← AC	13, 25	VOM

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(ii) Two Address Instruction

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2 (ii) 
$$X = \frac{A-B+C*(D+E-F)}{G+H*K}$$

Two Address Instruction:

MOV R1, D	[D]M → RA R1 ← M[D]	3 4005
MUL R1, E	[E]M → RA R1 ← R1 * M[E]	3 4006
SUB R1, F	[F]M → RA R1 ← R1 - M[F]	7 4007
MUL R1, C	[C]M → RA R1 ← R1 * M[C]	3 4008
ADD R1, A	[A]M → RA R1 ← R1 + M[A]	4 4009
SUB R1, B	[B]M → RA R1 ← R1 - M[B]	3 4010
MOV R2, H	[H]M → RA R2 ← M[H]	7 4011
MUL R2, K	[K]M → RA R2 ← R2 * M[K]	4 4012
ADD R2, G	[G]M → RA R2 ← R2 + M[G]	4 4013
DIV R1, R2	[R2]M → RA R1 ← R1 / R2	4 4014
MOV X, R1	RA → [X]M M[X] ← R1	3 4015

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(iii) Three Address Instruction

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2.(iii)  $X = \frac{A-B+C*(D+E-F)}{G+H*K}$

Three Address Instruction :

MUL R1, D, E	$R1 \leftarrow M[D] * M[E]$
SUB R1, F, R1	$R1 \leftarrow R1 - F$
MUL R1, C, R1	$R1 \leftarrow R1 * M[C]$
ADD R1, A, R1	$R1 \leftarrow R1 + M[A]$
SUB R1, B, R1	$R1 \leftarrow R1 - M[B]$
ADD R2, G, H	$R2 \leftarrow M[G] + M[H]$
MUL R2, K, R2	$R2 \leftarrow R2 * M[K]$
DIV X, R1, R2	$M[X] \leftarrow R1 / R2$



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(iv) Zero Address Instruction

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2 (iv)  $X = \frac{A-B+C*(D+E-F)}{G+H*K}$

Zero Address Instruction

POSTFIX EXPRESSION :-  $AB-CDE*F-++G+HK*+/-$

PUSH A	TOS $\leftarrow$ M[A]
PUSH B	TOS $\leftarrow$ M[B]
SUB	TOS $\leftarrow$ M[A] - M[B]
PUSH C	TOS $\leftarrow$ M[C]
PUSH D	TOS $\leftarrow$ M[D]
PUSH E	TOS $\leftarrow$ M[E]
MUL	TOS $\leftarrow$ M[D] * M[E]
PUSH F	TOS $\leftarrow$ M[F]
SUB	TOS $\leftarrow$ M[D] * M[E] - M[F]
MUL	TOS $\leftarrow$ M[C] * (M[D] * M[E] - M[F])
ADD	TOS $\leftarrow$ M[A] - M[B] + M[C] * (M[D] * M[E] - M[F])
PUSH G	TOS $\leftarrow$ M[G]
PUSH H	TOS $\leftarrow$ M[H]
PUSH K	TOS $\leftarrow$ M[K]
MUL	TOS $\leftarrow$ M[H] * M[K]
ADD	TOS $\leftarrow$ M[G] + M[H] * M[K]
DIV	TOS $\leftarrow$ (M[A] - M[B] + M[C] * (M[D] * M[E] - M[F])) / (M[G] + M[H] * M[K])
POP X	M[X] $\leftarrow$ TOS

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Q3. An instruction is stored at memory location 300 with its address field stored at memory location 301. Address field has the value 400. A processor register R1 has the value 200. Calculate the effective address if the addressing mode of the instruction is (i) Direct (ii) Immediate (iii) Relative (iv) Register Indirect (v) Index with R1 as index register.

**Solution:**

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Address	Memory
300	LOAD TO AC    MODE
301	ADDRESS = 400

PC = 300

R1 = 200

XR = 200

AC

Tabular List

S. No.	ADDRESSING MODE	EFFECTIVE ADDRESS
1	Direct	400
2	Immediate	301
3	Relative	$400 + 302 = 702$
4	Register Indirect	200
5	Indexed	$400 + 200 = 600$



## Assignment

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Q4. A two word instruction is stored at memory location designated by symbol W. The address field of the instruction (stored at W+1) is designated by symbol Y. The operand used during the execution of the instruction is stored at an address symbolized by Z. The index register contains the value X. State how Z is calculated by other addresses if the addressing mode of the instruction is:

- (i) Direct (ii) Indirect (iii) Relative (iv) indexed

**Solution:**

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4.

Address	Memory
W	2 Word Instruction
W+1	Address = Y
Z	Operand

PC = W  
XR = X  
AC

Memory Figure

(i) In direct addressing mode, address of operand is the address part of instruction  
or,  $Z = Y$

(ii) Indirect Addressing Mode for Z: -  
 $Z = M[Y]$   
 $M[Y] \rightarrow$  Address of operand stored at address 'Y'.

(iii) Relative :-  
Instruction is stored at : W  
Address part is at : W+1  
 $\therefore$  After instruction is fetched, PC increments to : W+2  
 $\therefore Z = Y + W + 2$

(iv) Indexed  
 $XR = X$ , Address = Y  
 $\therefore Z = X + Y$