

COA – PB – Solution of selected questions (Programs from UNIT-5)

PB – 273 - Write ALP for addition of 10 numbers.

	ORG 100
100	CLA
101	LOP, ADD PTR I / Add number available at location 150
102	ISZ PTR / check pointer value
103	ISZ CTR / check counter value
104	BUN LOP
105	STA SUM
106	HLT
107	PTR, HEX 150 / assume starting location is 150 (hex)
108	CTR, DEC -10 / for 10 numbers, set counter value = -10
109	SUM, HEX 0
	END

PB – 274 – Cancelled

PB – 275 - Write assembly language program to add two double precision numbers.

$ \begin{array}{r} \text{AH AL} \rightarrow 32 \text{ bits} \\ + \text{BH BL} \rightarrow 32 \text{ bits} \\ \hline \text{CH CL} \end{array} $		$ \begin{array}{l} \text{BH AL} = 16\text{-low order} \\ \text{bits} \\ \text{BH AH} = 16\text{-high order} \\ \text{bits} \end{array} $
ORG 100		AH = 0032
LDA AL		AL = 1800
ADD BL		BH = 0001
STA CL		BL = 0020
CLA		
CIL		0032 1800
ADD AH		0001 0020
ADD BH		CH CL = 0033 1820
STA CH		
HLT		
AL, HEX 1800		
AH, HEX 0032		
BL, HEX 0020		
BH, HEX 0001		
CL, HEX 0		
CH, HEX 0		
END		

PB – 278 – Lecture note

PB – 279 – Lecture note

PB – 280 - Write a program loop, using a pointer and a counter that clears to 0 the contents of hexadecimal locations 500 through 5FF.

```
ORG 100
100 CLA
101 LOP, STA PTR I
102 ISZ PTR
103 ISZ CTR
104 BUN LOP
105 HLT
106 PTR, HEX 500
107 CTR, DEC -256
END
```

PB – 281- Write a program to multiply two positive numbers by a repeated addition method.

Assume: $5*4 = 5+5+5+5 = 20$

```
ORG 100
LDA A           / Load multipliers
SZA             / Is it zero?
BUN NZR
HLT             / A=0, product = 0 in AC
NZR, CMA
INC
STA CTR         / Store -A in Counter
CLA             / Start with AC = 0
LOP, ADD B
ISZ CTR
BUN LOP         / Repeat Loop A times
HLT
A, DEC 4
B, DEC 5
CTR, HEX 0
END
```

PB – 282 - Write an assembly language program for the logical expression (A XOR B) + (A' XOR B')

$$(A \text{ XOR } B) + (A' \text{ XOR } B') = A \text{ XOR } B$$

Program for Logical XOR operation between A and B:

$$Z = X \oplus Y = \overline{X}Y + X\overline{Y}$$

$$= \overline{\overline{\overline{X}Y} + \overline{X\overline{Y}}}$$

$$= \overline{\overline{X}Y} \cdot \overline{X\overline{Y}}$$

```

ORG 100
LDA Y
CMA
AND X
CMA
STA TMP
LDA X
CMA
AND Y
CMA
AND TMP
CMA
STA Z
HLT

X, DEC 8
Y, DEC 5
Z, HEX 0
TMP, HEX 0
END
    
```

8 → 1000 ⊕
 5 → 0101
 1101

PB – 283 - Write an assembly language program for multiplication 2*6 by repeated addition method.

```

ORX 100
LDA A      / Load Multiplier
SZA        / Is it zero?
BUN NZR
HLT        / A=0, product = 0 in AC
NZR, CMA
INC
STA CTR    / Store -A in Counter
CLA        / Start with AC = 0
LOP, ADD B
ISZ CTR
BUN LOP    / Repeat Loop A times
HLT
A, DEC 4   }
B, DEC 5   } Same program but only change
CTR, HEX 0 }
END        B, DEC 2

```

PB – 284 - Write a program to subtract two double precision numbers.

$$\begin{array}{r} A_H A_L \\ - B_H B_L \\ \hline C_H C_L \end{array} \quad \left. \begin{array}{l} A + (2's \text{ comp of } B) = A - B \end{array} \right\}$$

```

                                FF31 8FC3
                                F010 BE82
                                OF21 0141
ORX 100
LDA BL
CMA
INC
ADD AL
STA CL
Save Carry [ CLA
            CIL
            STA TMP
LDA BH
CMA
INC
ADD AH
Add Carry → ADD TMP
STA CH
HLT
TMP, HEX 0
CH, HEX 0
CL, HEX 0
AL, HEX 8FC3
AH, HEX FF31
BH, HEX F010
BL, HEX BE82
END

```

PB – 285 - Write an assembly language program for multiplication 5*5 by repeated addition method. For example, $5*5 = 5+5+5+5+5$

```

ORX 100
LDA A      / Load Multiplier
SZA        / Is it zero?
BUN NZR
HLT        / A=0, product = 0 in AC
NZR, CMA
INC
STA CTR    / Store - A in Counter
CLA        / Start with AC = 0
LOP, ADD B
ISZ CTR
BUN LOP    / Repeat Loop A times
HLT
A, DEC 4   }
B, DEC 5   }
CTR, HEX 0
END

```

Same program but only change

A, DEC 5

B, DEC 5

PB – 286 - Write a program that evaluates XOR of two logic operands.

Same as – 282

PB – 287 - Write a program that evaluates OR of two logic operands.

```

ORX 100
LDA A      / Load A
CMA
STA T      / Store at T
LDA B      / Load B
CMA
AND T
CMA
STA RES    / Store result at RES
HLT
A, DEC 5
T, HEX 0
B, DEC 4
RES, HEX 0
END

```

OR Operation

$$Y = A + B$$

$$= \overline{A+B}$$

$$= \overline{A} \cdot \overline{B}$$

PB – 288 - Write a program that evaluates XNOR of two logic operands.

$$Z = X \oplus Y = \overline{X}Y + X\overline{Y}$$

$$= \overline{\overline{\overline{X}Y} \cdot \overline{X\overline{Y}}}$$

$$= \overline{\overline{X}Y} \cdot \overline{X\overline{Y}}$$

```

ORG 100
LDA Y
CMA
AND X
CMA
STA TMP
LDA X
CMA
AND Y
CMA
AND TMP
CMA
STA Z
HLT

X, DEC 8
Y, DEC 5
Z, HEX 0
TMP, HEX 0
END

```

8 → 1000
 5 → 0101
 ⊕
 1101

Remove CMA, so that it becomes program for XNOR

PB – 289 - Write a program that evaluates NOR of two logic operands.

Assume that $C = A \text{ NOR } B = (A+B)' = A' B'$

	ORG 100
100	LDA A
101	CMA
102	STA P
103	LDA B
104	CMA
105	AND P
106	STA C
107	HLT
108	A, HEX 00FF / assume A = 00FF H
109	B, HEX FF00 / assume B = FF00 H
10A	C, HEX 0000 / Initially C and P = 0000 H
10B	P, HEX 0000
	END

PB – 290 - Write a program that evaluates circular left shift of an operand.

	ORG 100
100	LDA A
101	CIL / Final content in AC after CIL = 01FE H (If E = 0)
102	HLT
103	A, HEX 00FF / assume A = 00FF H
	END

PB – 291 - Write a program that evaluates circular right shift of an operand.

	ORG 100
100	LDA A
101	CIR / Final content in AC after CIR = 007F H (If E = 0)
102	HLT
103	A, HEX 00FF / assume A = 00FF H
	END

PB – 292 - Write a program that evaluates arithmetic shift left of an operand

ashl operation is similar to shl (logical shift left operation)

	ORG 100
100	LDA A
101	CLE / E = 0
102	CIL
103	HLT
104	A, HEX FFFF / assume A = FFFF H
	END

PB – 293 - Write a program that evaluates arithmetic shift right of an operand

	ORG 100
100	CLE / E = 0
101	LDA A
102	SPA / Skip if AC is positive; E remains 0
103	CME / AC is negative; set E to 1
104	CIR / circulate E and AC
105	HLT
106	A, HEX F234
	END

PB – 294 - Write a subroutine to circulate E and AC four times to right. If AC contains 079C in hex and E=1 what are contents of AC and E after subroutine is executed?

	ORG 100
100	BSA SH4
101	STA X
102	HLT
103	X, HEX 079C
104	SH4, HEX 0
105	CLE
106	CME
107	CIR
108	CIR
109	CIR
10A	CIR
10B	BUN SH4 I
	END

PB – 295 - Write an Assembly language program for addition of 150 numbers. Consider starting address of data is at memory location 5FF.

	ORG 100
100	CLA
101	LOP, ADD PTR I
102	ISZ PTR
103	ISZ CTR
104	BUN LOP
105	STA SUM
106	HLT
107	PTR, HEX 5FF
108	CTR, DEC -150
109	SUM, HEX 0
	END

PB – 296 - Write a program that evaluates XOR of three logic operands.

For example, $Z = A \text{ XOR } B \text{ XOR } C = (A'B' + A'B) \text{ XOR } C$

$$= (A'B')' (A'B)'C + (A'B' + A'B) C'$$

$$= (A' + B)(A + B')C + AB'C' + A'BC'$$

$$= A'B'C + ABC + AB'C' + A'BC'$$

	ORG 100
100	LDA A
101	CMA
102	STA T1 /T1 = A'
103	LDA B
104	CMA
105	STA T2 /T2 = B'
106	LDA C
107	AND T1
108	AND T2
109	STA T3 /T3 = A'B'C
10A	LDA A
10B	AND B
10C	AND C
10D	STA T4 / T4 = ABC
10E	LDA C
10F	CMA
110	STA T5 /T5 = C'
111	AND T2
112	AND A
113	STA T6 /T6 = AB'C'
114	LDA T1
115	AND B
116	AND T5
117	ADD T6
118	ADD T4
119	ADD T3
11A	STA Z
11B	HLT
11C	A, HEX 000A
11D	B, HEX 000B
11E	C, HEX 000C
11F	T1, HEX 0
120	T2, HEX 0
121	T3, HEX 0
122	T4, HEX 0
123	T5, HEX 0
124	T6, HEX 0
	END

PB – 297 - Write a program using subroutine to shift logical left five times in X and Y. Initially X has value A937 and Y has value C305 in hex. What are the contents of X & Y in hex after the execution of above program?

	ORG 100
100	LDA X
101	BSA SH4
102	STA X
103	LDA Y
104	BSA SH4
105	STA Y
106	HLT
107	X, HEX A937
108	Y, HEX C305
109	SH4, HEX 0
10A	CLE
10B	CIL
10C	CLE
10D	CIL
10E	CLE
10F	CIL
110	CLE
111	CIL
112	BUN SH4 I
	END

PB – 298 – Same as 295

PB - 299

Write an ALP for multiplication of data present at A and B respectively.

A = 0000 1111

B = 0000 1011

C = A*B

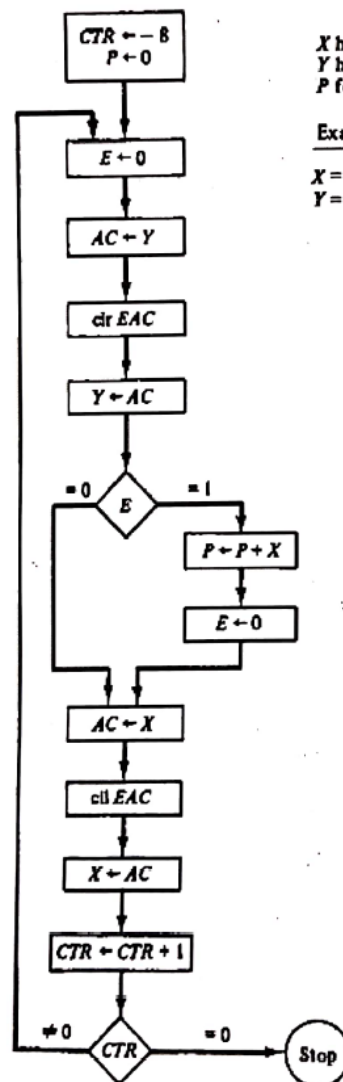
Let's take X = Multiplicand
Y = Multiplier
P = Product of X & Y

X =	0000 1111	P
Y =	0000 1011	0000 0000
	0000 1111	0000 1111
	0001 1110	0010 1101
	0000 0000	0010 1101
	0111 1000	1010 0101
	1010 0101	

ORG 100

100	LOP, CLE	/ Clear E
101	LDA Y	/ Load Multiplier (Y)
102	CIR	/ Transfers multiplier bit to E
103	STA Y	/ Store shifted multiplier
104	SZE	/ Check if E bit = 0 & skip
105	BUN ONE	/ If bit = 1, go to ONE
106	BUN ZRO	/ If bit = 0, go to ZRO
107	ONE, LDA X	/ Load Multiplicand
108	ADD P	/ Add to partial product
109	STA P	/ Store partial product
110	CLE	/ Clear E
111	ZRO, LDA X	/ Load Multiplicand
112	CIL	/ Shift left
113	STA X	/ Store shifted Multiplicand

114	ISZ	CTR	/ Increment Counters
115	BUN	LOP	/ Counters not zero, repeat
116	HLT		/ Counters = 0 then halt
117	CTR,	DEC -8	/ Counters value
118	X,	HEX 000F	
119	Y,	HEX 000B	
120	P,	HEX 0	
121	END		



X holds the multiplicand
Y holds the multiplier
P forms the product

Example with four significant digits

X = 0000 1111	P
Y = 0000 1011	0000 0000
0000 1111	0000 1111
0001 1110	0010 1101
0000 0000	0010 1101
0111 1000	10100101
10100101	

[Flowchart for Multiplication Program]

PB – 300, 301 – Same as 296

PB – 302, 303 – Multiplication by repetitive addition – Same as 281